

Environmental markets for graziers

Key markets, product opportunities and risks

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Summary

Environmental markets facilitate the exchange of environmental goods and services incentivising sustainable land management and restoration, attracting investment and offering cost-effective alternatives to regulation. Unfortunately, there is limited independent information available to inform graziers. This report investigates the schemes available, drivers of demand and supply, benefits and costs, opportunities and risks, and taxation implications for Queensland graziers. Markets relevant to Queensland include the Australian Carbon Credit Units (ACCU) scheme, Reef Credit Scheme, Land Restoration Fund (LRF – a grant scheme), Nature Repair Market and Cassowary Credit Scheme. The ACCU scheme targets carbon abatement and has the most participation with 2,503 projects and 161 million ACCUs issued nationally. Relevant categories are (1) agriculture methods such as soil carbon and beef cattle herd management – 182 Queensland projects, (2) vegetation methods such as environmental plantings, plantation forestry, human-induced regeneration (closed), avoided deforestation (closed) and blue carbon – 281 Queensland projects, and (3) savannah burning methods – 53 Queensland projects. ACCU methods automatically end for registration after 10 years. Most projects across Australia are vegetation (1,200 or 48%) or agriculture methods (801 or 32%), whereas most ACCU credits have been issued to vegetation (88M), waste (49M), savannah burning (15M) and agriculture methods (2.6M).

The Reef Credit scheme targets water quality improvements in the Great Barrier Reef (GBR) catchments and has issued 61,000 reef credits across 14 projects – 12 dissolved inorganic nitrogen (DIN), one wastewater and one gully remediation. Reef credits can be stacked with ACCUs but must be additional (e.g. different pollutant reduction). The LRF provides grants to Queensland ACCU projects that deliver co-benefits. By paying higher prices (grants) for ACCUs, the LRF can support projects that might otherwise be unviable. Three investment rounds have been held contracting 26 projects – 12 environmental plantings ACCU projects and 7 avoided clearing. In total, 1.3 million ACCU's were purchased plus co-benefits for median prices each round of $53-$120/ACCU. Environmental co-benefits were the most contracted including threatened wildlife or ecosystems, native vegetation and GBR. The Nature Repair Market incentivises the enhancement and protection of rainforests and biodiversity by issuing certificates, which can be stacked with ACCUs. No projects are currently registered but one method is available – replanting native forest and woodland ecosystems. The Cassowary Credit Scheme has one method currently available – Rainforest Replanting (1 project), which can be stacked with ACCUs.

Drivers of demand and supply

The Safeguard Mechanism involves legislated emissions reduction targets for industrial facilities, that emit more than 100,000 tonnes of carbon dioxide equivalent per year (currently, there are 219 industrial facilities subject to the Safeguard Mechanism). These facilities currently purchase 60% of ACCU holdings to offset emissions, which is expected to increase each year to 2030. Demand for environmental goods and services also comes from the Nature Positive Plan, targeting zero extinctions and protection of 30% of Australia's land and seas by 2030, along with the Reef 2050 Plan and Landscape Repair Program. Voluntary demand grew to 1.1 million ACCUs in 2024 driven by environmental, social and governance (ESG) goals and customer expectations, while new regulations for sustainability reporting (e.g. carbon emissions) may further strengthen demand. Consumer demand for sustainably produced food (ecolabelling and standards) is another demand mechanism but willingness to pay varies between products

and consumers. While consumer preferences are evident (e.g. organic foods), price is the dominant influence in purchasing decisions, followed by health considerations.

While participation in environmental markets has risen over time, it remains low and there is an undersupply of environmental goods and services. For example, Australia has a long way to go to meet legislated targets of 43% below 2005 levels by 2030 and net zero by 2050 (currently ~37% below with 433 million tonnes carbon dioxide equivalent (Mt CO_2e) emitted in 2023). However, research estimates there is economic potential to sequester 2.7 times current amounts (44 Mt CO_2e) each year and technical potential to sequester 30 times. Agriculture occupies 80% of Queensland's land area and Australian agriculture accounted for 18.4% of total greenhouse gas emissions in 2023. Agricultural industry bodies have committed to achieving carbon neutrality, which will involve adopting practices that lower emissions or sequester carbon in soil and vegetation. Despite the diversity of schemes, participation by producers remains low with 14 Reef Credit projects, 1 Cassowary Credit project and no Nature Repair Market projects.

Benefits and costs

Participating in environmental market schemes offer benefits including diversified income from the sale of credits, co-benefits like improved soil health, productivity or farm resilience, cheaper financing through 'green loans' and marketing opportunities (carbon neutral or sustainable). Establishing projects often requires significant upfront investment, ongoing costs and compliance with complex regulatory requirements. These costs include feasibility assessments, legal and accounting advice, planning, mapping, approvals and long-term monitoring, reporting and auditing, which can be resource-intensive. While some methods tend to be lower cost (savannah burning or avoided clearing), some are expensive like methods involving tree planting. Opportunity costs, such as foregone revenue (lower production) or reduced property values (reduced flexibility in land use), are borne when projects compete with primary production for land and resources, such as blue carbon or vegetation methods (e.g. environmental plantings). Net gains or losses depend on the characteristics of a project and vary case by case. Therefore, primary producers need to obtain professional advice and conduct a cost benefit analysis before signing up to a project.

Investment analysis

Investment analyses were based on primary producers implementing projects for four ACCU methods. Methods were chosen given their relevance or higher participation . Marginal cashflow changes were calculated by subtracting project costs from awarded ACCU income. Given variability amongst projects, results are not reflective of all projects but provide an indication of viability. Case-by-case assessments are needed to determine suitability for individual businesses.

Soil organic carbon measurement

Globally, the top metre of soil holds approximately twice the amount of carbon as the atmosphere and three times more than vegetation. Land clearing typically decreases soil organic carbon (SOC) stocks by 20-60%. Primary determinants of SOC stocks are moisture availability (higher rainfall = more carbon) and soil properties (e.g. higher clay content = greater capacity), whereas land management impacts are smaller. Management options include increasing carbon inputs such as crop/animal residues (e.g. legumes), compost and amendments and decreasing carbon losses by reducing mineralisation or erosion, or improving water or soil management (e.g. less tillage). Suitable soils for projects can sequester large amounts of carbon and are depleted of soil organic matter.

Under suitable conditions (climate, soil and management), SOC sequestration is achievable. For example, sequestration increased by 0.015–3.3 t CO_2e/ha/yr when reducing grazing intensity, 0–1.47 t CO_2e/ha/yr when sowing more productive grasses, and 0.29–2.79 t CO_2e/ha/yr when establishing legumes. Of the 11 Queensland projects that have reported increased SOC stocks (out of a total of 135 Queensland projects), 10 projects altered their grazing intensity and 9 re-established pasture. These 11 projects had average SOC sequestration of 6.09 t CO_2e/ha/yr. Studies have identified that co-benefits (e.g. soil health) motivate farmers to participate in projects. However, these projects have risks including sequestration reversal due to climate (e.g. drought) or fire.

The analysis examined establishing leucaena to increase SOC stocks on 433ha of a Fitzroy farm. Given establishing leucaena increased farm profitability, the aim was to identify whether undertaking an ACCU project concurrently would further improve profitability. The total cost of undertaking the project over 25 years was $190,055–$440,915 depending on soil sampling and auditing costs. Four SOC sequestration rates were examined including a low, medium and high rate (0.29, 1.43 and 2.79 t CO_2e/ha/yr) based on measurements from Australian trials. A very high rate was also included (6.09 t CO_2e/ha/yr) based on the average reported by the 11 ACCU projects. However, this rate is 2.2 times higher than observations in studies, which is most likely because the sequestration was climate driven, as was observed in the study by Mitchell et al. (2024). The very high rate has not been reported by scientific studies and is therefore likely to be unrealistic. The rates would sequester 3,014–63,287 t CO_2e by year 25 and generate 2,260–47,465 ACCUs after applying discounts. To payback project costs at the current ACCU price ($35/ACCU), the project would need to achieve high to very high SOC sequestration (see table below), or at least medium but with low soil sampling and auditing costs. At higher ACCU prices ($50-$100/ACCU), graziers would need at least medium SOC sequestration.

Net Present Value of soil organic carbon sequestration to establish leucaena in the Fitzroy region on a 433ha project area, with varying carbon prices and sequestration rates for 25-year project

Sequestration rate	Net Present Value (millions) at ACCU price of $35	Net Present Value (millions) at ACCU price of $50	Net Present Value (millions) at ACCU price of $100
Low	-$0.22 to -$0.08	-$0.2 to -$0.06	-$0.15 to -$0.01
Medium	-$0.07 to $0.07	$0.01 to $0.16	$0.29 to $0.43
High	$0.11 to $0.26	$0.27 to $0.42	$0.81 to $0.95
Very high	$0.56 to $0.7	$0.91 to $1.05	$2.07 to $2.22

Environmental plantings

Over 40% of Australia's woodlands and forests have been cleared resulting in lost biodiversity and stored carbon. Carbon sequestered by trees varies depending on species, age, planting design, soil type, climate, management, etc. Vegetation growth is key to estimating sequestered carbon, which is highest in a tree's early growth (ages 4–11) and levels off as the tree matures. Timber plantings with silviculture management or fast growing trees can have high carbon sequestration, while native mixed-species plantings (typically environmental plantings) offer greater biodiversity benefits. Six Queensland studies measured sequestration rates in vegetation identifying ranges from 0.035 t CO_2e/ha/yr, for managed regrowth in the arid west, to 12.49 t CO_2e/ha/yr for hardwood monoculture in high-rainfall areas of the coastal southeast. Central Queensland sites with Brigalow or Eucalypt measured rates of 1.4–2.2 t CO_2e/ha/yr across 20 years. Co-benefits included lower risks of erosion and dryland salinity, and enhanced biodiversity. Increased tree coverage may reduce carrying capacity and farms in lower productivity regions (e.g. Mulga Lands) can have lower opportunity costs to undertake vegetation projects. FullCAM is used to estimate carbon stored in biomass and lowers project costs.

The environmental plantings method is the most utilised of the current vegetation methods (23 Queensland projects). Consequently, the analysis examined an ACCU project using this method across 5% (433 ha) and 50% (4,350 ha) of the farm in the Fitzroy. Total project costs over 433 ha and 25 years was $1.6–$3.6 million. These costs depended heavily on seedling and planting costs of $1.3-$3.3 million (79-90% of total). An opportunity cost for foregone net cattle income of ~$0.2 million (6-13% of total) was also factored in. Low, medium and high carbon sequestration rates (1.4, 1.8, and 2.2 t CO_2e/ha/yr) were examined based on measurements from central Queensland studies. These rates would sequester 15,155–23,815 t CO_2e in vegetation by year 25 and generate 11,366–17,861 ACCUs after discounting. Results indicate the project doesn't generate enough ACCUs to payback the project costs at any of the examined rates or ACCU prices. This is largely due to the high costs associated with buying and planting seedlings (79-90% of total). The findings are similar when 50% of the farm is planted.

Net Present Value of carbon sequestration by reforestation in the Fitzroy for a 433ha project (5% of farm), with varying carbon prices and sequestration rates

Sequestration rate	Net Present Value (millions) at ACCU price of $35	Net Present Value (millions) at ACCU price of $50	Net Present Value (millions) at ACCU price of $100
Low	-$3.05 to -$1.19	-$2.96 to -$1.1	-$2.67 to -$0.81
Medium	-$2.99 to -$1.13	-$2.88 to -$1.02	-$2.51 to -$0.65
High	-$2.94 to -$1.07	-$2.8 to -$0.94	-$2.34 to -$0.48

Beef cattle herd management

Methane emissions from livestock, mostly through burping, contribute 11% of Australia's total CO_2e emissions. Methane contributes 27-30 times more to global warming than CO_2 but, unlike fossil fuels, has a short life of ~12 years and is eventually recycled back into the atmosphere as CO_2. Australia produced 4.2% of global beef production in 2024-25 and was the seventh largest producer and in the top three exporters globally. Compared to other large beef producers and exporters, Australia has low cattle emissions intensity (1.9 t CO_2e) like Brazil (1.9) but much lower than the United States (2.6-2.9) and European Union (2.4-2.7).

The beef cattle herd management method aims to reduce emissions intensity by improving herd efficiency and producing more beef per unit of methane emitted. Improved weaning, conception, growth and mortality rates all improve efficiency. Examples of project activities include supplement feeding (e.g. phosphorus), installing new fences, increasing density of watering points, planting improved pastures and reducing stocking rates to carrying capacity. Three of the 11 Queensland projects have been issued credits totalling 1,044,037 ACCUs. Data must be reported every 2 years including cattle numbers, liveweights, births, mortality, entry/exit dates, along with 3 years of baseline emissions and conducting three audits. This method complements grazing businesses with co-benefits by improving herd productivity and not competing with cattle production for land use. However, this method was suspended in December 2024 and the potential for continuation is not currently known.

Three projects were analysed over seven year permanence periods. Given all three activities increase farm profitability without an ACCU project, the objective was to identify whether undertaking an ACCU project concurrently would further improve profitability. The method's calculator was used to estimate avoided emissions. The first project established leucaena across 433 ha on a Fitzroy farm. Total project costs over 7 years were $113,000–$160,000, depending mostly on additional mustering and record-keeping ($78,000–$108,000) and auditing ($21,000–$33,000). Excluding farm labour reduced costs to $32,500–$48,000 (same across all 3 projects). The leucaena paddock was stocked from years 4 to 7, which increased steer growth rates, and improved kg beef/AE and emissions intensity by 14%. After discounting, avoided emissions totalled 1,032 t CO_2e net abatement and generated 1,032 ACCUs worth $36,127 at $35/ACCU. Including farm labour costs, the project doesn't generate enough ACCUs to payback the project's costs at any ACCU price (see table below). The project could repay project costs at $50/ACCU if labour costs were excluded and auditing costs low.

The second project supplemented breeding cattle with phosphorus on phosphorus deficient country in the Fitzroy. Across Queensland, 12% of land is deficient in soil phosphorus and 18% acutely deficient. Low soil phosphorus can result in phosphorus deficient cattle and adversely impact herd productivity. Supplementing cattle can correct the deficiency and improve appetite, feed intake, growth, fertility, milk production and mortality. Project costs were similar to the leucaena project totalling $115,000–$164,000. The benefits of supplementation included heavier cows (+15kg), lower mortality (-2%) and higher conception (+6%). However, these improvements only increased emissions intensity by 4% in the fifth year. Consequently, avoided emissions only totalled 2.1 t CO_2e net abatement by year 7, and generated just 2 ACCUs after subtracting the 4% discount from baseline emissions. Even when excluding farm labour costs, the project does not generate enough ACCUs to repay the project's costs (see table below).

The third project supplemented all cattle with phosphorus on acutely phosphorus deficient country in the Burdekin. Soil phosphorus levels are acutely deficient across large areas of the Desert Uplands region, just west of the Burdekin. Cattle acutely deficient in phosphorus can suffer large declines in herd productivity. Project costs were higher than previous projects at $136,000–$197,000 due to higher stocking rates. Supplements increased cattle weights (+23kg to 27kg) and weaning (by 10%), and lowered mortality (by 1–4%) and the size of the breeding herd (from 1,358 to 1,078 head). These improvements increased kg beef/AE and emissions intensity by 38% from year 4. Avoided emissions were much larger than the previous two projects totalling 7,593 t CO_2e net abatement and generated 7,593 ACCUs (including discounts) worth $265,700 at $35/ACCU. Including farm labour costs, the project was found to increase farm profitability by $43,064–$94,175 at $35/ACCU. Attaining higher ACCU prices would improve profitability further.

Net Present Value of emissions avoidance for three different beef cattle herd management method projects – including farm labour costs

Project	Net Present Value (millions) at ACCU price of $35	Net Present Value (millions) at ACCU price of $50	Net Present Value (millions) at ACCU price of $100
Leucaena	-$0.11 to -$0.07	-$0.1 to -$0.06	-$0.06 to -$0.02
Phosphorus supplements *(Deficient)*	-$0.14 to -$0.1	-$0.14 to -$0.1	-$0.14 to -$0.1
Phosphorus supplements *(Acutely deficient)*	$0.04 to $0.09	$0.13 to $0.18	$0.43 to $0.48

At $35/ACCU, at least 3,221–5,632 t CO_2e net abatement, or ACCUs, was needed for the project to repay project costs ($112,731-$197,117). Emissions intensity and kg beef/AE are closely linked. Implementing activities that deliver larger improvements in kg beef/AE generate relatively more ACCUs. The 38% improvement in kg beef/AE from phosphorus supplementation in the Burdekin generated 7,593 ACCUs but the 14% improvement from establishing leucaena fell short generating only 1,032 ACCUs. If leucaena would have increased kg beef/AE by 38%, then it would have increased the number of ACCUs generated in year 7 from 310 to 861 (2.8 times more). Activities with long implementation periods may not produce sufficient kg beef/AE improvements within the 7-year timeframe (e.g. genetics). Larger properties have more incentives to participate. If the same parameters were applied across a property twice the size, then each project would generate twice the ACCUs. While project costs would also likely increase, marginal costs would likely be lower due to greater scale. Lastly, less productive graziers may also have more incentives to participate as they can generate more ACCUs for any given increase in production efficiency. If the leucaena property had a baseline emissions intensity of 18 instead of 9 t CO_2e/t LWG, then almost double the number of ACCUs would be generated.

Blue carbon

Large areas of Queensland's coastal wetlands have been modified to exclude tidal flows for agricultural and urban development, typically by constructing bund walls. Coastal wetland ecosystems enhance water quality and biodiversity, and provide habitat for aquatic animals and plants, and migratory birds. These areas have higher carbon stocks than terrestrial forests with mangroves and saltmarsh potentially sequestrating up to 11 Mt CO_2e/ha/yr and seagrass 4.9–5.6 Mt CO_2e/ha/yr. Degraded coastal agricultural land suffering from waterlogging, salinisation or soil acidification generally has low profitability so blue carbon projects can potentially be undertaken with the least impact on production and business profitability. Consequently, there is an opportunity to restore these ecosystems with Australia having the largest blue carbon ecosystems and storage capacity of any country.

Blue carbon ACCU projects reintroduce tidal flow to coastal wetlands by removing or modifying barriers like sea walls or drains. BlueCAM is used to calculate soil and vegetation sequestration and emissions avoidance, which helps to lower project costs by not requiring in-field samples. Participants must (1) prepare hydrological assessments, plans and tidal inundation maps, (2) report on-ground observations, geolocated imagery, or vegetation cover data every 6 months to 5 years, and (3) conduct three audits. There is only one Queensland project (no ACCUs issued yet).

Waltham et al (2025) investigated earthworks to remove bund walls and tidal gates and reprofiling landscapes to maximise tidal inundation at Mossman. Three sugarcane farms were examined (158–345 ha) with marginal land and low yields, extensive weeds and saline intrusion. They sequestered 5,213–26,539 t CO_2e over 25 years, worth $182,500–$928,900 at $35/ACCU. ACCU project developer costs ranged from $413,000 to $998,000. Landholder opportunity costs included foregone sugarcane net revenue and reduced property values. Over 25 years, these costs ranged between $2.9-$4.9 million for a business with full production capacity, $0.8-$1.6 million for a business that had ceased production and $1.6-$2.9 million for a midpoint scenario. The analysis examined (1) an ACCU only project, and (2) if ACCUs and reef credits could hypothetically be stacked. ACCU only projects cannot generate enough ACCUs to repay project costs even for businesses that had ceased production and have lower opportunity costs (see table below). However, projects could be viable for businesses that had ceased sugarcane production if ACCUs could be stacked with reef credits. While this may not be possible, it highlights stacking opportunities with other schemes such as those targeting biodiversity. Other studies identified similar findings in the Johnstone River and Fitzroy.

Net Present Value of removing bund walls and tidal gates to maximise tidal inundation in the Mossman region using the Blue Carbon method

Sugarcane production	Net Present Value (millions) at ACCU prices of $40	Net Present Value (millions) at ACCU prices of $70	Net Present Value (millions) at ACCU prices of $100	Net Present Value (millions) at ACCU and Reef Credit prices of $40 / $100	Net Present Value (millions) at ACCU and Reef Credit prices of $70 / $150	Net Present Value (millions) at ACCU and Reef Credit prices of $100 / $200
Full prod.	-$3.7 to -$1.9	-$3.6 to -$1.8	-$3.4 to -$1.8	-$1.9 to -$1.1	-$0.8 to -$0.6	-$0.1 to $0.3
Midpoint	-$2.1 to -$1.1	-$1.9 to -$1.1	-$1.8 to -$1	-$0.4 to -$0.3	$0.1 to $0.9	$0.6 to $2
Ceased prod.	-$1.2 to -$0.7	-$1.1 to -$0.7	-$1 to -$0.7	$0.2 to $0.6	$0.9 to $1.7	$1.4 to $2.8

Source: Adapted from Waltham et al. (2025)

Opportunities and risks

Environmental market schemes offer opportunities to sequester carbon and increase biodiversity. Also, primary producers can diversify their income from the sale of credits and obtain co-benefits (e.g. soil health, erosion and salinity). Stacking credits across different environmental markets (e.g. carbon and biodiversity) presents opportunities to improve project viability but must be "additional". Conversely, they also present challenges and risks that can limit participation. Lack of financial viability is a key risk exacerbated by potentially significant upfront costs and volatile credit prices. Certain projects can decrease agricultural production and income (e.g. vegetation and blue carbon) and reduce property values due to lost flexibility, contractual delivery and liability obligations and revenue uncertainty. The variability of biophysical processes and climate (rainfall, climate change, etc) can cause the reversal of sequestration or project failure through floods, droughts and bushfires. Government policy uncertainty permeates other risks such as the premature cancellation of methods. Credibility issues are another risk and can undermine trust in the schemes and threaten long-term demand for credits (and prices). Key challenges include long permanence periods and the complexity of scheme rules. Complexity creates asymmetrical information where intermediaries may have an advantage with contract negotiations. Participation can also have significant taxation implications. While strategies exist to mitigate these risks (e.g. adaptive management), primary producers must assess the potential trade-offs and consequences before undertaking a project. As such, addressing these risks through targeted design and access to independent support services will be crucial to success.

Individual methods

Opportunities were identified for soil carbon if graziers had 433 ha of land with the capacity to achieve at least moderate SOC sequestration (1.43–6.09 t CO_2e/ha/yr) over 25 years. Most agricultural land with large SOC deficits is in the southeast quadrant of Queensland. Establishing legumes and reducing grazing intensity can sequester SOC and undertaking multiple beneficial changes may be an opportunity. Soil carbon projects can provide co-benefits (improved productivity) and do not necessarily compete for land use. A weakness is the high cost of soil sampling, reporting and auditing. Risks include difficulties achieving project objectives or target sequestration rates, and sequestration reversal through drought, fire or long-term SOC dynamics.

Environmental plantings opportunities include using marginal land with low opportunity costs and generating co-benefits (mitigation of dryland salinity and erosion). Nonetheless, this project was not found to payback project costs even at high sequestration rates and ACCU prices.

However, these projects enhance biodiversity, which creates an opportunity to stack with biodiversity credits (e.g. LRF, Nature Repair Market or Cassowary credits). Challenges include very high costs to buy and plant seedlings. Risks include sequestration reversal (bushfires), reduced property value and difficulty achieving project activities (e.g. tree establishment).

Beef cattle herd management projects can payback project costs if activities generate 7,500 t CO_2e net abatement (after discounts) within the 7 year period. This method doesn't compete with cattle production for land use. While already low, this method helps to further improve Australia's cattle emissions intensity and productivity, which could contribute to lowering global emissions given Australia is a major exporter. Improved productivity may also help free up marginal land that could be used to achieve environmental objectives (carbon, biodiversity, etc.). Risks include the absolute removal of this method and not achieving project objectives (e.g. emissions targets).

Low lying and degraded coastal agricultural land (e.g. waterlogging and salinisation) with low profitability was identified as most suitable for blue carbon projects. Particularly, landholders that have ceased agricultural production and have low opportunity costs. Nonetheless, Waltham et al (2025) identified that a blue carbon project alone was unable to repay project costs unless stacked with reef credits. While this may not be possible, there may be opportunities to stack with biodiversity credits. Key challenges include high project costs (e.g. opportunity costs) and limited coastal sites. Risks include negative impacts on freshwater wetlands.

Tax implications

While rules vary between environmental markets and legal structures (individual, trust, company, partnership), primary producers need to be aware that income from environmental markets may not qualify as primary production income. This is important to access concessions like the Farm Management Deposit scheme and tax averaging, and land tax and transfer duty concessions. Currently, income from schemes other than the ACCU scheme (e.g. Reef Credit) is treated as non-primary production income. The concessional tax treatment of income from ACCUs as primary production income is limited to specific circumstances. Consequently, it is essential that graziers seek professional advice before undertaking projects.

Contribution to climate change, reef and drought goals

Primary producers are the largest land managers in Queensland. Across Queensland, there are currently 516 agriculture, vegetation and savannah burning projects that have been issued ACCU's since 2011, while other schemes have 33 registered projects. Across Australia, 161.2 million ACCUs have been issued since 2011 (30.6 million across Queensland). Fitch et al. (2022) estimated that vegetation and agriculture methods have the economic potential to sequester 106–130 million t CO_2e annually (a quarter of Australia's annual emissions). Australia was ~37% below 2005 levels in 2023 with a target of net zero by 2050, which indicates that participation in environmental market scheme projects remains relatively low. The impact of environmental market schemes is limited by the number and scale of the projects.

Reasons deterring participation include a lack of financial viability due to high upfront project costs (including forgone revenue and reduced land values), risks of project failure, credit revenue uncertainty (price and number of credits), tax and legal implications and loss of flexibility. Targeting the facilitators (economic benefits, providing information and technical assistance) and barriers to entry can support scheme participation. Other barriers to entry include scheme complexity and awareness, cumbersome management requirements and long project timeframes (permanence periods). However, the demand for environmental goods and services is increasing through regulations (Safeguard Mechanism) and voluntary initiatives (ESG), which help support credit prices if integrity and trust can be maintained.

Key opportunities for primary producers to participate in schemes include undertaking projects that complement the existing business of primary production, provide production efficiency improvements and co-benefits (e.g. soil health), and changing land use on marginal (lower opportunity cost) agricultural land. Furthermore, stacking credits across schemes may be key to improve scalability. While four key methods were examined in this report, it is recommended that more investment analyses are conducted to examine the profitability implications from undertaking projects for other relevant scheme methods including stacking credits across multiple schemes. Drafting new methods is also likely to generate opportunities such as methane-reducing cattle feed additives and silvopastoral systems for suitable southern Queensland areas. It is also recommended to extend the concessional tax treatment of ACCUs to other schemes and revise the definition of primary production in taxation legislation to include activities undertaken pursuant to environmental market schemes. Also, further investigation is needed into the 'additionality' requirement of many schemes.

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1 Introduction

Global environmental challenges such as climate change, water scarcity, land degradation, and biodiversity loss are intensifying (Pearse 2018). The environmental policy toolkit comprises a range of instruments, including regulations, government provided services, voluntary initiatives by individuals, communities, and businesses, as well as incentive or market-based mechanisms (Pearse 2018). Market-based approaches can include user fees or taxes, tradable permits, certification schemes like eco-labels, and payments for ecosystem services (Pearse 2018).

Environmental markets, which first emerged in the early 1970s, are increasingly popular as a mechanism to tackle environmental problems (Stavins 2003; Fowler et al. 2024). This is exemplified by the rise of emissions trading schemes across the globe from the European Union, the USA and Canada to South Korea, Australia, New Zealand, and China (Millward-Hopkins 2016). Their emergence reflects the neoliberal global trend of marketisation and privatisation, and the preference for market-based incentivise over command-and-control policies (Pearse 2018; Lankoski et al. 2015).

Environmental markets are market-based instruments that facilitate the exchange of environmental goods and services (such as biodiversity, habitat, and clean air and water) for monetary or other forms of value (Pearse 2018). They are designed to incentivise protection, restoration, and sustainable use of environmental assets, for example, restoration of coastal wetlands, reforestation of cleared land, soil organic carbon sequestration, and reduction of fertiliser and pesticide run-off from farms (Anderson and Libecap 2014).

Environmental markets facilitate the valuation and trade of ecosystem services, such as biodiversity, water quality, and carbon sequestration, which have historically been underpriced and overused (Pearse 2018; Sangha et al. 2024; Lankoski et al. 2015). These markets can improve resource allocation, attract private investment and offer cost-effective alternatives to government regulation (Sangha et al. 2024; Lankoski et al. 2015). The growing interest and participation in environmental markets can mobilise broader stakeholder involvement and funding, though debates persist regarding their equity, efficiency and environmental outcomes (Lankoski et al. 2015; Pearse 2018). However, environmental markets may not be a viable solution in cases where there is a lack of competition or the commodity traded is not fully defined (Pearse 2018). Further potential limitations of environmental market schemes for primary producers include issues such as high transaction costs, monitoring and compliance costs, loss of flexibility over operations and long-term contractual commitments.

Australia has taken a pioneering role in the development of environmental markets, marked by a range of initiatives and substantial investment (Milne et al. 2024). For example, Australia’s Nature Repair Market is the world’s first national, legislated, voluntary biodiversity market. Both Australia’s federal and state governments have adopted market-based strategies to address biodiversity loss and climate change, exemplified by the Australian Carbon Credit Units Scheme (ACCU scheme) established in 2011 which is one of the world’s largest land sector climate mitigation schemes (Milne et al. 2024). Government agencies have been central to the design, coordination, and regulation of these markets, while also actively participating as buyers and sellers of environmental credits (Milne et al. 2024).

The key environmental markets currently in operation in Australia and Queensland, which are the focus of this report, are the ACCU scheme, the Nature Repair Market, and the Queensland based Land Restoration Fund (LRF) (this is a grant scheme rather than a separate market), Reef Credit scheme and Cassowary Credit scheme. These markets vary in size, scope and maturity, are governed by different regulatory requirements, and have distinct environmental focus areas. The following table summarises the key characteristics of these markets.

Table 1: Environmental Markets in Australia and Queensland

Environmental Market	ACCU Scheme	Reef Credit Scheme	Land Restoration Fund (LRF) (grant scheme)	Nature Repair Market	Cassowary Credits
Year scheme commenced	2011	2017	2020	2025	May 2025
Commodity	Carbon	Great Barrier Reef catchment water quality	Carbon + co-benefits	Biodiversity	Biodiversity
Jurisdiction	National	Queensland	Queensland	National	Queensland
Legislated	Yes	No	No	Yes	No
Credit issued	1 ACCU = 1 t CO_2e abated	1 reef credit = 1kg Dissolved Inorganic Nitrogen or 538kg Fine Sediment	ACCU + premium for co-benefits	1 biodiversity certificate = biodiversity outcome delivered by a project (1 certificate issued per project)	1 cassowary credit = improvement in rainforest condition
Buyers	Voluntary (some demand is driven by regulatory restrictions on emissions via the Safeguard Mechanism)[1]	Voluntary	Voluntary	Voluntary	Voluntary
Scheme Administrator	Clean Energy Regulator	Eco-Markets Australia	Clean Energy Regulator and Land Restoration Fund	Clean Energy Regulator	Eco-Markets Australia

[1] The ACCU scheme is a voluntary environmental market scheme, and no purchasers of ACCUs are ***required*** to purchase credits. The Safeguard Mechanism has simulated demand for ACCUs by requiring Safeguard facilities to meet emissions reduction targets; in circumstances where Safeguard facilities cannot meet the targets, they have the ***option*** to purchase and surrender ACCUs to comply with the targets.

No. of methodologies	9 vegetation, agriculture and savannah burning methods	5 methods	3 categories of co-benefits	1 method	1 method
Price of credits	$35.90/ACCU[2]	$170/DIN[3]	$52.50 (2020), $71.16 (2021), $120 (2023) /ACCU + co-benefit[4]	Not known	Not known
No. of credits issued	161,203,002 ACCUs[5]	60,868 reef credits	1,320,030 premium ACCUs were contracted by the LRF in 2020, 2021, and 2023[6]	0	0
No. of projects	2,503 projects[7]	14 projects	26 projects	0	1 project

Source: Partially adapted from Deane et al. (2024)

As demonstrated by Table 1 above, the ACCU scheme, which commenced in 2011, is the largest environmental market scheme in Australia with 2,503 registered projects and 161,203,002 credits having been issued. The other environmental market schemes are significantly smaller in comparison to the ACCU scheme.

Participation in these environmental market schemes has risen over time, however, it remains low and there is an under supply of the environmental goods and services. For example, since 2014, projects registered under the ACCU scheme have generated 161,203,002 t CO_2e abatement, which is equivalent to only 37% of Australia's ***annual*** emissions[8]. Furthermore, since 2017, projects registered under the Reef Credit scheme have prevented 60,686 kg of dissolved inorganic nitrogen (DIN) from entering the Great Barrier Reef, which is equivalent to only 0.55% of the total amount of DIN (11,000 t/yr) that enters the GBR lagoon ***annually*** (McCloskey et al. 2021).

Opportunity for Queensland primary producers

Environmental markets are gaining importance in Australia, particularly in circumstances where Australia's Federal and State governments have made major commitments to protecting the environment, such as the Australian government's legislated greenhouse gas emissions targets (to reduce emissions to 43% below 2005 levels by 2030, and to net zero by 2050), and the Safeguard Mechanism (legislated emission reduction requirement for Australia's largest

[2] The ACCU spot price was $35.90 on 23 May 2025 (Core Markets 2025b).
[3] Eco-Markets Australia (2025c).
[4] Queensland Government (2025a).
[5] ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d).
[6] Queensland Government (2025c).
[7] ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d).
[8] Australia's annual net greenhouse gas emissions were 432.9 Mt CO_2e in 2023 (DCCEEW 2024).

industrial facilities) (Byrareddy et al. 2023). Private industry and businesses are increasingly demanding environmental goods and services to meet regulatory requirements (such as Safeguard facilities meeting emissions reduction targets set by the Safeguard Mechanism) as well as for voluntary investment initiatives primarily driven by a combination of social licence strategy and environmental, social and governance reporting. Sustainability is a key concern of today's society, and one that businesses can no longer afford to ignore (De Valck et al. 2022). There is rising consumer demand for food produced according to higher environmental standards and increased expectations that companies will adopt environmentally responsible practices (De Valck et al. 2022). These factors are driving demand for environmental market scheme credits and thereby creating an opportunity for the agriculture sector to benefit from participating in environmental market schemes by supplying credits (McLean et al. 2023).

Australian agriculture is the largest land management sector, occupying 54.63% of Australia's land area (ABARES 2025a). In Queensland, that percentage is higher at 80.03% (ABARES 2025). This creates opportunities for Australian and Queensland primary producers to engage in environmental market schemes and take advantage of the potential co-benefits that may be created. For example, Fitch et al. (2022) identified that Australia has significant capacity to sequester carbon through vegetation and soil management practice changes; Table 2 below illustrates the results of Fitch et al. (2022), namely the millions of tonnes of carbon dioxide equivalent (Mt CO_2e) actually sequestered in the year 2021-2022, the technical potential of annual carbon sequestration in Mt CO_2e by 2050, and the economic potential of annual carbon sequestration in Mt CO_2e by 2050. Fitch et al. (2022) distinguished *technical* potential, meaning the maximum amount of sequestration biophysically possible without consideration of economic feasibility or resource competition (e.g. land, energy, water), from *economic* potential, meaning the amount of sequestration possible based on concerted efforts to implement technical and management changes and based on insights and assumptions regarding resource availability, adoption barriers and market settings (e.g., the price of credits was assumed to be $30 in the analysis by Fitch et al. (2022)).

Table 2: Comparison between annual carbon sequestration rates for 2021-22, technical potential by 2050 and economic potential by 2050

ACCU Scheme method	Perman-ent plantin-gs	Plantatio-n forestry	Human induced regeneration of native forest[9]	Avoided clearing[10]	Savanna fire management	Soil carbon	Blue carbon	Total (Mt CO_2e/ yr)
2021-22 actual sequestration (Mt CO_2e)	2.1	11.5	20	NE	5.6	4.8	NE	**44**
2050 technical potential (Mt CO_2e/yr)	516	630	60.1	9.2	6.2	115	NE	**1,336.5**
2050 economic potential (Mt CO_2e/yr)	16.4	31.8	39.2	7.7	6.2	5-29	NE	**106.3 – 130.3**

Source: Adapted from Fitch et al. (2022); NE = No estimate

[9] This method is closed.
[10] This method is closed.

The results from the analysis by Fitch et al. (2022) demonstrate a significant gap between the amounts of carbon currently being sequestered and the potential for carbon sequestration; for example, in 2021-22 only 44 Mt CO_2e was sequestered in total, whereas there is a technical potential to sequester ~30 times that amount (1,336.5 Mt CO_2e/yr) and an economic potential to sequester ~2.7 times that amount (106.3–130.3 Mt CO_2e/yr) each year (Fitch et al. 2022). Furthermore, the volumes of annual potential technical sequestration posited by Fitch et al. (2022) are significant, given that in the year ended December 2023, Australia's net greenhouse gas emissions were 432.9 Mt CO_2e, indicating that achieving net zero is at least technically feasible (DCCEEW 2024).

Fitch et al. (2022) did however, caveat their report by acknowledging that, 'the difference between technical potential and actual sequestration as an indicator of opportunity should be viewed with caution'. This is because the technical sequestration may not be attainable in some cases due to serious technical or economic barriers that are unable to be addressed (Fitch et al. 2022).

Primary producers can benefit from participating in environmental market schemes in a range of ways such as earning a diversified source of income from the sale of credits; gaining ecosystem co-benefits such as enhanced biodiversity, expanded habitat availability, improved soil health, structure, and water retention, better management of erosion and salinity, and improved water quality; gaining access to green loans that offer lower interest rates; and potentially earning a price premium for heterogeneous products like carbon neutral or environmentally sustainable produce. Furthermore, key opportunities may lie in developing lower opportunity cost marginal agricultural land into environmental market scheme projects, as well as targeting projects that generate credits that can be stacked or bundled with credits from another environmental market scheme.

There are, however, costs involved in participating in environmental market schemes that can be significant and, in some circumstances, render a project financially unviable. These costs include the cost of undertaking a project and the opportunity cost of reduced primary production activities. Furthermore, there are significant risks associated with participation in environmental market schemes including a potential reduction in land value, negative impacts on long-term primary productivity of farmland, government policy uncertainty, scientific uncertainty, financial unviability of projects, risk of project failure and permanence obligations, and complex and asymmetrical information. Participation in environmental market schemes can also have significant taxation implications for primary producers.

Considering the costs and risks associated with environmental market schemes, McLean et al. (2023) stated the following:

> 'Novel income streams from environmental services, carbon sequestration, and the like, have attracted a lot of attention in recent years. We believe that there is a real risk that these income streams may be ephemeral, fickle and at this time there is limited independent objective information to make well informed decisions. The core business of economically sustainable beef production should, in our opinion, always be the primary focus… we are not suggesting these potential income streams be ignored, if they can be accessed without affecting or putting the core business at risk, they warrant serious consideration' (McLean et al. 2023).

Ultimately, the opportunity to gain from participating in environmental market schemes varies from primary producer to primary producer, and a case-by-case assessment is required to determine the suitability of participation for individual business enterprises.

The role of this report is threefold: first, investigate the key environmental market schemes currently available and emerging for Queensland primary producers, namely the ACCU scheme, Reef Credit scheme, LRF (grant scheme), Nature Repair Market and Cassowary Credit scheme, and canvas the requirements to participate in these schemes; second, analyse the financial viability of participating in four of the ACCU scheme methods by using case study farm businesses; and third, to identify and analyse the key drivers of demand for and supply of environmental market scheme credits, as well as identify and analyse the benefits, costs, opportunities, risks and taxation implications associated with participating in environmental market schemes for Queensland primary producers. This report excludes analysis of water markets and broader climate policy debates, and aims to deliver practical insights for producers, policymakers, and researchers engaged in the sustainable development of Queensland's grazing sector.

2 Environmental Markets

2.1 ACCU Scheme

2.1.1 Overview

The Australian Carbon Credit Unit scheme (ACCU scheme) is the largest environmental market established in Australia by the *Carbon Credits (Carbon Farming Initiative) Act 2011* (Cth) (the Act) that commenced on 8 December 2011 (Milne et al. 2024). The ACCU scheme and the Safeguard Mechanism (discussed below) are Australia's key national policies to reduce greenhouse gas emissions. Under the ACCU scheme, landholders have an opportunity to undertake projects to remove and store carbon from the atmosphere (sequestration) and/or to reduce or avoid greenhouse emissions (emission avoidance). One ACCU is equal to one tonne of carbon dioxide equivalent (t CO_2e) emissions that a project stores or avoids (CER 2024). Since its establishment, 161,203,002 ACCUs[11] have been issued under the scheme and 2,503 projects[12] have been registered (CER 2025d).

The ACCU scheme has five objectives including (1) to remove greenhouse gases from the atmosphere and avoid emissions of greenhouse gases; (2) to create incentives for people to carry on certain offsets projects; (3) to increase carbon abatement in a manner that is consistent with the protection of Australia's natural environment and improves resilience to the effects of climate change; (4) to authorise the purchase by the Commonwealth of units that represent carbon abatement; and (5) to facilitate the achievement of Australia's greenhouse gas emissions reduction targets (s3, *Carbon Credits (Carbon Farming Initiative) Act 2011* (Cth)).

The Clean Energy Regulator (CER) is responsible for administering the ACCU scheme, including assessing project applications for registrations, assessing project reporting, ensuring scheme compliance, issuing ACCUs, managing carbon abatement contracts, and publishing the ACCU scheme project and contract registers (CER 2024).

The Safeguard Mechanism

The Safeguard Mechanism, legislated by the *National Greenhouse and Energy Reporting Act 2007*(Cth), is designed to reduce emissions from Australia's largest industrial facilities to ensure Australia meets its emissions reduction targets of 43% below 2005 level by 2030 and net zero by 2050. The Safeguard Mechanism was initially legislated in 2014 and subsequently reformed in 2023 (DCCEEW 2024a). Industrial facilities, such as in the electricity sector, mining, oil and gas production, manufacturing, transport and waste facilities, that emit more than 100,000 tonnes of carbon dioxide equivalent per year are subject to the Safeguard Mechanism. The legislation sets targets (known as baselines) on the net greenhouse gas emissions produced by the Safeguard facilities and requires that the baselines decline by 4.9% each year to 2030 (except for the electricity sector) (DCCEEW 2024a). Under the Safeguard Mechanism, the electricity sector is subject to a single 'sectoral' baseline across all electricity generators connected to one of Australia's main electricity grids (DCCEEW 2024a). Safeguard facilities can voluntarily purchase and surrender ACCUs to meet their compliance obligations under the Safeguard Mechanism. In 2022-23, there were 219 Safeguard facilities, accounting for 30% of Australia's greenhouse gas emissions (DCCEEW 2024a). The CER administers the Safeguard Mechanism.

[11] However, 211,374 ACCUs out of the 161,203,002 ACCUs have been relinquished (CER 2025d).
[12] However, 325 projects out of the 2,503 projects have been revoked (CER 2025d).

In addition to the Safeguard facilities that voluntarily purchase ACCUs to meet the Safeguard Mechanism regulated emissions targets, ACCUs are also purchased voluntarily by government and private buyers seeking to offset their emissions (CER 2024).

ACCU Scheme Requirements

Integrity of ACCUs[13] is critical to ensuring the efficacy of the ACCU scheme. ACCU scheme credits have integrity when there is confidence that they represent real, additional and permanent abatement (DAFF 2025; Macintosh et al. 2024a; Thamo and Pannell 2016). 'Real' refers to the accuracy with which the carbon sequestration or emission avoidance directly attributable to project activities is reflected in the credits. 'Additionality' refers to the requirement that the carbon abatement resulted from activities that would not have occurred without the incentive provided by the ACCU scheme. 'Permanence' refers to the requirement that carbon sequestration levels must be maintained (DAFF 2025; Thamo and Pannell 2016; Macintosh et al. 2024).

To operate under the ACCU scheme, projects must meet the following eligibility criteria:

- be new (activities must not have started);
- go beyond business-as-usual activities;
- not be required by law;
- not be receiving financial support from specified government programs;
- not be an excluded activity under the Carbon Credits (Carbon Farming Initiative) Rule 2015; and
- follow an approved method that sets out the rules for running the project and estimating emissions reductions (CER 2024).

Project participants must also:

- have the legal right to carry out project activities;
- have the legal right to be issued all ACCUs from the project; and
- undergo a fit and proper person assessment (CER 2024).

For each method, there are additional requirements that must be met, which are set out at Appendix 9.1 of this report. Furthermore, there are specific eligibility requirements for safeguard facilities looking to run new projects or activities.

2.1.2 ACCU scheme methods

To generate ACCUs, participants must undertake a project using a prescribed method. Legislation known as 'Methodology Determinations' set out the methods and details the activities that can be conducted, how the carbon abatement must be measured, and the

[13] Section 133 of the *Carbon Credits (Carbon Farming Initiative) Act 2011* (CFI Act) sets out the **offsets integrity standards**:

1. Additionality: Methods should result in carbon abatement that is unlikely to occur in the ordinary course of events (disregarding the effect of the Act);
2. Measurable and verifiable: If a method involves ascertaining the removal of GHG from the atmosphere, the reduction of emissions of GHG to the atmosphere, or the emissions of GHG to the atmosphere, then the removal, reduction or emission should be measurable and capable of being verified;
3. Eligible carbon abatement: Abatement generated under a method should be able to be used to meet Australia's international mitigation obligations;
4. Evidence-based: Methods should be supported by clear and convincing evidence;
5. Project emissions: The net abatement amount should deduct material emissions of GHG that were a direct consequence of carrying out the project;
6. Conservative: If a method involves an estimate, projection or assumption, the estimate, projection or assumption should be conservative.

monitoring, record keeping and reporting requirements. The methods are designed to ensure that emissions reductions are genuine, measurable, and meet the additionality requirements outlined in the Act (Harper and Sochacki 2019).

There are several types of methods including agricultural methods (soil carbon and animal management strategies to reduce farm and land emissions); vegetation methods (projects remove carbon dioxide from the atmosphere and store it as carbon in plants); energy efficiency methods (reduce electricity and natural gas use); landfill and waste methods (upgrade or install facilities to reduce waste emissions); mining, oil and gas methods (projects re-route, flare or combust leaked facility emissions); and transport methods (projects upgrade aviation, sea and land vehicles to reduce emissions) (CER 2024).

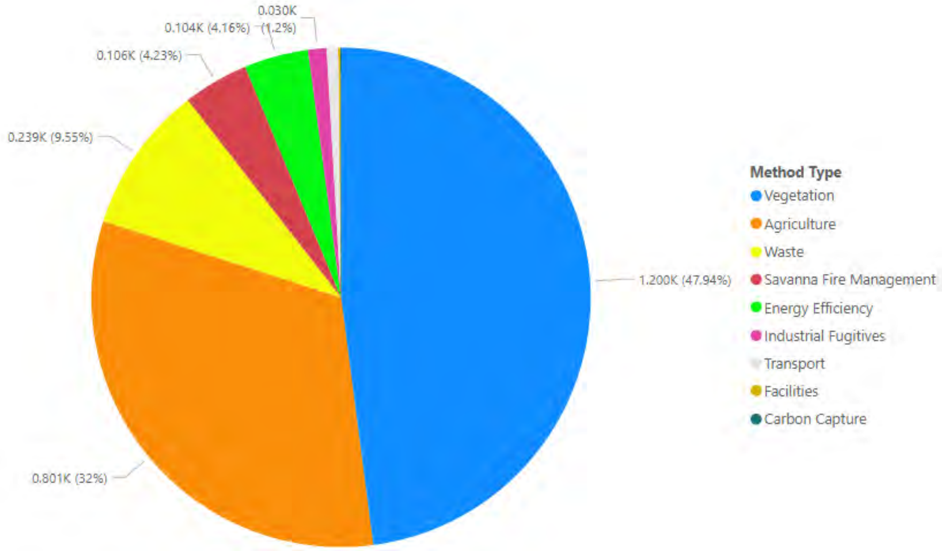
A description of the rules and summary of the current uptake of the nine currently available agriculture, vegetation and savanna burning methods is provided at Appendix 9.1. In addition to the currently available methods, descriptions and summaries of the avoided clearing of native regrowth method (expired on 31 March 2025) and the beef cattle herd management method (suspended 17 December 2024) have also been included at Appendix 9.1 due to the relevance of these methods to Queensland primary producers.

Classified as subordinate legislative instruments, ACCU scheme methods automatically end or 'sunset' 10 years after they are made (CER 2024p). Once expired, no new projects can be registered under the method, but existing projects may continue operating until the conclusion of their crediting period, provided that registration and the crediting period had commenced prior to the method expiration (CER 2024p).

The CER publishes information on its website about all projects registered on the ACCU scheme Project Register. Figure 1 below consists of the recent ACCU scheme Project Register data as of 28 February 2025 and illustrates the number of projects registered by method type. The total number of projects registered under the ACCU scheme is 2,503 projects, however, 325 of those projects have been revoked (CER 2025d)[14]. Of the methods, the greatest number of projects have been registered using a vegetation method (1,200 or 48%), followed by agriculture (801 or 32%), waste (239 or 10%) and savanna burning (106 or 4%).

[14] Of the vegetation, agriculture and savanna fire management methods, 235 projects have been revoked. The exact reasons for revocation are not provided in the ACCU Scheme Register; instead, the section of legislation used for the revocation is described and includes s29 CFI Rules and s32 CFI Act (project proponent voluntarily seeks for the project to be revoked and credits were issued in which case all credits must be relinquished if the project was a sequestration offsets project), s30 CFI Rules and s33 CFI Act (project proponent voluntarily seeks for the project to be revoked and no credits were issued), and s32 CFI Rules (regulator unilaterally revokes declaration of eligible offsets project if a requirement is not met, such as consent from eligible interest holders has not been obtained) and s30 CFI Act (variation of project land area).

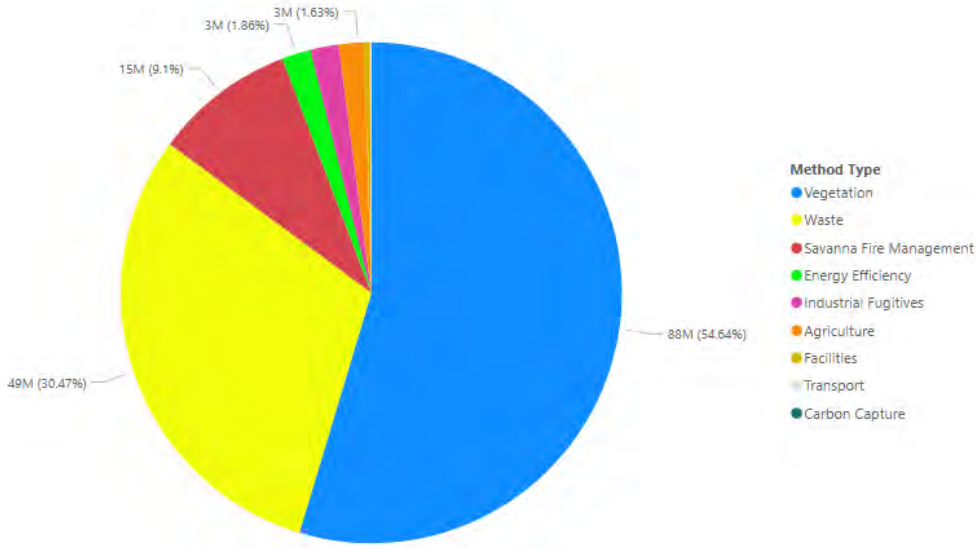
Figure 1: Number of registered projects by method type under the ACCU Scheme



Source: Adapted from ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d)

The total number of ACCUs issued since the commencement of the scheme is 161,203,002 ACCUs, however, 211,374 ACCUs have been relinquished[15]. Figure 2 below illustrates the number of ACCUs issued by method type using ACCU Scheme Project Register data as of 28 February 2025. The most ACCUs have been issued to projects using vegetation methods (88M or 55%), followed by waste (49M or 30%), and then savanna burning (15M or 9%). The number of ACCU's issued using agricultural methods is relatively small (3M or 2%).

Figure 2: Number of ACCUs issued by method type under the ACCU Scheme



[15] Of the agriculture, vegetation and savanna burning methods, 66,700 ACCUs have been relinquished by 13 projects. The exact reasons for revocation are not provided in the ACCU Scheme Register; instead, the section of legislation under which the relinquishment was required is provided and includes s88 CFI Act (false or misleading information provided to CER), s32 CFI Act, s390(5) CFI Amendment Act (project converted from a 100-year to a 25-year permanence period), and s23(1)(d) CFI Rules (variation of the project area).

Source: Adapted from ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d)

Agricultural, Vegetation and Savanna Burning Methods – open and closed

The methods suitable for adoption by Queensland primary producers are the agricultural, vegetation and savanna burning methods. There are several methods within each of the agricultural, vegetation and savanna burning method types, all of which are listed in Table 6 below, but the key methods include soil carbon, beef cattle herd management method (suspended), plantation forestry, environmental plantings, avoided deforestation (closed), human-induced regeneration (closed) and savannah burning. Many of the methods have expired or been revoked; nevertheless, projects that were registered under these methods whilst they were operational and have reached their crediting period can continue to run using the subsequently closed methods.

Tables 3, 4, and 5 provide a brief description of and outline suitable management activities to achieve each method within the agricultural method type, vegetation method type and the savannah burning method type, respectively.

Table 3: Brief description of each method and suitable activities – Agricultural methods

Estimating soil organic carbon sequestration using measurement and models	Sequester carbon in the soil by: • Using new/different management practices. • Apply nutrients to the land. • Undertaking new irrigation. • Re-establishing/rejuvenating pasture. • Establishing and permanently maintaining pasture where there was none, or limited (cropland or bare fallow). • Altering stocking rate (grazing duration/intensity). • Modifying landscape or landform features to remediate land. • Using legume species in cropping or pasture system.
Estimating sequestration of carbon in soil using default values (expires 30/09/2025)	Sequester carbon in the soil by: • Sustainable intensification, by implementing land management practices to increase soil carbon (e.g. managing nutrients, introducing new irrigation, or renovating pasture). • Stubble retention, where crop residue that was previously removed by baling or burning is retained in the field. • Conversion to pasture, where cropped land is changed to permanent pasture.
Fertiliser in irrigated cotton (expires 30/09/2025)	Reduce emissions by: • Improving nitrogen fertiliser use efficiency by lowering synthetic fertiliser use or increasing lint yield without increasing fertiliser rates.
Animal effluent management	Reduce emissions by:

	• Diverting waste from anaerobic ponds to alternative treatment systems (e.g. digesters or covered ponds), which capture and destroy methane or convert it into biomethane (e.g. dairies and piggeries).
Beef cattle herd management (closed)	Reduce emissions by: • Improving cattle productivity. • Reducing the average age of a herd. • Reducing the proportion of unproductive animals. • Changing the number of animals in each livestock class.
Feeding nitrates to beef cattle (closed)	Reduce methane emissions by: • Substituting urea supplements with nitrate supplements in the form of lick blocks.

Table 4: Brief description of each method and suitable activities – Vegetation methods

Reforestation by environmental or mallee plantings	Sequester greenhouse gas emissions by: • Establishing and maintaining vegetation such as trees or shrubs on land that has been clear of forest for at least 5 years. Plantings can be either mallee eucalypts or a mixture of native species.
Reforestation and afforestation (expires 30/09/2025)	Sequester greenhouse gas emissions by: • Permanent planting of forest trees in an agricultural area on land that has been grazed, cropped, or allowed to lie fallow for at least 5 years prior. The land must not be cleared native forest.
Blue carbon	Sequester greenhouse gas emissions by: • Reintroduce tidal flows and convert freshwater wetlands to coastal wetland ecosystems or rewet drained coastal wetlands by changing or removing mechanisms restricting tidal flows.
Plantation forestry	Sequester greenhouse gas emissions by: • Establishing a new plantation forest, converting short rotation to long rotation existing plantation forests, transitioning plantation forests to permanent forests, or avoiding conversion of an existing or recently harvested plantation forest. There must not have been a native forest on the land in the previous 7 years. Other options available but none are relevant to cattle/sugarcane farms.
Avoided clearing of native regrowth (closed)	Sequester greenhouse gas emissions by: • Retain areas of native forest that would otherwise be cleared in the normal course of events (area must been cleared at least twice in the past and been used for grazing/cropping).

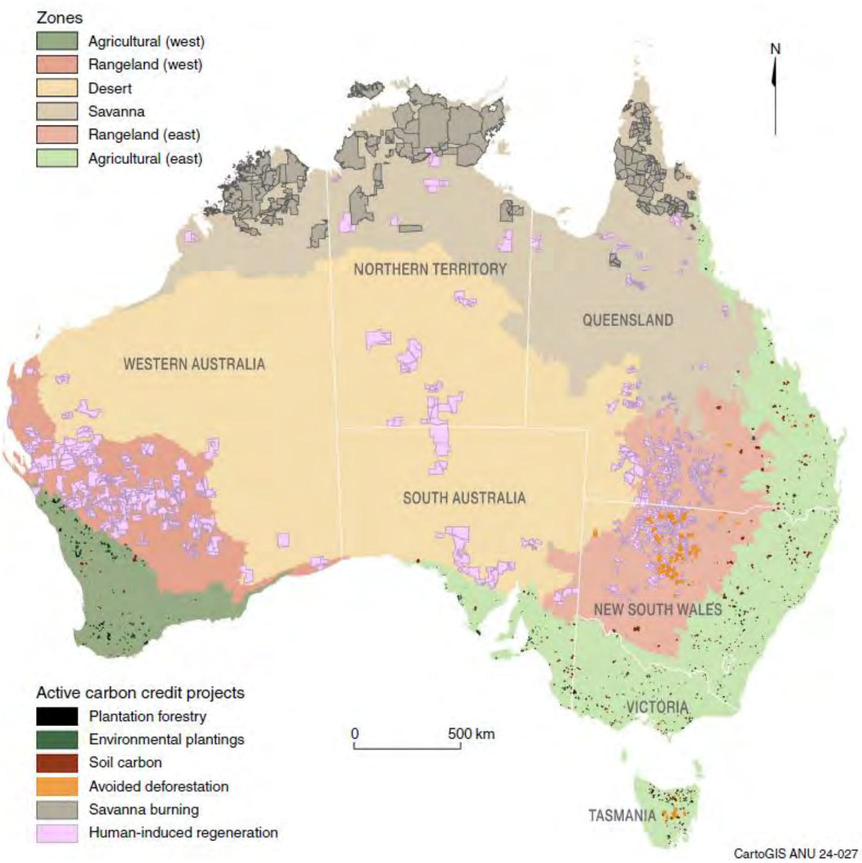
Table 5: Brief description of each method and suitable activities – Savannah burning methods

Savanna fire management methods	Increase carbon sequestration in dead organic matter and avoid emissions from the unplanned burning of savannas late in the dry season by: • Implementing savanna fire management activities including annual planned burning to reduce the frequency and intensity of late-dry season fires and sequester carbon in` dead organic matter.

Under the ACCU scheme, the method type that most projects adopt is not necessarily the method type with greatest number of ACCUs issued. Across Australia, the greatest number of projects have been registered using vegetation methods (1,200 projects), followed by agriculture methods (801 projects) and then savannah burning methods (106 projects) (CER 2025d), whereas the most ACCUs have been issued to projects using vegetation methods (88,079,709 ACCUs), followed by savannah burning method projects (14,675,051 ACCUs) and then agricultural method projects (2,623,640 ACCUs) (CER 2025d).

Figure 3 below illustrates the number and location of active projects using agricultural, vegetation and savanna burning methods (both open and closed) registered under the ACCU scheme in Australia (save for projects using the beef cattle herd management method, which are not included and account for only 15 projects). From the map, it is observed that the savannah burning method projects are located in northern Australia, as is required by the method rules. Additionally, the human-induced method is notably the most utilised method, and its projects, together with the avoided deforestation method projects, are predominantly located in the lower rainfall rangeland and desert zones. Conversely, the plantation forestry, environmental plantings, and soil carbon method projects are mostly located in areas with higher rainfall including the east and west agricultural zones.

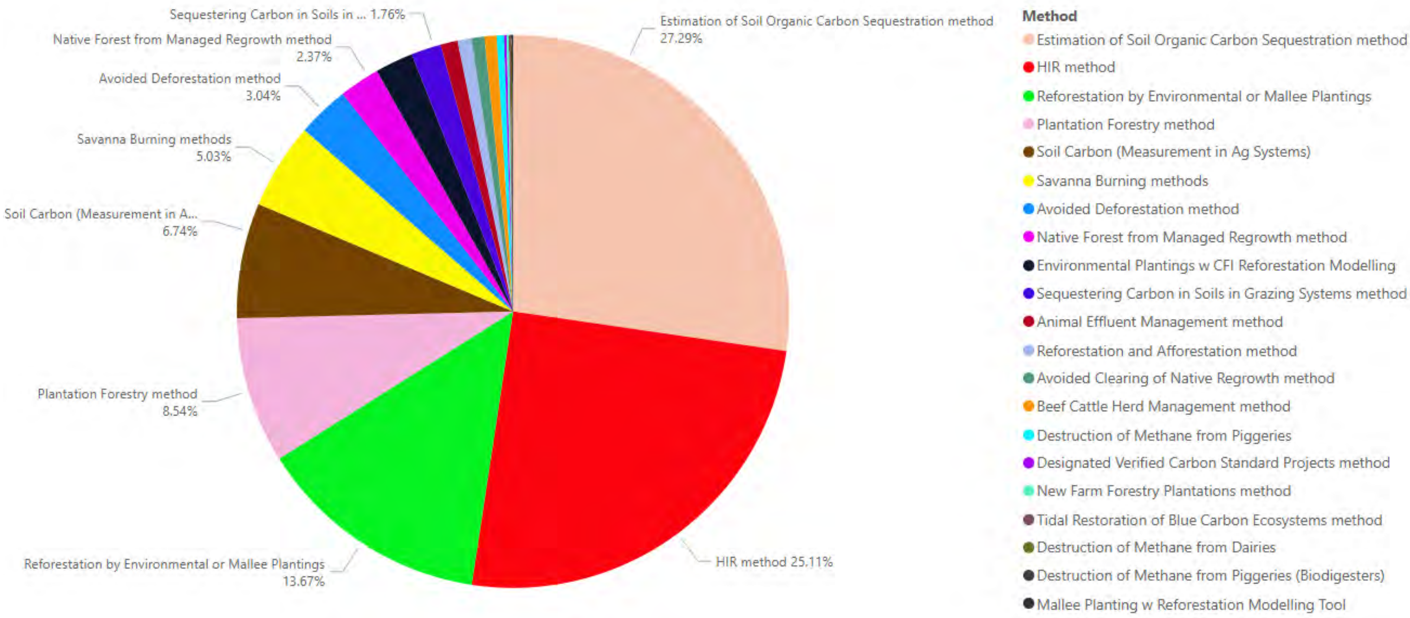
Figure 3: Map of all agricultural, vegetation and savannah burning ACCU scheme methods



Source: Adapted from Milne et al. (2024)

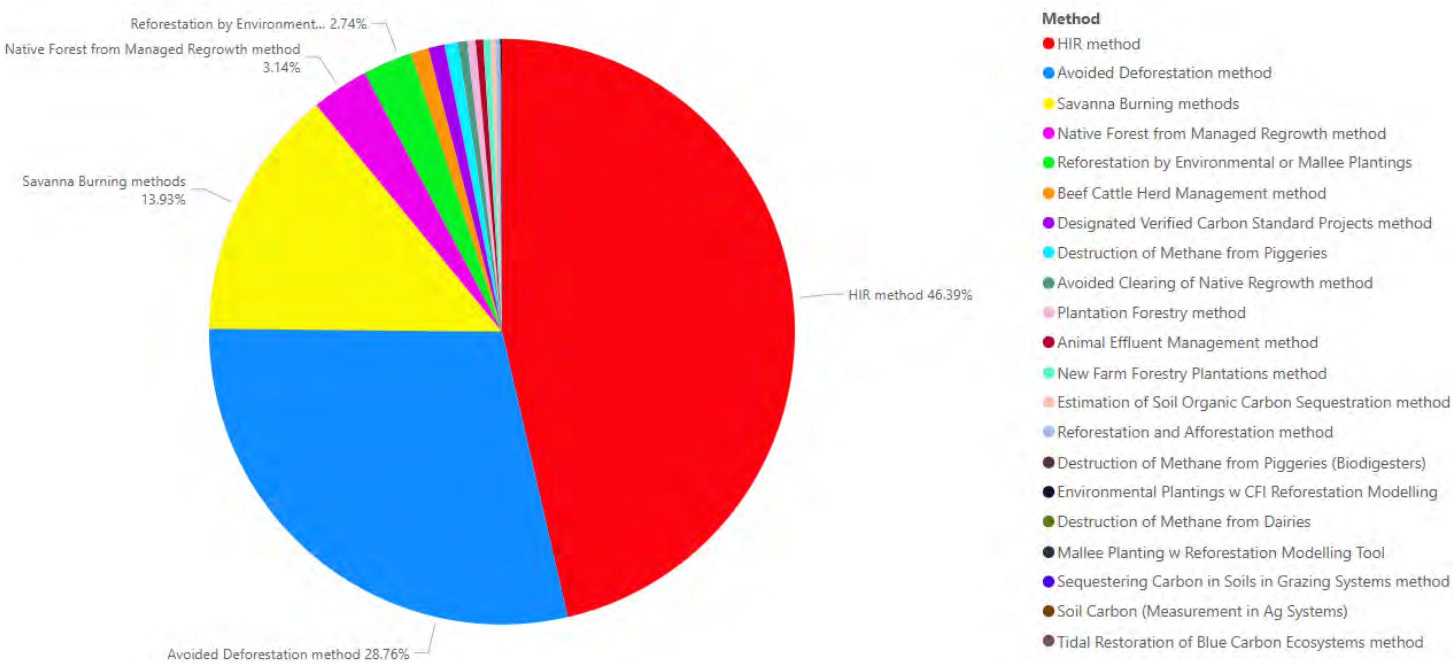
Figure 4 below illustrates the number of projects registered for all of the agriculture, vegetation and savanna burning methods, both open and closed, followed by Figure 5 that shows the number of ACCUs issued by method type for the agriculture, vegetation and savanna burning methods, open and closed.

Figure 4: Projects registered by agricultural, vegetation and savanna burning method type



Source: Adapted from ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d)

Figure 5: ACCUs issued by agricultural, vegetation and savanna burning method type



Source: Adapted from ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d)

Vegetation methods

As illustrated in Figure 4 above, out of the vegetation methods, across Australia the largest number of projects have been registered using the now closed human-induced regeneration of a permanent even-aged native forest method (HIR method) (529 projects), followed by the reforestation by environmental or mallee plantings method (288 projects), then the plantation forestry method (180 projects) and then the now closed avoided deforestation method (AD method) (closed) (64 projects).

Out of the vegetation methods (Figure 5), across Australia the largest number of ACCUs have been issued to projects using the closed HIR method (48,888,689 ACCUs), followed by projects using the closed AD method (30,306,813 ACCUs), then the now closed native forest from managed regrowth (3,305,370 ACCUs), and then the reforestation by environmental or mallee plantings method (2,887,130 ACCUs). 'Notably, [the HIR and AD methods] are low input and/or low transaction cost methods, being prevalent on marginal agricultural land across the rangelands' (Milne et al. 2024).

In Queensland, the vegetation method that has had the greatest adoption rate is the closed HIR method (183 projects), followed by the closed native forest from managed regrowth method (50 projects), then the reforestation by environmental or mallee plantings method (23 projects) and then the closed avoided clearing of native regrowth method (16 projects).

In Queensland, the most ACCUs have been issued for vegetation method projects using the closed HIR method (20,477,305 ACCUs), followed by the closed native forest from managed regrowth method (3,305,370 ACCUs), then the closed avoided clearing of native regrowth method (535,629 ACCUs) and then the reforestation and afforestation method (30,191 ACCUs).

Agricultural methods

As illustrated by Figure 4 above, out of the agriculture methods, across Australia the largest number of projects have been registered using the estimation of soil organic carbon sequestration method (575 projects), followed by projects using the closed measurement of soil carbon sequestration in agricultural systems method (142 projects), then the closed sequestering carbon in soils in grazing systems method (37 projects) and then the animal effluent management method (21 projects).

As illustrated by Figure 5 above, out of the agriculture methods, across Australia the largest number of ACCUs have been issued to projects using the suspended beef cattle herd management method (1,044,037 ACCUs), followed by the closed destruction of methane generated from manure in piggeries method (774,637 ACCUs), then the animal effluent management method (426,046 ACCUs) and then the current soil organic carbon measurement method (320,424 ACCUs).

In Queensland, the agricultural method that has had the greatest adoption rate is the current soil organic carbon measurement method (135 projects), followed by the closed measurement of soil carbon sequestration in agricultural systems method (25 projects, and then the beef cattle herd management method (11 projects).

In Queensland, the most ACCUs have been issued for agricultural method projects using the closed suspended beef cattle herd management method (1,044,037 ACCUs), followed by the closed destruction of methane generated from manure in piggeries method (432,920 ACCUs), and then the current soil organic carbon measurement method (279,084 ACCUs).

Table 6 below summarises the number of projects registered by method type, the number of ACCUs issued by method type, and the number of projects that have received ACCUs nationwide. Additionally, the number of projects by method type and number of ACCUs issued by method type have been included for Queensland. The rows that have been greyed out represent methodologies that have closed.

Table 6: Agricultural, vegetation and savanna burning method (open and closed) projects (data as at 28/02/2025)

Project method	Sunset date	Total no. projects registered nationally	Total no. of ACCUs issued nationally	Total no. of projects with ACCUs issued (nationally)	No. projects registered in Qld	Total no. of ACCUs issued in Qld
Agricultural methods (total)		**801**	**2,623,640**	**40**	**182**	**1,756,041**
Estimating soil organic carbon sequestration using measurement and models (Methodology Determination 2021)	1/10/2032	**575**	**320,424**	**26**	**135**	**279,084**
Animal effluent management (Methodology Determination 2019)[16]	1/04/2030	21	426,046	4	3	0
Estimating sequestration of carbon in soil using default values (Methodology Determination 2015)	**1/10/2025**	0	0	0	0	
Fertiliser use efficiency in irrigated cotton (Methodology Determination 2015)	**1/10/2025**	0	0	0	0	
Beef cattle herd management (Methodology Determination 2015)[17]	Suspended on 17/12/2024 until sunset on 1/10/2025	15	1,044,037	3	11	1,044,037
Measurement of soil carbon sequestration in agricultural systems (Methodology Determination 2018)	Closed	142	0	0	25	0
Sequestering carbon in soils in grazing systems (Methodology Determination 2014)[18]	Closed	37	0	0	5	0
Destruction of methane generated from manure in piggeries-1.1	Closed	9	774,637	6	3	432,920

[16] Projects registered under the *Carbon Credits (Carbon Farming Initiative-Animal Effluent Management) Methodology Determination 2019* and *Carbon Credits (Carbon Farming Initiative-Animal Effluent Management) Methodology Determination 2019 (Compilation No. 1)* are included.
[17] Projects registered under the *Carbon Credits (Carbon Farming Initiative-Beef Cattle Herd Management) Methodology Determination 2015* and *Carbon Credits (Carbon Farming Initiative-Beef Cattle Herd Management) Methodology Determination 2015 (Compilation No. 1)* are included.
[18] Projects registered under the *Carbon Credits (Carbon Farming Initiative) (Sequestering Carbon in Soils in Grazing Systems) Methodology Determination 2014*, *Carbon Credits (Carbon Farming Initiative) (Sequestering Carbon in Soils in Grazing Systems) Methodology Determination 2014 (Compilation No. 1)* and *Carbon Credits (Carbon Farming Initiative) (Sequestering Carbon in Soils in Grazing Systems) Methodology Determination 2014 (Compilation No. 2)* are included.

Project method	Sunset date	Total no. projects registered nationally	Total no. of ACCUs issued nationally	Total no. of projects with ACCUs issued (nationally)	No. projects registered in Qld	Total no. of ACCUs issued in Qld
(Methodology Determination 2013)[19]						
Destruction of methane from piggeries using engineered biodigesters (Methodology Determination 2013)	Closed	1	58,496	1	0	0
Destruction of methane from dairy manure in covered anaerobic ponds (Methodology Determination 2012)	Closed	1	0	0	0	0
Vegetation methods (total)		**1,200**	**88,079,709**	**431**	**281**	**24,395,083**
Reforestation by environmental or mallee plantings FullCAM method 2024 (Methodology Determination 2024) (incl. projects commenced under earlier versions of method[20])	1/04/2035	288	2,887,130	30	23	18,642
Plantation Forestry method (Methodology Determination 2022) (incl. projects commenced under earlier versions of method[21])	1/04/2032	180	510,864	25	3	0
Reforestation and afforestation (Methodology Determination 2015) (incl. projects commenced under earlier versions of method[22])	**1/10/2025**	17	254,137	8	1	30,191
Tidal restoration of blue carbon ecosystems method (Methodology Determination 2022)	1/04/2032	2	0	0	1	0

[19] Projects registered under the *Carbon Credits (Carbon Farming Initiative) (Destruction of Methane Generated from Manure in Piggeries-1.1) Methodology Determination 2013* and *Carbon Credits (Carbon Farming Initiative) (Destruction of Methane Generated from Manure in Piggeries-1.1) Methodology Determination 2013 (Compilation No. 1)* are included.
[20] Projects registered under the *Carbon Credits (Carbon Farming Initiative) (Reforestation by Environmental or Mallee Plantings—FullCAM) Methodology Determination 2024, Carbon Credits (Carbon Farming Initiative) (Reforestation by Environmental or Mallee Plantings-FullCAM) Methodology Determination 2014, Carbon Credits (Carbon Farming Initiative) (Reforestation by Environmental or Mallee Plantings-FullCAM) Methodology Determination 2014 (Compilation No. 1)*, and *Carbon Credits (Carbon Farming Initiative) (Reforestation by Environmental or Mallee Plantings-FullCAM) Methodology Determination 2014 (Compilation No. 2)* are included.
[21] Projects registered under the *Carbon Credit (Carbon Farming Initiative-Plantation Forestry) Methodology Determination 2022, Carbon Credit (Carbon Farming Initiative-Plantation Forestry) Methodology Determination 2017*, and *Carbon Credit (Carbon Farming Initiative-Plantation Forestry) Methodology Determination 2017 (Compilation No. 1)* are included.
[22] Projects registered under the *Carbon Credits (Carbon Farming Initiative) (Reforestation and Afforestation) Methodology Determination 2013, Carbon Credits (Carbon Farming Initiative) (Reforestation and Afforestation-1.2) Methodology Determination 2013*, and *Carbon Credits (Carbon Farming Initiative-Reforestation and Afforestation 2.0) Methodology Determination 2015* are included.

Project method	Sunset date	Total no. projects registered nationally	Total no. of ACCUs issued nationally	Total no. of projects with ACCUs issued (nationally)	No. projects registered in Qld	Total no. of ACCUs issued in Qld
Avoided clearing of native regrowth (Methodology Determination 2015) (incl. projects commenced under earlier versions of method[23])	Closed on 1/04/2025	16	535,629	11	16	535,629
Designated verified carbon standard projects (Methodology Determination 2015)	Closed on 1/04/2025	3	939,399	3	0	0
Avoided deforestation method (Methodology Determination 2015) (incl. projects commenced under earlier versions of method[24])	Closed	64	30,306,813	61	0	0
Human-Induced Regeneration of a Permanent Even-Aged Native Forest (Methodology Determination 2013)[25]	Closed	529	48,888,689	265	183	20,477,305
Measurement Based Methods for New Farm Forestry Plantations (Methodology Determination 2014)	Closed	3	409,017	1	0	0
Native Forest from Managed Regrowth (Methodology Determination 2013)[26]	Closed	50	3,305,370	22	50	3,305,370
Quantifying Carbon Sequestration by Permanent Mallee Plantings using the Reforestation Modelling Tool (Methodology Determination 2013)	Closed	1	0	0	0	0

[23] Projects registered under the *Carbon Credit (Carbon Farming Initiative-Avoided Clearing of Native Regrowth) Methodology Determination 2015* and *Carbon Credit (Carbon Farming Initiative-Avoided Clearing of Native Regrowth) Methodology Determination 2015 (Compilation No. 1)* are included.

[24] Projects registered under the *Carbon Credit (Carbon Farming Initiative-Avoided Deforestation 1.1) Methodology Determination 2015*, and *Carbon Credit (Carbon Farming Initiative) (Avoided Deforestation) Methodology Determination 2013* are included.

[25] Projects registered under the *Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest-1.1) Methodology Determination 2013 (Compilation No. 1), Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest-1.1) Methodology Determination 2013 (Compilation No. 2)*, and *Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest-1.1) Methodology Determination 2013 (Compilation No. 3)* are included.

[26] Projects registered under the *Carbon Credits (Carbon Farming Initiative) (Native Forest from Managed Regrowth) Methodology Determination 2013, Carbon Credits (Carbon Farming Initiative) (Native Forest from Managed Regrowth) Methodology Determination 2013 (Compilation No. 1)*, and *Carbon Credits (Carbon Farming Initiative) (Native Forest from Managed Regrowth) Methodology Determination 2013 (Compilation No. 2)* are included.

Project method	Sunset date	Total no. projects registered nationally	Total no. of ACCUs issued nationally	Total no. of projects with ACCUs issued (nationally)	No. projects registered in Qld	Total no. of ACCUs issued in Qld
Quantifying carbon sequestration by permanent environmental plantings of native tree species using CFI reforestation modelling tool (Methodology Determination 2012)	Closed	47	42,661	5	4	27,946
Savanna burning and Savanna fire management (total)		**106**	**14,675,051**	**72**	**53**	**4,487,622**
Savanna Fire Management-Emissions Avoidance and Savanna Fire Management-Sequestration and Emissions Avoidance (Methodology Determination 2018)[27]	1/10/2028	20	192,732	6	7	19,414
Emissions Abatement through Savanna Fire Management (Methodology Determination 2015)	Closed	72	13,311,202	57	37	4,037,517
Reduction of Greenhouse Gas Emissions through Early Dry Season Savanna Burning-1.1 (Methodology Determination 2013)	Closed	14	1,171,117	9	9	430,691
Total		**2,107**	**105,378,400**	**543**	**516**	**30,638,746**

Source: Adapted from ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d)

Types of projects: sequestration offsets projects and emissions avoidance offsets projects

There are two categories of projects that can be undertaken under all methods, sequestration offsets projects and emissions avoidance offsets projects.

Sequestration Offsets Projects

Sequestration offsets projects involve removing carbon dioxide from the atmosphere by sequestering carbon in living biomass, dead organic matter and/or soil, or removing carbon dioxide from the atmosphere by sequestering carbon in, and to avoid emissions of greenhouses gases from, living biomass, dead organic matter and/or soil.[28]

Permanence period

Sequestration offsets projects must elect a permanence period of either 100 years or 25 years. This is because the environmental benefit of a sequestration project would be reversed if the

[27] Projects registered under the *Carbon Credits (Carbon Farming Initiative-Savanna Fire Management-Emissions Avoidance) Methodology Determination 2018* and *Carbon Credits (Carbon Farming Initiative-Savanna Fire Management-Sequestration and Emissions Avoidance) Methodology Determination 2018* are included.

[28] s 54, *Carbon Credits (Carbon Farming Initiative) Act 2011*.

carbon sequestered in vegetation or soil as part of the project was released back into the atmosphere (CER 2024). Sequestration is regarded as having a 'permanent' benefit to the environment if it is maintained for 100 years (CER 2024). The permanence period commences when the project is issued ACCUs or land is added to the project area (CER 2024).

Discounting

For sequestration offsets projects, the ACCUs are determined by discounting the net abatement number (total number of tonnes of carbon dioxide equivalent abated by project) to ensure that the carbon abatement is not overstated. There are two discounts applied, the risk of reversal buffer and the permanence period discount. The permanence period discount is zero for projects with a 100-year permanence period, and 20% for projects with a 25-year permanence period (unless otherwise stated in the methodology). The risk of reversal buffer, designed to account for the risk that the carbon abatement is lost, is a discount of 5% for both 100-year and 25-year permanence period projects. The discounts for sequestration offsets projects are summarised in Table 7 below.

Table 7: Sequestration offsets projects discounting

Project type	Permanence period discount	Risk of reversal buffer	Total discount
25-year permanence period project	20%	5%	25%
100-year permanence period project	0%	5%	5%

Risk of relinquishment of ACCUs

For a sequestration offset project, there is a risk that ACCUs issued must be relinquished due to a reversal of carbon sequestration that occurs during the permanence period (e.g. wildfire). Relinquishment is addressed in sections 90 and 91 of the Carbon Credits (Carbon Farming Initiative) Act 2011 (Cth). Under section 90, relinquishment may be required where there is a significant reversal[29] and the reversal is not due to a natural disturbance[30], fire risk reduction, or conduct by a person outside of the reasonable control of the project proponent. Under section 91, relinquishment may still be required for significant reversals[31] due to natural disturbances or conduct by a person outside of the reasonable control of the project proponent if the project proponent fails to take reasonable steps to mitigate the impact. The number of ACCUs to be relinquished cannot exceed the total credits issued. A "significant reversal" is defined as affecting at least 5% of the project area or 50 hectares, depending on the cause.

Therefore, if there was a significant reversal of SOC sequestration due to a biophysical factor that is not a natural disturbance, then under section 90 of the Act, the relinquishment of ACCUs

[29] If the reversal relates to an event other than a natural disturbance or conduct, then a reversal of the removal of carbon dioxide from the atmosphere is taken to be a ***significant reversal*** if the size of the project area in which the reversal occurs is at least the smaller of 5% of the total project area or 50 hectares (s88 *Carbon Credits (Carbon Farming Initiative) Rule 2015*).

[30] 'Natural disturbance' is defined as flood, bushfire, drought, pest attack, or disease (s 5, *Carbon Credits (Carbon Farming Initiative) Act 2011*).

[31] In relation to a natural disturbance, a reversal of the removal of carbon dioxide from the atmosphere is taken to be a ***significant reversal*** if the size of the project area in which the reversal occurs is at least the 5% of the total project area, and in relation to conduct, a reversal of the removal of carbon dioxide from the atmosphere is taken to be a ***significant reversal*** if the size of the project area in which the reversal occurs is at least the smaller of 5% of the total project area or 50 hectares (s89 *Carbon Credits (Carbon Farming Initiative) Rule 2015*).

may be required. If conversely, there was a significant reversal of SOC sequestration because of a natural disturbance (flood, drought, bushfire, pest attack or disease), then, pursuant to section 91 of the Act, ACCUs would only have to be relinquished if the Regulator was not satisfied that the project proponent had, within a reasonable period, taken reasonable steps to mitigate the effect of the natural disturbance.

Emissions Avoidance Offsets Projects

Emissions avoidance offsets projects involve projects that avoid emissions of greenhouse gas, and that are not sequestration offsets projects.[32] An emissions avoidance offsets project is an ***area-based emissions avoidance project*** if it is a project to avoid emissions of greenhouse gases from the burning of savannas, or a project using the fertiliser use efficiency in irrigated cotton method.

For emissions avoidance offsets projects, the carbon abatement amount from which the ACCUs are determined is the total number of tonnes of carbon dioxide equivalent net abatement amount for the project in relation to the reporting period. No discount is applied.[33] There is no permanence period for emissions avoidance offsets projects, unless otherwise provided by the methodology determination.

2.1.3 Price of ACCUs

Prior to the 2022 Independent Review of Australian Carbon Credit Units, the CER (formerly the Emissions Reduction Fund (ERF)) on behalf of the Australian Government, entered into contracts with project proponents and agreed to purchase ACCUs at a fixed price via auction. The Australian Government, via the CER, has been the largest purchaser of ACCUs (Milne et al. 2024). To date, 15 auctions have been held from 2015 until March 2023, with the ACCU price averaging between $10.23 and $18.94/ACCU (Waltham et al. 2025). The ACCU price averaged $17.12/ACCU at the latest auction (Waltham et al. 2025).

However, the 2022 Independent Review identified an actual or perceived conflict of interest of the CER that is responsible for monitoring, compliance and enforcement, and accordingly, it was recommended that the responsibility for Australian Government purchasing of ACCUs should be moved out of the CER and into another Australian Government body (Chubb et al. 2022). The Department of Climate Change, Energy, the Environment and Water is currently implementing the review recommendations and considering how ACCU scheme purchasing processes will be conducted in the future.

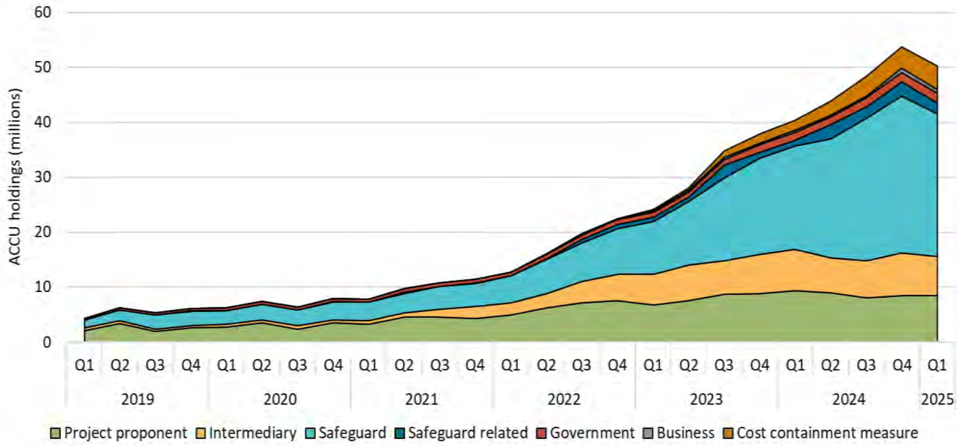
Currently, ACCUs can be sold to the secondary market at a higher price compared to the CER auctions. Typical buyers of ACCUs may include corporations covered by the Safeguard Mechanism, organisations seeking to voluntarily offset their emissions, and investors aiming to diversify their portfolios while supporting climate change mitigation (CER 2024). Facilities subject to the Safeguard Mechanism can meet their emission reduction obligations by using credits as offsets (Macintosh et al. 2024a), and accordingly, demand for ACCUs is expected to significantly increase because of the Safeguard Mechanism reforms (Ernst and Young Global Limited 2023; Milne et al. 2024). This compliance-driven demand benefits ACCU suppliers by enhancing market certainty, though the potential for future reforms that may weaken the Safeguard Mechanism remains (Deane et al. 2024). Figure 6 below illustrates the ACCU holdings

[32] s 53, *Carbon Credits (Carbon Farming Initiative) Act 2011.*

[33] s 18, *Carbon Credits (Carbon Farming Initiative) Act 2011*.

by market participation category over time (CER 2024o). Safeguard and safeguard-related entities held 60% of ACCU holdings as of 31 December 2024 (CER 2024o).

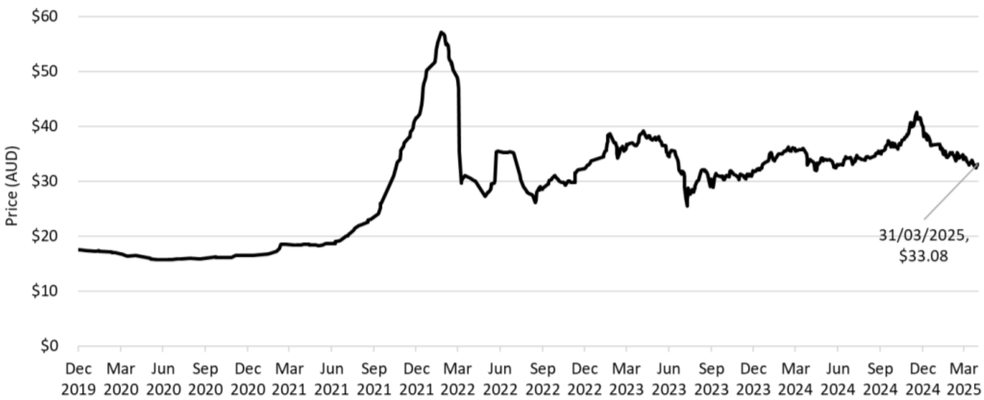
Figure 6: Australian carbon credit unit (ACCU) holdings (in millions) by market participation



Source: Adapted from CER (2025f)

The value of ACCUs fluctuates based on supply and demand in the market. Figure 7 below illustrates the generic ACCU average spot price (which is the daily volume weight average of spot trades for ACCUs with an unspecified method) from December 2019 to March 2025. The ACCU spot price was $35.90 on 23 May 2025 (Core Markets 2025b).

Figure 7: Generic Australian ACCU volume weighted average spot price



Source: Adapted from (CER 2025f)

Although volatile, the ACCU average spot price appears to be trending upwards over time. However, the ACCU price fell from $42.50 in November 2024 to $33.08 on 31 March 2025 (CER 2025). The increase in the ACCU price in the fourth quarter of 2024 was a result of increased trading activity driven by safeguard entities who purchased ACCUs to meet compliance obligations (CER 2025). The spot ACCU price peaked on 24 January 2022 at $57. The price hike was due to demand outstripping supply (CER 2022a). The price momentum in the second half of 2021 was driven by 'rapidly increasing corporate, state and territory government demand, hedging by accumulation and speculation' (CER 2022b). The price increase aligned with international trends. In 2021, carbon markets worldwide saw significant price increases for carbon instruments, driven by global momentum on climate action (CER 2022b).

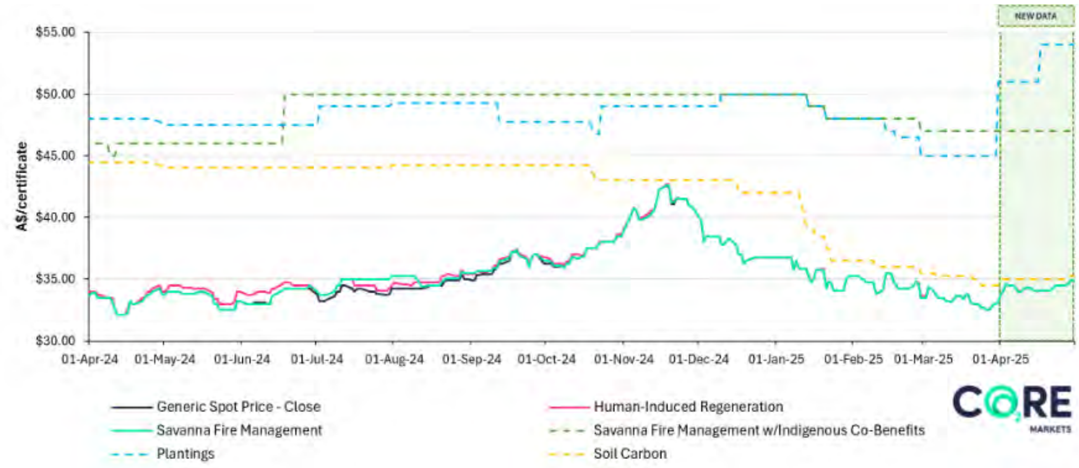
In March 2022, a marked reduction in the reported spot ACCU price occurred following an announcement on 4 March 2022 by the then Minister of Industry, Energy and Emissions

Reduction of a change to the rules for ERF fixed delivery contracts, so that holders of the contracts could pay an exit fee to be released from the fixed delivery obligations to the Commonwealth (this was an attractive option because there was a significant difference between the average fixed delivery contract price of $11.70 and the spot ACCU price of about $50) (CER 2022a). The price drop may also have been because of negative claims around some of the methods and potential changes to the Safeguard Mechanism (CER 2022a).

Price of ACCUs depending on method

The price of an ACCU varies depending on the method used to generate the ACCU, and its price is distinct from the generic ACCU average spot price illustrated in Figure 7 above, which is the average of spot ACCU trades for unspecified method types. The price of ACCUs by method type is depicted in Figure 8 below, which captures the ACCU price by method type for the period from April 2024 to April 2025.

Figure 8: ACCU Spot Price by Method for 1 April 2024 to 1 May 2025



Source: Adapted from Core Markets (2025a)

'Generic' refers to the ACCU spot price where buyers and sellers have not stipulated the method type. 'Plantings' refers to the spot ACCU price for environmental planting ACCUs. In April 2025, the price of ACCUs was highest for environmental planting method ACCUs between $50 and $55/ACCU, followed by savanna fire management method ACCUs with indigenous co-benefits at about $42/ACCU, then soil carbon ACCUs at $35/ACCU, and then savanna fire management, HIR and generic ACCUs (which have the same price and was just below $35/ACCU at the beginning of April and rose to $35/ACCU by the end of the month). During mid-April, a parcel of environmental planting method ACCUs sold for $54/ACCU (Core Markets 2025a). At the end of April 2025, the price of savanna fire management, HIR and generic was lowest out of all methods, closing at $35/ACCU (Core Markets 2025a). HIR, then AD, and then savanna fire management methods account for the largest supply of ACCUs, which could explain the lower price (see Figure 5 above). To date, most of the ACCUs purchased have been generic and HIR ACCUs (Core Markets 2025c).

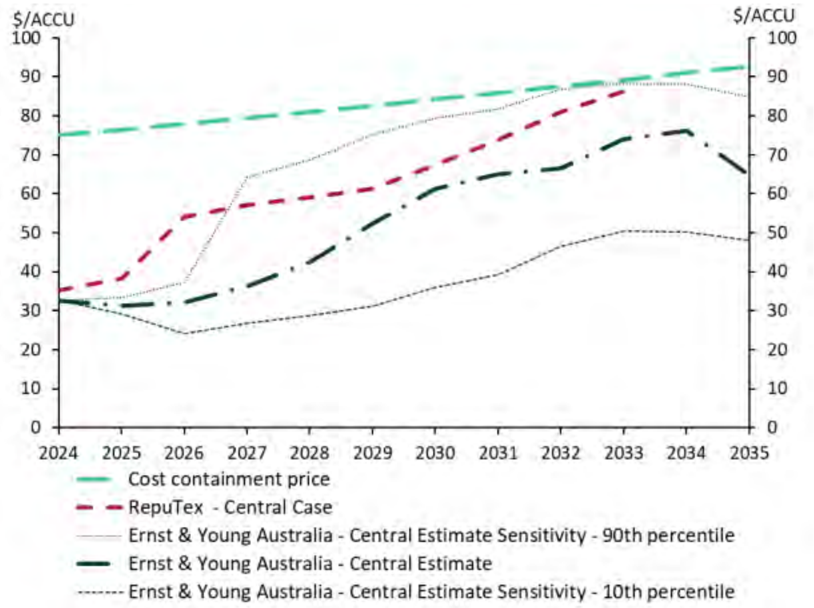
Cost containment measure

The cost containment measure, introduced in 2023-24, sets a fixed ACCU price for safeguard facilities purchasing ACCUs to offset emissions exceeding their baselines (CER 2025i). The measure was introduced to provide safeguard facilities with compliance cost certainty and was set at $75 in 2023-24 (indexed each financial year to CPI plus 2%) (CER 2025I). In 2024-25, an ACCU purchased under the measure costs $79.20 (CER 2025I).

Future ACCU price

The future price of ACCUs is predicted to rise. In its 2023 report, Ernst and Young Global Limited's (**EY**) forecast that the ACCU price will double to around AU$75 before 2035 (EY 2023). Further, they estimated that beyond 2035, the ACCU price will remain relatively stable between AU$65 and AU$75 (EY 2023). However, sensitivity analysis completed by EY suggested prices could range from AU$30 to AU$125 per ACCU (EY 2023). Figure 9 below illustrates the forecast ACCU price scenarios from 2024 to 2035 published in DCCEEW (2023a) and based on forecasts by EY and RepuTex EnergyIQ Platform.

Figure 9: Forecast ACCU Prices, 2024 to 2035



Source: Adapted from DCCEEW (2023a)

Analysis by CORE Markets (2025c) suggested that demand for ACCUs will peak in the financial year (FY) 2031 at 45% above demand in FY 2026. This forecast was based on ACCU demand being driven primarily by Safeguard Mechanism entities in the short term until FY2031, by which time Safeguard Mechanism entities will implement decarbonisation initiatives (instead of purchasing ACCUs for offsets) that, in the medium to long term, are anticipated to be increasingly commercially viable and technologically ready (e.g. green hydrogen and electrified mobility) (Core Markets 2025c). Conversely, CORE Markets (2025c) predicted that non-Safeguard related demand for ACCUs will steadily rise, even as demand by Safeguard facilities declines. Furthermore, CORE Markets (2025c) posited that non-Safeguard related buyers will be more selective of ACCUs and willing to pay a premium for ACCUs generated by methods that align with the buyer's brand.

CORE Markets (2025c) anticipated that preferences amongst non-Safeguard related buyers, will shift away from HIR and generic ACCUs to higher priced ACCUs with higher perceived quality, or with co-benefits. Additionally, CORE Markets (2025c) predicted that all demand will preference ACCUs generated by newer methods compared to methods under review or that have been revoked.

CORE Markets (2025c) forecast that demand will increase for ACCUs generated by environmental planting and soil carbon methods, stating, 'we expect these two methods to represent the majority of the voluntary demand and ~25% of Safeguard demand by 2040'.

The price of ACCUs that are stacked with a biodiversity credit under the Nature Repair Market or co-benefits under the Land Restoration Fund (LRF), or ACCUs sold with reef credits under the Reef Credit scheme or cassowary credits under the Cassowary Credit scheme are expected to collect a higher price. For example, The Australian newspaper published an article on 1 September 2024 stating that Regen Farmers Mutual, a farmer cooperative undertaking an ACCU scheme project together with a pilot LRF project, has 'agreed to sell the first 1000 ACCUs from [its] Traprock project to the charity Carbon 4 Good for $100 per unit' (Harcourt 2024).

2.1.4 Carbon service providers

Carbon service providers are organisations with expertise regarding the implementation and running of carbon farming projects under the ACCU scheme. Landholders can undertake carbon farming projects themselves, but due to the complexity and technical skills required to develop, manage and deliver a project, landholders often engage carbon service providers for assistance (Slegers et al. 2023). Landholder and carbon service providers enter into a contract, the terms of which are negotiable between the parties. Typical arrangements may involve the landholder being the project proponent with the overall responsibility for and control of the project, and the carbon service provider's role being to provide assistance with the development, management and delivery of the project (Slegers et al. 2023). Other arrangements can involve the carbon service provider undertaking the entire project while the landholder has a passive role of providing consents and compliance with project requirements (Slegers et al. 2023). Renumeration of carbon service providers depends on the contract negotiated by the parties, but may include a fixed fee, percentage of ACCUs issued or percentage of the ACCU sale proceeds (Slegers et al. 2023). Commercial lawyers Slegers et al. (2023) stated:

> 'In the authors' experience, where the Service Provider seeks payment in the form of a percentage share from the income of the sale of Carbon Project ACCUs, that percentage share is often significant - generally upwards of 25%. However, as the market has started to mature, Landholders have begun to push back on this split and have proposed a lower percentage share or a fixed fee model.'

The exact number of projects that are involved with a carbon service provider is not known, as the carbon service provider will not necessarily be the project proponent (Slegers et al. 2023). Approximately 1,051 projects (which amounts to 42% of projects) on the ACCU scheme register have a carbon service provider registered as the project proponent. However, the involvement of carbon service providers is likely much greater, given that there are 36 signatories to the voluntary Australian Carbon Industry Code of Conduct launched in 2018[34], and not all those companies are listed on the ACCU scheme register as project proponents. Furthermore, the Chubb Review indicated that 75% of ACCU scheme projects were involved with carbon service providers signed up to the Australian Carbon Industry Code of Conduct (Chubb et al. 2022). Of the registered project proponents, the carbon service providers with the most projects include Agriprove Solutions (523 projects or 20.9%), followed by Terra Carbon Pty Ltd (GreenCollar) (240 projects or 9.6%), then Australian Integrated Carbon (64 projects or 2.6%) and then Corporate Carbon Solutions (44 projects or 1.8%). There are several other carbon service providers who

[34] Recommendation 12 of the Chubb Review was to mandate performance standards for carbon service providers (Chubb et al. 2022).

are the registered project proponents on the ACCU scheme register, and those identified by this report are included in Table 8 below.

Table 8: Carbon service providers listed as project proponent on the ACCU Scheme Register

Carbon service provider project proponent (incl not-for-profit organisations)	ACCU Scheme method	Code of Conduct Signatory	No. of projects
Agriprove Solutions	Soil carbon	Y	523
Terra Carbon Pty Ltd (GreenCollar)	Native forest managed regrowth, HIR, reforestation by environmental or mallee plantings, avoided clearing of native regrowth, avoided deforestation, savanna fire management, soil carbon and animal effluent management	Y	240
Australian Integrated Carbon	HIR	Y	64
Corporate Carbon Solutions	Soil carbon, HIR, reforestation by environmental or mallee plantings, reforestation and afforestation	Y	44
Landari	Plantation forestry, soil carbon	N	28
Carbon Neutral and Carbon Neutral Charitable Fund Limited	New Farm Forestry, Reforestation by environmental or mallee plantings, plantation forestry, HIR	Y	28
LOAM Carbon	Soil carbon	N	19
Country Carbon	Savanna fire management and soil carbon	N	18
Carbon Fix	Reforestation by environmental or mallee plantings, soil carbon, plantation forestry	N	12
RegenCo	Soil carbon, HIR and beef cattle herd management	Y	12
Canopy Nature Based Solutions	Reforestation by environmental or mallee plantings	Y	11
Greenfleet Australia	Reforestation by environmental or mallee plantings	N	11
Climate Revive and Corporate Carbon Advisory	HIR	N	10
Corporate Carbon Advisory	Beef cattle herd management, savanna fire management, HIR, plantation forestry, reforestation by environmental or mallee plantings	N	10
CO2 Australia Limited	HIR and reforestation by environmental or mallee plantings	Y	9
Atlas Carbon	Soil carbon	Y	6
Outback Carbon	Plantation forestry	N	6

Total			**1,051 (42%)**

Adapted from ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d)

As shown above, some carbon service providers are only involved with one method type, such as Agriprove Solutions and soil carbon and Australian Integrated Carbon and the HIR method.

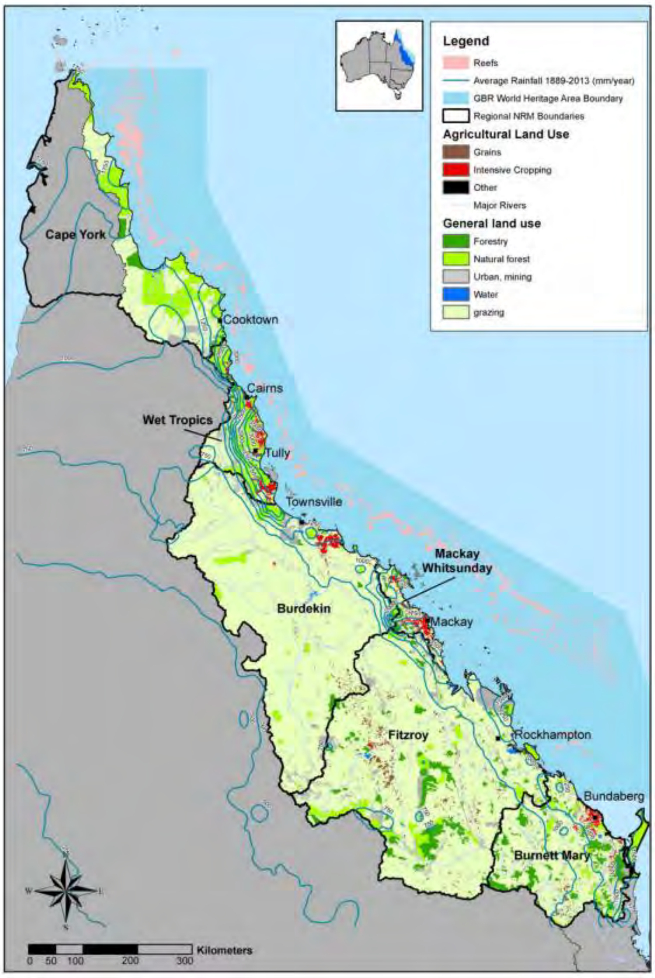
Whilst there are several carbon service providers, approximately 30% of the market is concentrated with Agriprove Solutions and GreenCollar, which raises concerns regarding the power imbalance between landholders and carbon service providers in negotiations.

2.2 Reef Credit Scheme

2.2.1 Overview

The Great Barrier Reef (GBR) is the world's largest coral reef ecosystem and a listed World Heritage site due to its unique natural attributes and significant scientific, environmental, economic and societal value to both Australians and the international community. The GBR World Heritage Area spans 348,000km² along the Queensland coastline as illustrated in Figure 10 below, which identifies the Natural Resource Management Regions and the primary land use.

Figure 10: Map of GBR World Heritage area



Source: Adapted from Thorburn et al. (2013)

The GBR has deteriorated because of the cumulative impacts associated primarily with climate change, as well as coastal development, land-based runoff and direct use (Hamylton et al. 2022). The GBR Marine Park Authority (GBRMPA) is Australia's lead management agency for the reef and is responsible for preparing an Outlook Report every 5 years to summarise 'the long-term outlook for the Reef based on its condition, use, influencing factors, management effectiveness, resilience and risks' (GBRMPA 2024). The 2024 Outlook Report highlighted the primary, ongoing risk of climate change and noted that future warming would lead to further degradation of the Reef. The 2024 Outlook Report recognised that over the last five years (2019 to 2023), the natural values of the GBR Region, including species, habitats, and ecosystem processes, experienced both improvements and declines. 'Overall, the condition of habitats remains poor on a Region-wide scale, in large part due to the ongoing vulnerability of coral reef habitats' (GBRMPA 2024).

Over the past 45 years, the management approach for the GBR has evolved from focussing on supporting its natural recovery to implementing proactive and deliberate measures aimed at enhancing the Reef's resilience to climate-related impacts, poor water quality and other cumulative pressures (Hamylton et al. 2022). Improving water quality has been identified as a 'crucial step towards a more resilient Reef' (GBRMPA 2024). Poor water quality can reduce the ability of marine ecosystems to recover following a climate-related disturbance (2022 Scientific Consensus Statement). The 2017 Scientific Consensus Statement identified the key components of land-based runoff impacting the reef as: (1) ***nutrients***, which are an additional stress factor for many coastal coral species, promote crown-of-thorns starfish population outbreaks with destructive effects on mid-shelf and off-shore coral reefs, and promote macroalgal growth; (2) ***fine sediments***, which reduce the available light and oxygen to seagrass ecosystems and inshore coral reefs; and (3) ***pesticides***, which pose a toxicity risk to freshwater ecosystems and some inshore and coastal habitats (Reef 2050 WQIP 2017–2022).

The Commonwealth and Queensland Governments released the Reef 2050 Long-Term Sustainability Plan in 2015 in response to a recommendation by the World Heritage Committee, which sets out the 'overarching framework for protecting and managing the GBR [until] 2050' (Hamylton 2022). A separate plan falling within the overarching framework was released for water quality, known as the Reef 2050 Water Quality Improvement Plan 2017–2022 (**the Reef 2050 WQIP**) which includes a range of land, water quality and human dimension targets (Queensland Government 2024). The 2025 water quality targets set out in the Reef 2050 WQIP are to reduce fine sediment loads by 25%, particulate nutrients by 20%, dissolved inorganic nitrogen loads by 60%, and reducing pesticide to protect at least 99% of aquatic species at the end of the catchment.

Government, agricultural industry bodies, and natural resource management organisations have implemented a range of voluntary and regulatory policy instruments to promote the adoption of best management practices on farms in the GBR catchment, which has led to reduced DIN loads entering the reef (Waltham et al. 2021). 'Since 2019, water quality has continued to improve slowly reflecting modest improvements in agricultural land management practices and land-based runoff' (GBRMPA 2024). However, 'the load reductions achieved fall well short of the DIN reduction targets set out in the Reef WQIP' (Waltham et al. 2021).

Agriculture and the Great Barrier Reef

Land-based runoff is the leading cause of declining water quality, which has led to the deterioration of inshore marine ecosystems in certain areas of the GBR (GBRMA 2024). Agriculture, which accounts for approximately 80% of land use in the GBR catchment, is the primary source of land-based runoff pollutants (dissolved inorganic nitrogen, fine sediments and pesticides) (Waltham et al. 2021; Reef 2050 WQIP 2017-2022; GBRMA 2024). Runoff from grazing land typically consists of fine sediments and attached nitrogen, and runoff from cropping generally consists of DIN and pesticides (Thorburn et al. 2013). For example, 'fertiliser residues from agricultural land are considered a key contributor to DIN entering the GBR lagoon and sugarcane contributes up to 80% of the total DIN load (from anthropogenic sources) in some catchments' (Waltham et al. 2021). Furthermore, historical and active land clearing, for which agriculture remains the predominant purpose, has exposed land to erosive processes and negatively impacted water quality by contributing to land-based runoff (GBRMA 2024).

The 2024 Outlook Report identified the priority areas for reducing land-based runoff as:

- '**fine sediment and particulate nutrients**: Burdekin, Herbert, Fitzroy and Mary catchments;
- **dissolved inorganic nitrogen**: Herbert, Haughton, Mulgrave–Russell, Johnstone, Tully and Plane catchments; and
- **pesticides**: Mulgrave–Russell, Johnstone, Herbert, Haughton, Proserpine, O'Connell, Pioneer, Plane and Fitzroy catchments' (GBRMA 2024).

2.2.2 Reef Credit Scheme

The Reef Credit scheme is a voluntary market designed to incentivise landholders to improve the quality of water entering the GBR through changes to land management practices and changes to land use. In 2017, natural resource management organisations NQ Dry Tropics and Terrain NRM partnered with environmental markets investor GreenCollar and the Queensland Government to lead the development of the Reef Credit scheme and act as the Interim Steering Committee (Eco-Markets 2024). The Reef Credit scheme was launched in October 2017 by the Queensland Government as part of two water quality projects for the GBR, the Wet Tropics and Burdekin Makor Integrated Projects (Eco-Markets 2024). The Australian Government's Reef Trust, the Great Barrier Reef Foundation and the Queensland Government provided funding to support the development of the scheme, and in 2020, Eco-Markets Australia was established as the independent administrator of the Reef Credit scheme (Eco-Markets 2024).

The Reef Credit scheme has three objectives, including:

1. improve the quality of water flowing into the GBR;
2. support the achievement of water quality targets outlined in the Reef 2050 WQIP (2018) and any future updates; and
3. establish a market-based mechanism to encourage and reward projects that deliver measurable improvements in water quality (Eco-Markets 2024).

One reef credit is equal to 538kg of fine sediment prevented from entering the Reef catchment or 1kg of dissolved inorganic nitrogen (DIN) prevented from entering the Reef catchment. Reef credits remain valid for five years from the date of issue (*Reef Credit Standard v2.1).* Reef credits issued on account of pollutant reductions must meet the following core principles:

1. **Real**: 'all reef credits must be the result of registered reef credit projects that yield quantifiable and verifiable pollutant reductions or removals' (Eco-Markets 2024).
2. **Measurable**: 'all reef credits and underlying pollutant reductions and removals must be quantified using a credible baseline established in reef credit methodologies approved by the Secretariat' (Eco-Markets 2024).

3. **Permanent**: 'where reef credits are generated by projects that sequester pollutants in the landscape and therefore carry the risk of reversal, adequate safeguards must be in place to ensure that, should reversal occur, a mechanism is in place that guarantees replacement or compensation' (Eco-Markets 2024).
4. **Additional**: 'all reef credit generated pollutant reductions and removals must be over and above: (a) legal requirements (e.g. regulatory standards threshold for compliance, or activities required by a conservation covenant); and (b) reductions that would have occurred without the Reef Credit Project' (Eco-Markets 2024).
5. **Independently audited**: 'reef credits must be verified by an independent, third-party verifier, approved by the Secretariat' (Eco-Markets 2024).
6. **Unique**: 'each reef credit must be unique and only associated with a single Reef Credit Project' (Eco-Markets 2024).
7. **Transparent**: 'there must be sufficient and adequate public disclosure of information to ensure reef credits are trusted by project proponents and participants, investors, partners, stakeholders, governments and the general public' (Eco-Markets 2024).
8. **Conservative**: 'accurate or conservative assumptions, values, and procedures must be used to ensure reef credit pollutant reductions and removals are not over estimated. This includes a requirement that the project proponent assess, account for, and mitigate leakage[35], in accordance with the Reef Credit Standard and relevant approved Methodology' (Eco-Markets 2024).

The Reef Credit scheme is a voluntary scheme and participation is open to those who meet the requirements set out in the Reef Credit Standard and methodologies (Eco-Markets 2024). To date, Terra Carbon Pty Ltd (GreenCollar) is the project proponent for all projects save for the wastewater method project, which has been developed by RegenAqua Pty Ltd. The reason projects are being undertaken by specialist 'developers' like GreenCollar and RegenAqua Pty Ltd instead of primary producers is most likely due to the complexity of the methodologies and the specialist skills required to run projects.

Reef credits can be purchased by public and private entities and individuals seeking to support water quality improvements. Currently, there are nine purchasers of reef credits listed on the Reef Credit scheme registry including Qantas Airways Limited, Tourism Australia, Terrain NRM, HSBC, Australian Museum Trust, Groundswell Giving Ltd, Great Barrier Reef Foundation, Sydney Opera House Trust, and Queensland Alumina Limited (Eco-Markets 2025b).

Eco-Markets Australia administers the Reef Credit scheme. It is a not-for-profit company currently funded by the Queensland Government and governed by a board of directors. The day-to-day administration is delegated to the Secretariat (Eco-Markets Australia) which manages validation of credits, registration, verification, and reef credit certification and issuance processes (Eco-Markets 2024).

Overview of the Reef Credit process

Figure 11 below illustrates the steps involved in a Reef Credit scheme project.

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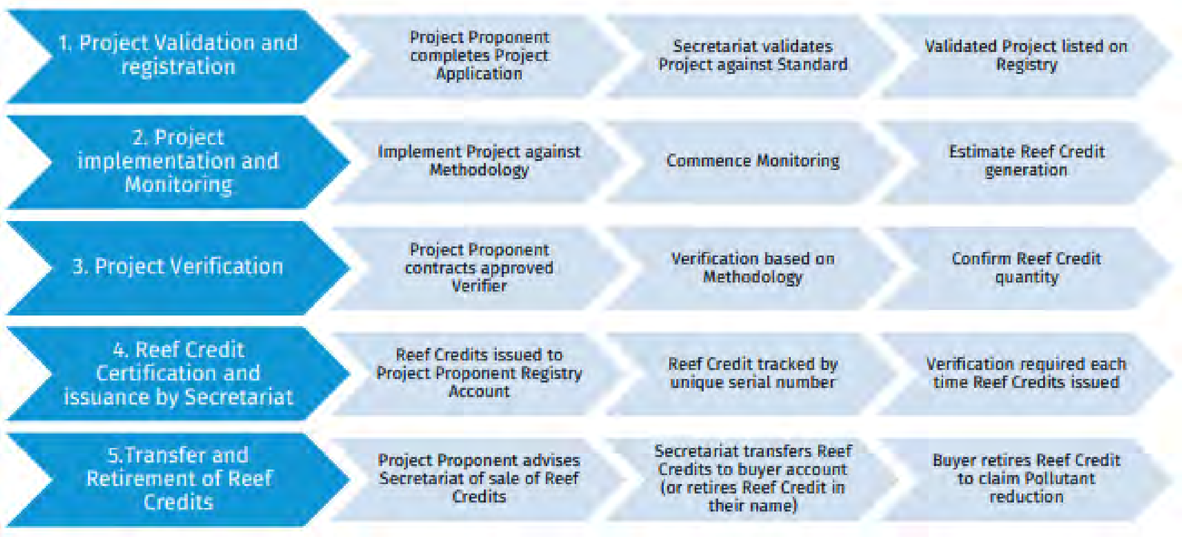
[35] **Leakage** means 'the displacement of activities that harm water quality from within the Project Area to a location outside the Project Area. Leakage occurs if improving water quality within Project Areas has a knock-on effect of reducing water quality elsewhere that affects the Great Barrier Reef' (Eco-Markets 2024).

Figure 11: Overview of the Reef Credit process



Source: Adapted from Eco-Markets (2024)

General requirements

To participate in the Reef Credit scheme, proponents must meet the eligibility requirements outlined in the Reef Credit Standard v2.1. Key requirements include:

- proponents must be an Australian resident, company or organisation, comply with relevant laws, and pass the fit and proper person test;
- proponents must have the legal right to carry out the project;
- projects must follow an approved Reef Credit Methodology and be located within the GBR catchment area; and
- credits cannot be claimed for the same pollutant reduction under another program, though other types of environmental credits may be generated if they are additional to the Reef Credits.

Monitoring requirements

Project proponents must monitor projects throughout the crediting and permanence periods, and record all necessary information required to measure and report pollutant reductions and any reversals in accordance with the methods. The monitoring documentation must be made available to the Secretariat and verifiers throughout the project (Reef Credit Standard v2.1).

If there is a risk of reversal, project proponents are required to maintain project records throughout the project and for 7 years after the end of the crediting period or permanence period (Reef Credit Standard v2.1).

Credit issuance

The issuance of Reef Credits involves a two-step process:

1. **Verification –** The project proponent selects an approved verifier (from a list on the Eco-Markets Australia website) to assess the project and monitoring reports. If satisfied, the verifier prepares a verification report, which the proponent submits to the Secretariat along with the monitoring report and credit issuance application.

2. **Issuance** – The Secretariat reviews the submitted documents. If all requirements are met, it certifies the number of reef credits to be issued.

Transfer and retirement of Reef Credits

Reef credits are transferred between registry accounts following their sale or purchase. The 'retirement' of a reef credit occurs at the earlier of either (a) a holder of the reef credits claims the water quality improvement associated with that credit, either on their behalf or on behalf of a third party; or (b) 5 years has passed since the credit was issued (Reef Credit Standard v2.1). On retirement, the credit is permanently removed from circulation in the registry system (Eco-Markets 2025b).

Risk of reversal

The applicability of the Risk of Reversal Buffer depends on the methodology adopted, and to date, no reef credits have been withheld in the Risk of Reversal Buffer for projects using the DIN method, gully method and wastewater method.

Based on the methodology, sequestration projects under the Reef Credit scheme must conduct a Risk of Reversal Assessment. If there is a risk of reversal, then safeguards must be installed to ensure pollutant sequestration is monitored and maintained during the permanence period.

The Risk of Reversal Buffer is determined for a project using the Risk of Reversal Assessment Tool. There are three Risk of Reversal Buffer reduction levels, including 0% (low risk), 5% (medium risk) and 10% (high risk) (Reef Credit Standard v2.1). A project's Risk of Reversal Buffer percentage is applied to calculate the number of credits that are deducted from the project proponents' reef credits and placed into a Buffer Account. The Buffer Account is used to mitigate against future reversals across the Reef Credit scheme (Reef Credit Standard v2.1).

Project proponents must notify the Secretariat of a Reversal event including the nature of the Reversal and any actions proposed to remedy its effects. Furthermore, project proponents must quantify the amount of pollutant reduction reversed, and on being notified, the Secretariat will cancel a corresponding number of reef credits from the Buffer Account (Reef Credit Standard v2.1). If project non-compliance was the cause of the reversal and it is not remedied or not capable of being remedied, the project may be cancelled (Reef Credit Standard v2.1).

2.2.3 Price of Reef Credits

Reef credits do not have a set price, and instead, the price of credits is negotiated between the project proponent seller and buyer for each transaction (Deane et al. 2024). The latest report, Quarterly Market Snapshot for October to December 2024, published by Eco-Markets Australia noted that the price of DIN reef credits was $170/credit for that quarter. At the time of writing this report, information about the price of credits available on the Eco-Markets Australia website was limited to the period of July 2023 until December 2024. From July 2023 until June 2024, the price of DIN reef credits was $100/credit. The price rose to $170/credit in July 2024 and remained consistent until December 2024. Table 9 below summarises the reef credit price information published on the Eco-Markets Australia website.

Table 9: Price of DIN reef credit from July 2023 until December 2024

Date	Reef Credit price
October – December 2024	$170/ DIN credit[36]

[36] (Eco-Markets Australia 2025c).

July – September 2024	$170/ DIN credit[37]
April – June 2024	$100/ DIN credit[38]
January – March 2024	$100/ DIN credit[39]
October – December 2023	$100/ DIN credit[40]
July – September 2023	$100/ DIN credit[41]

In the Reef Credit Guide v2.1 published by Eco-Markets Australia, it is noted that reef credits are subject to 'vintaging', whereby depending on the year the credit was issued, the price may vary (Eco-Markets 2024). Furthermore, the price may differ based on the type of pollutant reduction (i.e. DIN or fine sediment) (Eco-Markets 2024). Reef credits expire automatically 5 years from the date of issuance (Eco-Markets 2024). 'The purpose of vintaging is to ensure that water quality improvement claims are realised within a timeframe consistent with the Reef Credit Project intention and implementation' (Eco-Markets 2024).

2.2.4 Reef Credit scheme methods

Under the Reef Credit scheme, there are four method types (DIN, gully, grazing land management and wastewater methods) available for project proponents to use, and one emerging method type (constructed wetlands). The rules of these methods are identified at Appendix 9.2 of this report.

At the time of writing this report, participation in the Reef Credit scheme was low with a total of 14 projects registered under the Reef Credit scheme, 60,686 reef credits have been issued and 41,204 reef credits have been retired. All of the credits issued have been DIN credits. In total, 60,686 kg of DIN has been prevented from entering the GBR because of Reef Credit scheme projects. This is equivalent to 0.55% of the total amount of DIN (11,000 t/yr) that enters the GBR lagoon each year (McCloskey et al. 2021), which illustrates the undersupply of reef credits.

Table 10 below summarises the information published by Eco-Markets Australia in their annual reports, which are available for the financial years ending 30 June 2021, 2022, 2023 and 2024, and include the number of projects registered and the number of reef credits issued and retired. Figures for the current financial year so far are based on information published on Eco-Markets Australia's website.

Table 10: Supply of and demand for reef credits over time from 1 July 2020 until current

Year	Total projects registered by year	Total Reef Credits issued by year	Total Reef Credits retired by year
30/06/2021[42]	8	24,295	24,155
30/06/2022[43]	3	11,270	652
30/06/2023[44]	0	8,947	15,966
30/06/2024[45]	2	2,110	0
13/05/2025	1	14,246	431
TOTAL	**14**	**60,868**	**41,204**

[37] (Eco-Markets Australia 2024d).
[38] (Eco-Markets Australia 2024e).
[39] (Eco-Markets Australia 2024f)
[40] (Eco-Markets Australia 2023a).
[41] (Eco-Markets Australia 2023b).
[42] (Eco-Markets Australia 2021).
[43] (Eco-Markets Australia 2022).
[44] (Eco-Markets Australia 2023c).
[45] (Eco-Markets Australia (2024g).

Eco-Markets Australia Registry

The Eco-Markets Australia Registry publishes information about the Reef Credit scheme including the account holders, projects, issuances/listings of credits, holdings of credits, retired credits and a catchment summary (Eco-Markets 2025b). However, the data is limited to that which account holders have requested be made publicly available (Eco-Markets 2025b).

From the available data on the Eco-Markets Australia Registry, the reef region catchment with the most projects is the Wet Tropics (9 projects), followed by the Mackay Whitsunday region (3 projects) and then the Burdekin (2 projects). Twelve of the projects are using the DIN method, with one wastewater method project and one gully remediation project both based in the Burdekin. Table 11 below summarises the projects undertaken in the Reef Credit scheme by catchment by number of projects, credits issued and credits retired using the data that account holders have requested to be publicly available (Eco-Markets 2025b).

Table 11: Summary of Reef Credit scheme projects

Reef Region Catchment	River Basin Boundary Catchment	Number of Projects per Catchment	Number of Credits Issued per Catchment	Number of Credits Retired per Catchment
Wet Tropics	Mulgrave-Russell	1	373	373
Wet Tropics	Johnstone	4	14,399	13,002
Wet Tropics	Tully	2	12,918	12,104
Wet Tropics	Herbert	2	2,828	2,828
Burdekin	Haughton	1	0	0
Burdekin	Burdekin	1	0	0
Mackay Whitsunday	Proserpine	1	1,773	1,773
Mackay Whitsunday	O'Connell	2	5,437	5,437
Total			**37,728**	**35,517**

Source: Adapted from Eco-Markets (2025a)

Table 12 below contains the information available on the Eco-Markets Australia Registry and summarises the 14 projects registered under the Reef Credit scheme, including the name of the project, the methodology adopted, the project developer, the location of the project by reef region catchment and river basin boundary catchment, details of the project, project size, credits issued and when they were issued. It is noted that a total of 37,728 credits is captured on the Eco-Markets Australia Registry, whereas Eco-Markets Australia's website states that 60,686 credits have been issued. The discrepancy may be due to the Registry only displaying information that account holders have agreed to make public, or because it only includes data up to 2022 (given Eco-Markets Australia's annual reports indicate credits were issued in 2023 and 2024).

The project that has received the most credits based on the information published on the registry is the Tully Nutrient Run-off Reduction Project #1, which is based on a sugarcane farm at Tully and has been awarded 6,748 credits from 2018 to 2020. Notably, all of the projects have been developed by Terra Carbon Pty Ltd (GreenCollar), save for the wastewater management method project based in the Burdekin and developed by RegenAqua Pty Ltd.

Table 12: Available information about the projects registered under the Reef Credit Scheme

Item	Project Name	Methodology	Developer	Reef region catchment	River basin boundary catchment	Details	Project area	Credits issued	Years credits awarded
1	Herbert Nitrogen Use Efficiency Project #1	DIN method[46]	Terra Carbon Pty Ltd (GreenCollar)	Wet Tropics	Herbert	Located on a sugarcane farm	124.3ha	435	2020
2	Herbert Nitrogen Use Efficiency Project #2	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Wet Tropics	Herbert	Located on a sugarcane farm	96.5ha	2,393	2017-2021
3	Johnstone Nitrogen Use Efficiency Project #1	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Wet Tropics	Johnstone	Located on a sugarcane farm	561.1ha	6,363	2017-2020
4	Johnstone Nitrogen Use Efficiency Project #2	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Wet Tropics	Johnstone	Located on a sugarcane farm	292.4ha	2,335	2018-2020
5	Johnstone Nitrogen Use Efficiency Project #3	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Wet Tropics	Johnstone	Located on a sugarcane farm	235.9ha	5,701	2017-2021
6	Johnstone Nitrogen Use Efficiency Project #4	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Wet Tropics	Johnstone	Not known	431ha	-	-
7	Nutrient Reduction in Municipal Wastewater through Managed Algal Bioremediation	Wastewater method[47]	RegenAqua Pty Ltd	Burdekin	Haughton	Involves bioremediation facility for wastewater management solution being adopted by Burdekin Shire Council	NK	-	-

[46] Methodology for Accounting Reduction in Nutrient Run-Off Through Managed Fertiliser Application Version 1.1
[47] Method For Accounting Nutrient Reduction in Municipal Wastewater Treatment Plants Through Managed Bioremediation Operations’

8	O'Connell Nitrogen Use Efficiency Project #1	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Mackay Whitsunday	O'Connell	Located on agricultural land	NK	2,884	2019-2022
9	O'Connell Nitrogen Use Efficiency Project #2	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Mackay Whitsunday	O'Connell	Located on agricultural land	NK	2,553	2020-2022
10	Proserpine Nitrogen Use Efficiency Project #1	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Mackay Whitsunday	Proserpine	Located on agricultural land	95.6ha	1,773	2020-2022
11	Russell Nitrogen Use Efficiency Project #1	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Wet Tropics	Mulgrave-Russell	Located on a sugarcane farm	83.2ha	373	2019-2020
12	Tully Nutrient Run-off Reduction Project #1	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Wet Tropics	Tully	Located on a sugarcane farm	595.7ha	6,748	2018-2020
13	Tully Nutrient Run-off Reduction Project #2	DIN method	Terra Carbon Pty Ltd (GreenCollar)	Wet Tropics	Tully	Located on a sugarcane farm	569ha	6,170	2019-2020
14	Bowen Gully Rehabilitation Project #1	Gully restoration	Terra Carbon Pty Ltd (GreenCollar)	Burdekin	Bowen sub-catchment of Burdekin	Single distinct linear-alluvial gully system with significant erosion issues located on property west of Collinsville.	NK (~14.73ha active erosion with contributing catchment 131.7 ha).	-	-
	Total credits issued published on the Reef Credit Scheme Registry							**37,728**	

Source: Adapted from Eco-Markets (2025b)

Stacking

'Stacking' involves a single agri-environmental practice earning credits from multiple environmental markets, such as reef credits and ACCUs (Lankoski et al. 2015). In their announcement that the new grazing land management methodology was launched on 17 September 2024, Eco-Markets Australia noted that there may be 'stacking' opportunities for project proponents, stating:

> 'In addition to generating reef credits, landholders may have the potential to stack these credits with Australian carbon credits (ACCUs), further incentivising participation. This could provide diversified income streams, helping landholders to secure financial benefits while expanding contributions to environmental restoration' (Eco-Markets 2024a).

However, the Reef Credit Standard v2.1 requires that, 'project proponents may **not** claim credit for the same pollutant reduction under the Reef Credit scheme and another program' (Reef Credit Standard v2.1). Furthermore, 'projects may generate other forms of environmental credits, such as biodiversity, carbon or renewable energy certificates **which must be additional** to the Reef Credit' (Reef Credit Standard v2.1).

Under the Reef Credit scheme, additionality requires 'that a reef credit project generate pollutant reductions over and above legal requirements and reductions that would have occurred without the reef credit project' (Reef Credit Definitions v2.1). Furthermore, the Reef Credit Standard v2.1 provides:

> 'Where a pollutant reduction has already been funded under a different scheme or program at the same project site, a reef credit project may still be undertaken either concurrently or consecutively, however reef credits may only be issued for pollutant reduction that is **additional** to that already paid for. The calculation of the baseline must take into account pollutant reductions already accounted for in programs other than the reef credit scheme' (Reef Credit Definitions v2.1).

Therefore, pursuant to the Reef Credit scheme rules described above, it is unlikely that project proponents can claim credits under multiple schemes for the ***same pollutant reduction***. It is, however, possible to undertake another ecosystem services project (including carbon, biodiversity and renewable energy projects) on the same area and claim credits, provided the credits generated are separate and additional to the reef credits and are being claimed for different pollutant reductions.

2.2.5 Challenges

Deloitte Access Economics (2017) estimated that the asset value of the GBR is $56 billion. The reef supports 64,000 jobs and contributes $6.4 billion annually to the Australian economy, primarily from tourism, recreation, fishing and scientific industries (Deloitte Access Economics 2017; De Valck and Rolfe 2019). Despite the staggering value of the GBR, supply of reef credits is low, and demand for credits similarly remains a challenge. The success of the Reef Credit scheme depends upon both supply and demand for credits (Deane 2024). This section addresses the challenges that face the efficacy of the Reef Credit scheme.

Demand for reef credits

Since the commencement of the Reef Credit scheme in 2017, 41,204 reef credits have been purchased and retired by nine different purchasers including Qantas Airways Limited, Tourism Australia, Terrain NRM, HSBC, Australian Museum Trust, Groundswell Giving Ltd, Great Barrier Reef Foundation, Sydney Opera House Trust, and Queensland Alumina Limited (Eco-Markets

2025b). The Reef Credit scheme is distinguished from the ACCU scheme because unlike the ACCU scheme, there is no compliance-driven demand such as that created by the Safeguard Mechanism. This section analyses the drivers of demand for reef credits.

There is no demand for reef credits that is driven by regulatory restrictions. Instead, suppliers of reef credits are reliant on government grant funding and philanthropic investment (Deane et al. 2024). Strategic priorities such as corporate social responsibility are typical demand drivers for environmental goods and services (Vanderklift et al. 2019). For example, in 2024, Qantas Airways Limited committed $10 million over 10 years to the Reef Restoration Fund 'to support scientists, Traditional Owners and local tourism operators seeking to restore corals across the GBR and other iconic Australian coral reefs' (Qantas Airways Limited n.d.). Prices of credits generated through environmental market schemes can be low in the absence of regulatory restrictions driving demand (e.g. restrictions on water quality) because in those circumstances demand may be low (Deane et al. 2024). This is a risk to project proponents.

In 2023, the Queensland Government committed $10 million to the Reef Credit scheme 'to help kick-start the reef credit market, recruiting brokers to work with landholders to establish reef credit projects on grazing and sugarcane properties, and to secure potential buyers for the reef credits generated' (Queensland Government 2023). The Green Finance Institute made the following comments in relation to the Queensland Government's funding commitment:

> 'This is a positive signal and has provided confidence to farmers undertaking these projects that the credits they generate will be purchased. By the government committing to the purchase of credits, it can help the Reef Credit scheme reach critical mass which will raise further awareness and stimulate demand' (Green Finance Institute 2024).

Furthermore, Deane (2024) commented that:

> 'Government purchasing drives the demand for new credits and to a certain extent there is some good theory that underpins this – biodiversity and carbon sequestration are ecosystem services that support widespread benefits [and] therefore it is usually considered […] reasonable for public funds to support these projects. However, the intention of the market mechanisms is also to stimulate private investment. This can be difficult without a [compliance] mechanism like the [ACCU scheme] Safeguard mechanism' (Deane 2024).

Irrespective of the investment by the Queensland Government, demand for reef credits peaked in 2021 (as illustrated in Table 10 above) and the scheme has failed to gain traction since the 2023 investment. Mechanisms that can stimulate investment in the Reef Credit scheme include:

1. **Regulation** (negative incentive), such as mandating offsetting of nutrient and sediment pollution (Green Finance Institute 2024);
2. **Government policy** (positive incentive) can incentivise participation in the scheme through mechanisms such as subsidies, grants, or tax incentives (Deane 2024);
3. **ESG** (Environmental, Social, and Governance) reporting, both regulated and voluntary. Businesses can purchase reef credits to support environmental protection initiatives that they can publish in ESG reports (Deane 2024). In Australia, regulated reporting has been introduced via the *Treasury Laws Amendment (Financial Market Infrastructure and Other Measures) Act 2024,* the application of which is limited to certain enterprises (discussed in detail at section 3.1.1 Social Licence to Operate and ESG of this report);
4. **Government procurement policies** can require environmental impact reporting, which can increase demand for biodiversity credits (Deane 2024); and

5. **Increasing purchasing options of reef credits** can increase demand by improving accessibility (such as an option to purchase a percentage of a reef credit together with another product like GBR tourism or food). 'There is substantial evidence that Australians have high values to protect the GBR, so there may be potential for Australian consumers to demonstrate their demands for sustainable agricultural management practices more directly through their food purchasing choices […]' (Rolfe et al. 2023).

In summary, the Reef Credit scheme is a voluntary market that has experienced low levels of demand. The are several mechanisms that can be utilised to increase demand for credits, which are identified above.

Supply of reef credits

Like demand, supply of reef credits is problematically low, most likely because of low prices. An increase in demand can increase prices and ensure the success of the Reef Credit scheme. Since the commencement of the Reef Credit scheme in 2017, 14 projects have been registered and 60,686 reef credits have been generated. Twelve projects have utilised the DIN method, one project the wastewater method and one project the gully method. Supply of reef credits is significantly lower than that of ACCUs (since 2011, 2,503 ACCU projects have been registered and 161,203,002 ACCUs generated (CER 2025)). There are several drivers of supply analysed in this section, including factors influencing farmers' decisions to implement practice changes, the financial viability of projects, the monitoring requirements of projects, and the impact of competition with alternative funding sources.

First, the decision to undertake a project under the Reef Credit scheme and incorporate practice change in a primary production business is influenced by several factors such as financial viability, the market for credits, availability of information about environmental markets, farm location and farmer's demographics, government regulations and institutions interests/ agenda, interactions and relationships with stakeholders, factors related to the farming operation and management, and farmer's attitudes, beliefs and skills. Rundle-Thiele et al. (2021) identified the key barriers and facilitators of lasting behavioural change in the cane industry in relation to reducing nitrogen, pesticide and sediment runoff entering the GBR (the study was in relation to general practice change rather than farmers being paid to generate reef credits; nevertheless, there is significant overlap). A summary of the study's findings is included in Table 13 below:

Table 13: Summary table of the dimensions of practice change

Theme	Definition	Barrier	Enabler
Financial support & Market forces	Financial outputs and inputs	High upfront costs Lack of money Access to cash Lack of government funding Misplaced resources	Household income Diversified income Improved financial returns Financial support Market forces: commodity pricing Branding and image
Information dissemination	How the information is communicated	Failure to deliver communication that farmers need and value	Clear communication Bridging science and practice delivering access to scientists

		Low/no communication between stakeholders	Significant amount of data and knowledge on the GBR
Farmer & Farm characteristics	Farmer's demographic and farmland's geographic characteristics	Lack of resources	Farmland characteristics Farmer demographic characteristics Land/stock ownership Natural resources
Institutional setting & Regulations	Government regulations and institutions interests/ agenda	Lack of repercussion	Regulation and policy Institutional structure
Stakeholder interactions	Interactions and relationships between two or more stakeholders	Industry influence Lack of holistic approach Stakeholders' competing interest Lack of leadership	Extension service provision Training and education Peers Collaboration Community led Social norms
Farming practice	Factors related to the farming operation and management	Time Lack of innovation Lack of alternatives	Business management Technical aspects Labour availability
Beliefs Attitudes and Individual Capabilities	People's awareness, knowledge, capabilities, what people think, feel, believe and can already confidently do	Preference Resistance	Knowledge Perceptions Motivation and interest Skillset Experience with the promoted practice Trust Outcome expectations

Source: Adapted from Rundle-Thiele et al. (2021)

In addition to the factors contained in Table 13 above, the following are enablers of participation in the Reef Credit scheme:

1. **Co-benefits** of reef credits and placing additional value on credits through bundling or stacking opportunities with credits from other environmental markets can improve the financial viability of projects (Vanderklift et al. 2019; Green Finance Institute 2024); and

2. **Successful demonstration sites** of projects under the Reef Credit scheme can 'fill scientific knowledge gaps, attract investor interest, and build operational capabilities' (Vanderklift et al. 2019).

Second, the financial viability of a project under the Reef Credit scheme will vary between projects and each project proponent should undertake their own enquiries before embarking on a project. In general, the economic viability of Reef Credit scheme projects and the costs and benefits associated thereto are not well understood. However, the lack of supply of reef credits suggests that the price is too low to incentivise proponents undertaking new projects. More research and analysis in required.

The study by Waltham et al. (2021) investigated the economic feasibility of transitioning low-lying, high DIN risk sugarcane land to an alternative land use that required less or no nitrogen application. The alternative land uses investigated include: ‘1) grazing (grass-fed beef fattening); 2) farm forestry; 3) construction of engineered wetlands to provide water treatment in runoff before discharge to receiving waters; and 4) restoration of wetlands to provide services for aquatic ecosystems (such as fish habitat extension, or carbon sequestration)’ (Waltham et al. 2021). The study determined the value of DIN credit payments ($/kg DIN) ‘required to allow the landholder (or project proponent) to obtain payback periods of 5, 10 and 15 years on their investment, evaluated in terms of present value at 5% and 7% real annual discount rates’ (Waltham et al. 2021). The analysis was completed for a period of 30 years (Waltham et al. 2021). The report found that the price to incentivise DIN reduction varied across locations from ‘less than $30/kg DIN in the Mackay region, less than $60/kg DIN in the Burdekin Delta, and less than $100/kg DIN in the Burdekin River Irrigation Area’ (Waltham et al. 2021). Pages 141 to 143 of the report contain a summary of key results for each area. The study by Waltham et al. (2021) included in the economic analysis the cost of converting the land from sugarcane production to the new land use and the reduction in annuity gross margin as a result of the switch. However, the costs associated with a Reef Credit scheme project such as project establishment costs, monitoring costs, audit costs, and reporting costs were not considered.

The Innovative Gully Remediation Project, which ran from 2017 until 2020, was a $4 million project that aimed to ‘develop cost-effective and scalable options for the reduction of sediment and particulate nutrient export to the GBR lagoon’ (Telfer 2021). The project was jointly funded by Greening Australia and the Queensland Government and took place at a cattle property, ‘Strathalbyn Station’, located 45km north-west of Collinsville and 60km south of Ayr (Telfer 2021). The project involved several direct gully remediation trial sites totalling an area of 17.41ha and an additional 44ha of contributing gully catchment that was managed for groundcover retention (Telfer 2021). The project found that:

1. The total ‘upfront costs’, defined as ‘the direct costs of implementation of the treatment trials including materials, site survey, earthworks, mobilisation and demobilisation, infrastructure, water provision, works supervision, and revegetation’, for the ten trial sites was $2.37M[48] in 2019 dollars (Telfer 2021);
2. The maintenance costs for all sites incurred throughout the project between January 2018 and July 2020 amounted to $34,214[49] (excluding materials costs) (1.4% of the total upfront costs) (Telfer 2021); and
3. The gully remediation works generated an ‘annual estimated fine sediment saving to the GBR lagoon of 4,428 tonnes’ (Telfer 2021).

The results, including upfront costs and fine sediment load reduction, generated by gully remediation treatment trials undertaken at the Strathalbyn Station Northern gully complex from the Innovative Gully Remediation Project are summarised in Table 14 below.

Table 14: Results from the Innovative Gully Remediation Project

Treatment	Area (ha)	Upfront cost (2019 $)	Fine sediment load reduction
Treatment 1	1.2	192,197	282
Treatment 2	1.41	183,666	187

[48] $2,859,386 in 2024 (RBA inflation calculator)
[49] $41,213 in 2024 (RBA inflation calculator)

Treatment 3	1.77	230,893	478
Treatment 4	2.85	323,433	708
Treatment 5	0.3	146,055	Included in Treatment 8 analyses
Treatment 6	5.5	633,964	679
Treatment 7	1.46	240,680	426
Treatment 8a	2.34	422,913	1242
Treatment 8b	0.58		426
TOTALS	**17.41ha**	**$2,373,801**	**4,428 t/yr**

Source: Adapted from Telfer (2021)

Telfer (2021) acknowledged that limitations of the cost effectiveness analysis of the Innovative Gully Remediation Project included:

- It was assumed that the 'sediment reductions measured over the initial 2-3-year monitoring period translate to the same reduction over the 25-year assessment period [however,] only longer-term monitoring can answer that question' (Telfer 2021); and

- 'It is probable that the upfront costs associated with the Strathalbyn trials are higher than if the sites were not treated as "trials". The necessity of maintaining a control site in the middle of the gully complex, multiple mobilisations and demobilisations over a number of years, the imperative to trial new and innovative treatment methodologies, and the focus on achieving maximum sediment reductions for each treated gully have contributed to likely higher costs than if all the gullies were treated at once with a single methodology' (Telfer 2021).

Ultimately, more research is required to understand the complete nature of the costs and benefits associated with Reef Credit scheme projects.

Third, in addition to the factors influencing adoption of practice changes and the financial viability of projects, supply of credits can be impacted by the monitoring requirements that environmental market schemes impose on projects, which are typically extensive and designed to ensure credibility. The exact magnitude of monitoring costs associated with Reef Credit scheme projects are not known and need to be investigated further. However, monitoring costs may be expensive and could prevent participation in the Reef Credit scheme if the price of credits is not high enough to compensate project proponents. For example, there is currently only one project registered under the Reef Credit scheme using the gully method. Telfer (2021) noted that, 'monitoring water quality parameters in runoff in remote and generally inaccessible gullies has significant challenges, is expensive, often frustrating, and gives mixed result'. Simon Hunt, Senior Soil Conservation Officer of the Department of Primary Industries, is working on a gully remediation project at Spyglass Research Station in the Upper Burdekin and expressed a similar sentiment, commenting that water quality monitoring can be complex and requires a specific skill set to establish, maintain and perform the ongoing monitoring analysis (S. Hunt, pers. comm., 1 April 2025).

Fourth, funding opportunities available under alternative programs that support projects improving water quality may present as competition to the Reef Credit scheme. Table 15 below summarises the Australian and Queensland Government funding programs available offering support to water quality improvement projects in the GBR catchment.

Table 15: Australian and Queensland Government GBR water quality funding programs

Government	Program	Funding amount	Location	Program details
Joint Australian and Queensland Government	Streambank Remediation Program	$12.4 million (DCCEEW 2025a)	Burdekin, Mackay Whitsunday, Burnett Mary, Herbert River, and Fitzroy River catchments (DCCEEW 2025a)	This program aims to reduce streambank erosion and sediment flow into the Reef by repairing and remediating streambanks along rivers and waterways (DCCEEW 2025a)
Australian Government	Landscape Repair Program	$200 million (DCCEEW 2024e)	The projects are being delivered by Regional National Resource Management (NRM) groups: • Fitzroy Basin Association • Terrain NRM • Reef Catchments (Mackay Whitsunday Isaac) Limited • Burnett Mary Regional Group for Natural Resource Management • Cape York NRM • NQ Dry Tropics (DCCEEW 2024e)	Six projects have been awarded funding to improve water quality and aim to reduce sediment flowing to Reef catchments by: • restoring eroding gully systems • rehabilitating streambanks • improving groundcover through grazing land management (DCCEEW 2024e).
Australian Government	Reef Coastal Restoration Program	$28.5 million (DCCEEW 2024f)	Reef catchments	Support restoration and rehabilitation of coastal habitats, accelerating the progress towards meeting water quality targets. The Reef Coastal Restoration Program is funded through the Reef Trust and is part of the Australian Government's $1.2 billion investment to protect the Reef (DCCEEW 2024f).
Australian Government	Clearer Water for a Healthy Reef program	$192 million (DCCEEW 2024g)	Reef catchments (DCCEEW 2024g)	The funding will: • deliver projects to increase efforts to reduce nutrient and pesticide runoff; • support healthy wetland habitats, protect Reef biodiversity and build ecosystem resilience; • deliver Traditional Owner led and community programs to support on-ground activities; • support job creation and economic recovery for industries, regional communities and

				Traditional Owners (DCCEEW 2024g)
Queensland Government	Reef Place-Based Integrated Projects	$5.5 million (Queensland Government 2024b)	Wet Tropics, Burdekin, Mackay Whitsunday, Burnett Mary regions (Queensland Government 2024b)	Improve reef water quality (Queensland Government 2024b)
Queensland Government	Reef Assist Program (Funded through the Queensland Reef Water Quality program)	$33.5 million (Queensland Government 2024c)	Wet Tropics, Burdekin, Mackay Whitsunday, Burnett Mary, Fitzroy and Cape York regions (Queensland Government 2024c)	On-ground activities include: • gully and streambank restoration • riparian revegetation • natural wetland restoration and constructed wetland development • cane drainage management systems • urban development erosion management • pastoral land management (Queensland Government 2024c)
Queensland Government	Grazing Resilience and Sustainable Solutions (GRASS) program	$21.45 million until 2026 (DCCEEW 2025a)	Burdekin, Fitzroy and Burnett Mary regions (DPI 2024a)	Identify opportunities and provide support to improve poor or degraded land, and improve Reef water quality outcomes and land management by supporting on-ground works (DPI 2024a)
Queensland Government				'Queensland Government has allocated AUD$57.8 million to support agricultural practice change through improvement programs including the Queensland Department of Primary Industries extension programs, and nine cane and six grazing projects delivered by private agronomy, natural resource management and research groups to help agricultural producers adopt improved practices and better understand water quality impacts at a finer scale' (DCCEEW 2025a)

Conclusion: challenges facing the Reef Credit Scheme

The Reef Credit scheme is an innovative market-based approach to improving water quality in the GBR catchment, but it faces significant challenges that currently hinder its success. On the demand side, there has been limited uptake of reef credits. Despite government funding designed to encourage expansion of the scheme, demand peaked in 2021 and has struggled to gain momentum. Mechanisms like regulation, government policies, ESG reporting requirements, government procurement policies and increased purchasing options of reef credits offer potential pathways to stimulate demand.

Equally, the supply of reef credits remains problematically low, constrained by issues such as unclear financial viability of projects that can have high upfront costs, the complex and extensive project monitoring requirements, and competition with alternative funding programs. Enablers that can support project uptake include financial support and market forces, information dissemination, farmer characteristics (including beliefs, attitudes and individual capabilities), institutional settings and regulations, stakeholder interactions, farming practices, co-benefits, and demonstration projects (but as identified in Table 13 above, these factors can also act as barriers to uptake). Research into the financial viability of Reef Credit scheme projects is required to understand the extent of the costs and benefits that can improve confidence in project returns.

To ensure the long-term viability and scalability of the Reef Credit scheme, a coordinated approach, addressing both the demand and supply of credits, is necessary.

2.3 Land Restoration Fund

2.3.1 Overview

The Land Restoration Fund (LRF) is a $500-million Queensland Government grant scheme announced in 2017 that aims to grow the carbon farming industry in Queensland by supporting innovative land management projects that deliver carbon abatement and priority co-benefits. It is a grant scheme, rather than a separate environmental market scheme, which enables ACCU scheme projects to sell ACCUs plus co-benefits for a higher price. The Department of Environment, Tourism, Science and Innovation administers the LRF. The LRF framework is set out in *Land Restoration Fund Co-Benefits Standard v1.4* (LRF Co-Benefits Standard v1.4), which details how to measure, report and verify co-benefits generated from carbon projects.

The LRF investment priorities are contained in the LRF Priority Investment Plan (2023) and focus on land restoration that:

1. improves the health of wetlands and coastal ecosystems, including the GBR;
2. supports threatened species and ecosystems; and
3. supports social and economic sustainability.

2.3.2 LRF and ACCU Scheme

LRF projects must be registered ACCU scheme projects using an ACCU scheme method that generates ACCUs (Queensland Government 2024d). The LRF differs from the ACCU scheme as it 'supports projects that deliver demonstrated environmental, socio-economic and/or First Nations outcomes – called co-benefits – in addition to sequestering or avoiding carbon emissions' (Queensland Government 2024d). The co-benefits are bundled with the ACCUs and purchased by the LRF (Queensland Government 2024d). Table 16 below provides a comparison between the LRF and the ACCU scheme.

Table 16: Similarities and differences between the Land Restoration Fund and the ACCU Scheme

	Land Restoration Fund	ACCU Scheme
Purchases ACCUs	Yes	Yes

Pay for co-benefits in addition to carbon	Yes	No
Projects must register with the Clean Energy Regulator	Yes	Yes
Purchasing method	Contract for ACCUs and co-benefits through dedicated investment rounds	Contract for lowest-cost ACCUs through reverse auction

Source: Adapted from Queensland Government (2024d)

2.3.3 Co-benefits

LRF projects must be located in Queensland, registered under the ACCU scheme and generate ACCUs together with co-benefits. LRF projects can generate co-benefits from multiple categories. The current LRF co-benefit categories include:

- **Environmental co-benefits** – improved health of soils, wetlands and water, and enhanced biodiversity and threatened species habitat;
- **Socio-economic co-benefits** – supporting jobs and skill development in local communities, thereby providing economic benefits that improve the resilience and prosperity of regional communities; and
- **First Nations co-benefits** – encompassing a wide range of outcomes, including customary, cultural, economic, and business development advantages (e.g. opportunities for new on-country and service delivery businesses (LRF Co-Benefits Standard v1.4).

Environmental co-benefit classes

The LRF Co-Benefits Standard contains seven classes of environmental co-benefits able to be claimed and verified, including: native vegetation, threatened wildlife (including plants), threatened ecosystems, coastal ecosystems, wetlands, the GBR and soil health. 'The co-benefit classes are not mutually exclusive, and it may be possible for LRF projects to claim co-benefits under several or all co-benefit classes' (LRF Co-Benefits Standard v1.4). The assurance requirements, whether proponent assurance suffices or whether third party assurance is required, varies based on the ACCU scheme method used, and are detailed at section 3.1 of the LRF Co-Benefits Standard v1.4.

Socio-economic co-benefit classes

The LRF Co-Benefits Standard contains two classes of socio-economic co-benefits able to be claimed and verified, including: local community benefits and employment and skills benefits. 'It may be possible for LRF projects to claim co-benefits under both co-benefit classes' (LRF Co-Benefits Standard v1.4). Details of assurance and eligibility requirements for both classes are set out at section 4.1 of the LRF Co-Benefits Standard v1.4.

First Nations co-benefits

The LRF Co-Benefits Standard contains two classes of First Nations co-benefits able to be claimed and verified, including: First Nations benefits based on participation and First Nations benefits based on location. 'It may be possible for LRF projects to claim co-benefits under both co-benefit classes' (LRF Co-Benefits Standard v1.4). Details of assurance and eligibility requirements for both classes are set out at section 5.1 of the LRF Co-Benefits Standard v1.4. Table 17 below summarises the eligibility requirements for all environmental, socio-economic and First Nations co-benefits.

Table 17: Eligibility requirements of LRF co-benefit classes

Class	Eligibility
Environmental co-benefits	**Environmental co-benefits**
Soil health	LRF projects must result in a verified improvement to soil condition.
The Great Barrier Reef	LRF projects must result in: (a) a verified improvement to native vegetation in pre-clearing wetlands in a GBR catchment; and/or (b) a verified improvement to both native vegetation condition and soil condition within a GBR catchment that has a sediment target in the Reef Water Quality Improvement Plan.
Wetlands	LRF projects must result in: (a) a verified improvement to the condition of wetland native vegetation; and/or (b) a verified improvement to the condition of non-wetland vegetation and soil within 100m of a wetland in an Aquatic Conservation Assessment rated as natural or near natural, and as of high or very high significance.
Coastal ecosystems	LRF projects must result in a verified improvement to native vegetation condition in coastal regional ecosystems.
Threatened ecosystems	LRF projects must result in: (a) a verified improvement to native vegetation condition in a regional ecosystem with a biodiversity status of “of-concern” or “endangered”; and/or (b) a verified improvement to native vegetation condition in a regional ecosystem listed as containing threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999.*
Threatened wildlife (including plants)	LRF projects must result in: (a) a verified improvement to native vegetation condition within areas that meet the definitions of matters of state environmental significance (defined at 3.2.6 of LRF Standard) for wildlife habitat or matters of national environmental significance (defined at 3.2.6 of LRF Standard) for threatened species; and/or (b) a verified improvement to native vegetation condition of regional ecosystems that are potential habitat for threatened species other than highly mobile fauna.
Native vegetation	LRF projects must result in verified improvement to native vegetation condition
Socio-economic co-benefits	**Socio-economic co-benefits**
Local community benefits	LRF projects must: (a) be located in an area broadly defined as an area of relative socio-economic disadvantage (defined at 4.1.2 of LRF Standard), taking into account people's access to material and social resources, and their ability to participate in society; and/or (b) generate economic and social co-benefits for the local community.
Employment and skills benefits	LRF projects must: (a) result in the employment of regional workers; and/or

	(b) deliver skills training to regional workers; and (c) deliver these co-benefits in regional Queensland.
First Nations co-benefits	**First Nations co-benefits**
First Nations benefits based on location	LRF project must (a) take place on Indigenous land, which for the purposes of the LRF Co-benefits Standard may include: • Aboriginal freehold; • land with a native title determination; • land that is subject to a registered native title claim; or • land where there is an Indigenous Land Use Agreement (ILUA) in place, including where there is a benefit assigned for the use of the land for a carbon farming project (e.g. where there is a project being run by a pastoral leaseholder on land subject to a native title interest and under the ILUA the traditional owners receive a benefit from, or share of, the ACCUs generated); and (b) provide benefits to the relevant First Nations peoples for the land
First Nations benefits based on participation	LRF projects must be owned by First Nations peoples or directly involve First Nations participation, such as through the provision of Indigenous fire management services or the involvement of Indigenous Rangers.

Source: Adapted from LRF Co-Benefits Standard v1.4.

General LRF project requirements and processes

To ensure co-benefits are genuine, the LRF applies a Co-benefits Standard that includes eligibility, verification, and reporting requirements. LRF project proponents must submit annual reports detailing outcomes and activities[50]. Some of the environmental co-benefits are assessed using the Accounting for Nature® Framework (sets out measuring, reporting and third-party certification processes), while the Aboriginal Carbon Foundation's Core Benefits Verification Framework[51] can be used to validate the cultural, social, and environmental value of Aboriginal carbon farming projects (LRF Co-Benefits Standard v1.4).

2.3.4 Price and Supply of ACCUs + LRF co-benefits

The LRF enables project proponents to bundle ACCUs with LRF co-benefits and collect a higher price (Sangha et al. 2024). For example, The Australian newspaper published an article on 1 September 2024 stating that Regen Farmers Mutual, a farmer cooperative undertaking an ACCU scheme project together with a pilot LRF project, has 'agreed to sell the first 1000 ACCUs from [its] Traprock project to the charity Carbon 4 Good for $100 per unit' (Harcourt 2024).

Projects are contracted by the LRF to supply premium carbon credits, namely ACCUs plus co-benefits, at dedicated investment rounds (Waltham et al. 2025). The LRF has completed three investment rounds to date. The first investment round was held in 2020 where 11 projects were contracted to generate 975,170 ACCUs plus co-benefits for a median price of $52.50/ACCU plus

[50] Sections 6.4 and 6.5 of the *Land Restoration Fund Co-benefits Standard v1.4* describe the information to be included in the annual Monitoring and Reporting Plan and Co-benefit Report.

[51] Aboriginal Carbon Foundation, 2019, Core benefits verification framework: for the environmental, social and cultural values of Aboriginal carbon farming, Cairns, Queensland, Core Benefits Verification Framework (www.qld.gov.au), accessed March 2023.

co-benefits. On average, 7 categories of co-benefits were contracted per project (Queensland Government 2025a). The second investment round was held in 2021 where 7 projects were contracted to generate 164,213 ACCUs plus co-benefits for a median price of $71.16/ACCU plus co-benefits. On average, 6 categories of co-benefits were contracted per project (Queensland Government 2025a). The third investment round was held in 2023 and 8 projects were contracted to generate 180,657 ACCUs plus co-benefits for a median price of $120/ACCU plus co-benefits. On average, 6 categories of co-benefits were contracted per project (Queensland Government 2025a).

LRF environmental co-benefits are the most contracted (including threatened wildlife, threatened ecosystems, native vegetation, and GBR) followed by employment and skills, then community resilience. The ACCU scheme methods that have been contracted by the LRF include reforestation by environmental or mallee plantings (12 projects), avoided clearing of native regrowth (7 projects), human-induced regeneration of a permanent even-aged native forest (4 projects), savanna fire management (3 projects) and soil carbon (2 projects). Two projects out of the 26 contracted used two ACCU scheme methods.

According to the Queensland Government's Land Restoration Fund Investment Rounds Report, certain factors can enhance a project's value to the LRF and justify a higher price per ACCU plus co-benefits. These include projects that can deliver high quality co-benefits that align with the LRF priorities, and high costs projects such as reforestation projects that involve tree plantings. By placing value on co-benefits, the LRF can support projects that might otherwise be unviable due to factors such as small scale or high implementation costs (Queensland Government 2025a).

The LRF has contracted 26 projects to supply ACCUs plus co-benefits, the location of which is depicted in Figure 12 below.

Figure 12: Map of LRF contracted projects

Source: Adapted from Queensland Government's Land Restoration Fund Register (2025c)

The LRF Register on the Queensland Government website[52] contains information about the 26 contracted projects, including the project name, project proponent, location, ACCU scheme method, eligible co-benefits, project duration, amount of LRF investment in the project, and a project summary. Table 61 located at Appendix 9.3 summarises the LRF Register information for 26 projects.

2.4 Nature Repair Market

The Nature Repair Market is the world's first national, legislated, voluntary biodiversity market, established under the *Nature Repair Act 2023* (Cth) and supplemented by *Nature Repair (Biodiversity Assessment) Instrument 2025* (Cth) and *Nature Repair Rules 2024* (Cth) (DCCEEW n.d.). The scheme is a market mechanism designed to incentivise the delivery of improved biodiversity outcomes for Australia through changes in land management practices (CER 2025b).

The *Nature Repair Act 2023* (Cth) objectives include:

- promote the enhancement and protection of biodiversity in native species in Australia;
- contribute to meeting Australia's international biodiversity obligations;
- contribute to meeting Australia's domestic goal of no new extinctions;
- promote engagement and co-operation of market participants;
- support and promote the role of First Nations;
- enable the use of First Nations knowledge; and
- support better information on biodiversity (s3 *Nature Repair Act 2023* (Cth)).

The Nature Repair Market was designed to align with the ACCU scheme, and project proponents can undertake projects that can earn both ACCUs and biodiversity certificates, provided that they meet the requirements of both an ACCU scheme method and a Nature Repair Market method (DCCEEW 2025b). Currently, there is only one method available under the Nature Repair Market, namely the replanting native forest and woodland ecosystems method, and no projects are registered on the CER's Biodiversity Market Register. The rules for the replanting native forest and woodland ecosystems method are identified at Appendix 9.4 below.

The Nature Repair Committee is an independent advisory body appointed by the Minister for the Environment and Water to consider new methods and undertake periodic reviews of methods. The Nature Repair Market is administered by the Clean Energy Regulator who is responsible for biodiversity project registration, providing participation guidelines, maintaining the public project register, project assessment and verification, biodiversity certificate issuance, and publishing information to support the market (DCCEEW 2025b).

Nature Repair Market projects promote land management practices that enhance biodiversity. These may include activities such as tree planting on agricultural land, restoring vegetation along waterways, and protecting and managing existing habitats or native vegetation (DCCEEW 2025b). Projects can be carried out on land and water or both (DCCEEW 2025b).

[52] Land Restoration Fund Register | Environment, land and water | Queensland Government

Biodiversity certificates

Under the Nature Repair Market, project proponents are eligible to receive a single biodiversity certificate per project, reflecting the biodiversity improvements achieved (CER 2025c). These certificates can be sold, retained, or deposited with the Clean Energy Regulator (DCCEEW 2025b). Each certificate represents the measurable biodiversity outcomes delivered by a project (CER 2025b). Nature Repair Market biodiversity certificates are prohibited from being used for an environmental offsetting purpose (s76, *Nature Repair Act 2023*).

Demand for biodiversity certificates

Demand for biodiversity certificates may come from a variety of sources, including investments influenced by reporting and disclosure obligations (e.g. Taskforce on Nature-related Financial Disclosures), as well as philanthropic contributions, ESG focused investors and buyers of carbon credits seeking projects that also benefit nature (CER 2025b).

Price

The market for biodiversity certificates will determine their price. Factors including project characteristics (method and location) and project maturity (progress towards achieving a biodiversity outcome) are likely to impact the price of biodiversity certificates (CER 2025b).

Stacking ACCUs plus biodiversity certificates

Project proponents have an opportunity to increase the value of their credits by stacking ACCUs with a biodiversity certificate generated from the same project and project area (provided separate projects are conducted in compliance with the ACCU scheme and the Nature Repair Market). The ACCU scheme project must be registered first, followed by the Nature Repair Market scheme project so as to comply with the newness and additionality rules under the ACCU scheme (CER 2025c). Stacking is allowed as project proponents can earn ACCUs and a biodiversity certificate for the same activities (CER 2025b).

Permanence period

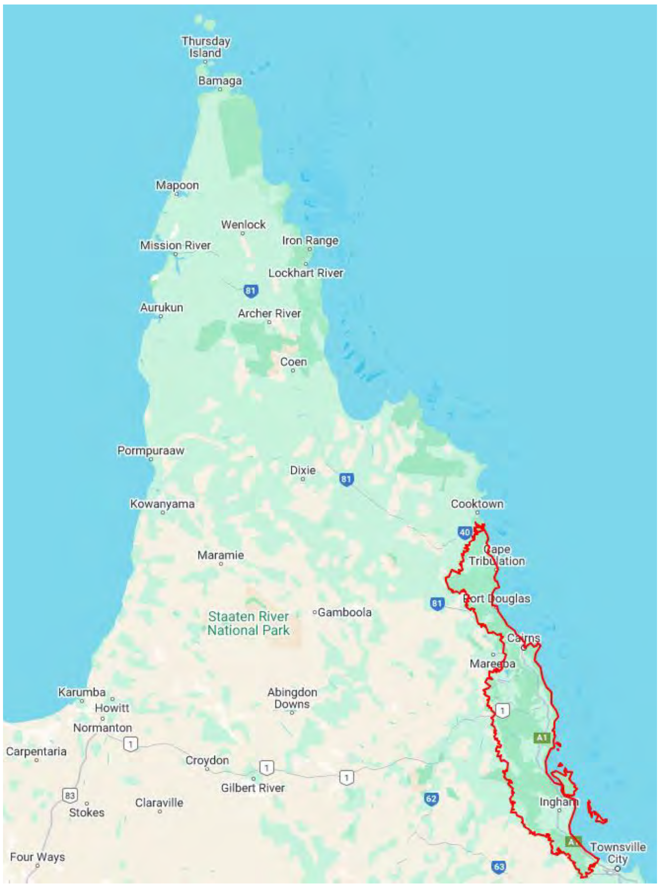
Projects under the Nature Repair Act can have a permanence period of 25 years (type A), 100 years (type B), or a period specified by a method (type C).

2.5 Cassowary Credit Scheme

The Wet Tropics region of Queensland is a globally important priority area for biodiversity conservation, containing 35% of Australia's mammals, 42% of Australia's freshwater fish species, 58% of Australia's butterflies, 40% of Australia's bird species, 400 species of coral, and 1500 reef fish species (Cassowary Credits 2024). However, the Wet Tropics region rainforests have suffered degradation because of fragmentation due to infrastructure projects, residential development and agricultural expansion, together with the introduction of invasive species, disease and the impacts of surrounding land uses (Eco-Markets Australia 2024c). Accordingly, the Cassowary Credits scheme has been established with the aim of increasing biodiversity.

The Cassowary Credits scheme is a new voluntary scheme designed for the Wet Tropics region in Far North Queensland and aims to achieve a positive gain in biodiversity. The scheme was developed by Terrain NRM with support from the Queensland Government's Land Restoration Fund and World Wildlife Fund (Terrain NRM 2024). Eco-Markets Australia is the independent administrator of the Cassowary Credit scheme. The scheme creates a market for biodiversity and 'enables investors such as governments, philanthropists or corporates to pay landholders and land managers to undertake habitat restoration activities' (Terrain NRM 2024). Cassowary Credits '*cannot* be used to meet conservation and restoration commitments in a compliance market, for example to satisfy legal offset obligations' (Cassowary Credits 2024). The scheme was launched in late May 2025 (Eco-Markets Australia 2024c). Figure 13 below illustrates the Wet Tropics region of Queensland where Cassowary Credit scheme projects can be undertaken.

Figure 13: Map of the Wet Tropics



Source: Adapted from Queensland Government (2013)

Integrity

To ensure the integrity of the Cassowary Credit scheme, the scheme is independently administered, and a transparent and secure registry system tracks and records all credit transactions (Terrain NRM 2024). Furthermore, the scheme has eight core principles relating to the generation of credits:

- **'Real** – All Cassowary Credit projects must yield quantifiable and verifiable improvements in rainforest condition.
- **Measurable** – All Cassowary Credits generated from project activities must be quantifiable using a process from an approved Cassowary Credit Methodology.
- **Permanent** – Any improvement in rainforest condition generated through the Cassowary Credit scheme must be permanent, as defined in the Cassowary Credit Standard.
- **Additional** – Any improvement in rainforest condition generated through the Cassowary Credit scheme must be additional to what would have happened without the project activities.

- **Independently verified –** Any improvement in rainforest condition generated through the Cassowary Credit scheme must be verified by an approved verifier.
- **Unique –** Each Cassowary Credit must be unique and only associated with a single Cassowary Credit Project.
- **Transparent –** There must be sufficient and adequate processes to ensure transparency and confidence in the scheme by all stakeholders.
- **Conservative –** Accurate or conservative assumptions, values, and procedures must be used to ensure improvements in rainforest condition are not over estimated' (Terrain NRM 2024).

To participate in the Cassowary Credit scheme, project proponents must use an approved methodology for their projects. Currently, there is one available methodology, the Rainforest Replanting Method, the rules for which are set out at Appendix 9.5 below. One unit of rainforest condition improvement is equal to one cassowary credit (Terrain NRM 2024). Project proponents under the Cassowary Credit scheme can earn cassowary credits through rainforest repair, reinstatement, enhanced protection or threat mitigation (Terrain NRM 2024). Projects range from planting rainforests on cleared land to weed control and improving the condition of existing vegetation (Terrain NRM 2024). Land unsuitable for agriculture is the scheme's target (Terrain NRM 2024). Terrain NRM (2024) identified, using GIS analysis, 50,000 hectares of land that is unsuitable for agriculture based on soil type, slope or closeness to watercourses.

Cassowary Credits reward steady progress toward restoring rainforest. 'Rather than being paid once a hectare of functional rainforest is produced (which could take many years), the scheme pays according to the rate of condition improvement from the starting baseline, enable[ing] a solid flow of income in the first few years after projects are established, which gradually levels off until the crediting limit of the scheme is reached (25 years)' (Terrain NRM 2024). The scheme's payment system is designed to align with high inputs during site preparation, planting and maintenance requirements early on, and ongoing but reducing maintenance and monitoring (Terrain NRM 2024). Stacking is possible for ACCUs with Cassowary Credits provided that the additionality requirements are met and the ACCU project is registered first (Terrain NRM 2024).

Permanence Period

The permanence period for Cassowary Credit scheme projects is 25 years, during which the vegetation in the project area cannot be cleared and the outcomes of the project must be protected. To ensure permanence requirements are met, Eco-Markets Australia (the Secretariat) will employ a compliance and assurance framework, and can seek information and advice regarding projects, as well as deregister and suspend projects, and refer projects for prosecution in the event of illegal activity (Terrain NRM 2024).

Risk of Reversal

Cassowary Credit scheme projects with be subjected to a risk of reversal buffer to account for any losses. 'A proposed Risk of Reversal Buffer of 5% will be discounted from all projects [... and] will be retained by the Cassowary Credit scheme Secretariat and used to mitigate future reversals across the Cassowary Credit scheme' (Terrain NRM 2024).

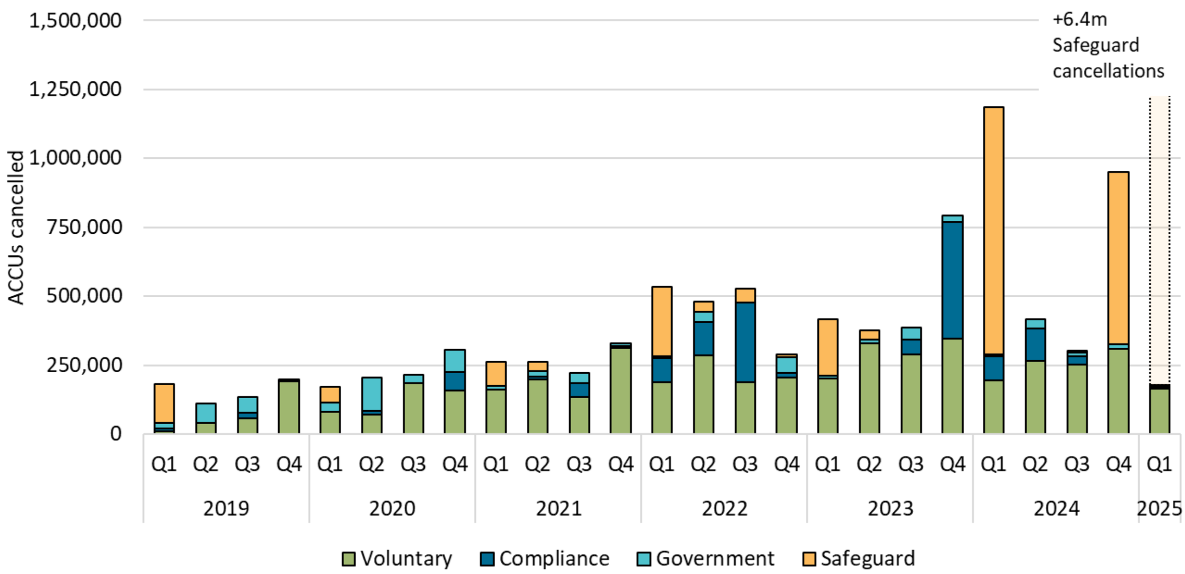
3 Drivers of demand and supply, benefits and costs

3.1 Drivers of Demand

This section identifies the drivers of demand for environmental market credits. Demand for environmental credits is key to securing changes in agricultural practices (Pudasaini et al. 2024a). Demand of environmental credits has been steadily increasing in the ACCU scheme and has been volatile in the reef credit scheme.

Figure 14: below illustrates the number of ACCUs cancelled (the abatement has been used) by demand source from January 2019 until March 2025. Although volatile, total demand has increased over time. Furthermore, demand by safeguard facilities noticeably increased in 2024 (likely because of the legislative reform in 2023). The CER estimates that '60% of ACCU holdings were held by safeguard and safeguard-related entities as of 31 December 2024' (CER 2025). Additionally, voluntary demand for ACCUs appears to have gradually increased from 2019 until 2025.

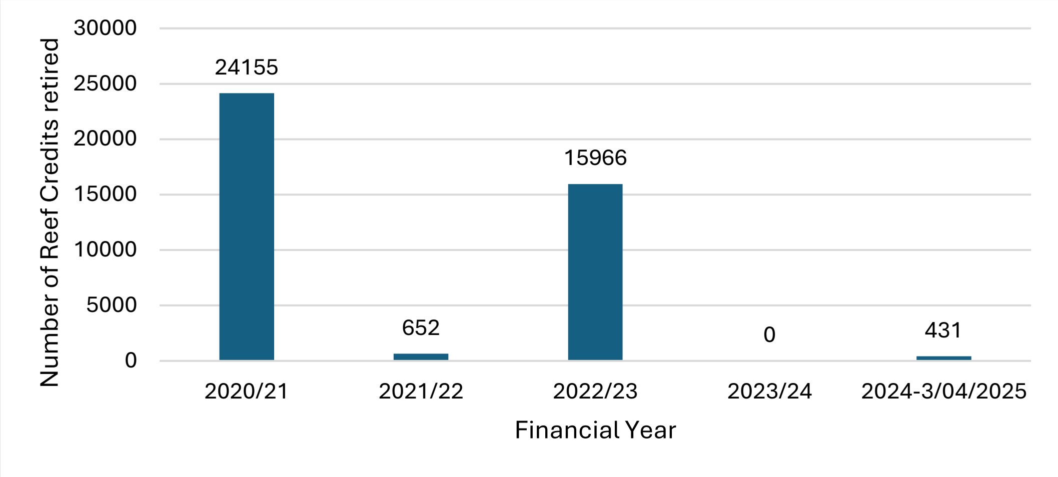
Figure 14: Australian carbon credit unit (ACCU) cancellations by demand source



Source: Adapted from CER (2025f)

Figure 15 below illustrates the number of Reef Credits retired (the abatement has been used) from the 2020/2021 financial year until 3 April 2025. The data for the 2024/2025 financial year is incomplete. The demand for Reef Credits has been volatile.

Figure 15: Number of Reef Credits retired by financial year



Source: Adapted from Eco-Markets Australia (2021), Eco-Markets Australia (2022), Eco-Markets Australia (2023c), and Eco-Markets Australia (2024g).

There are several drivers of demand for environmental market credits, including government regulation and policies, social licence to operate and ESG factors, and consumer preferences, and these are discussed in detail below.

3.1.1 Social Licence to Operate and ESG

Sustainability is a key concern in today's society, and one that businesses can no longer afford to ignore (De Valck et al. 2022). To stay competitive, companies must adopt environmentally responsible practices, as increasing regulatory demands and shifting consumer expectations are beginning to influence access to both markets and capital (De Valck et al. 2022). In this landscape, environmental markets can play a crucial role as they provide a mechanism for businesses to achieve positive environmental outcomes, signalling to consumers (such as by ecolabelling) that they have taken steps to reduce their environmental impact (this could be by purchasing credits for offsetting or by generating credits and insetting them, i.e. using them to offset against a business' own emissions) (De Valck et al. 2022).

Social licence to operate is increasingly important and refers to 'the ongoing acceptance and approval of an organisation's activities by its stakeholders and the general public' (AICD 2025). From this concept, there has been an increasing focus across industries on environmental, social and governance factors, known by the acronym 'ESG' (Pérez et al. 2022). In 2022, 98% of S&P 500 companies reported ESG information (CAQ 2025).

Australia introduced regulated sustainability reporting for climate-related financial disclosure requirements in September 2024 via the *Treasury Laws Amendment (Financial Market Infrastructure and Other Measures) Act 2024*. The entities subject to the legislation that is being implemented in three phases include:

1. Group 1: must report from 1 January 2025 if entity meets two of three reporting thresholds:
    - Consolidated gross revenue/financial year of $500 million or more;
    - Consolidated assets at end of financial year of $1 billion or more; and/or
    - More than 500 employees.
2. Group 2: must report from 1 July 2026 if entity meets two of three reporting thresholds:

- Consolidated gross revenue/financial year of $200 million or more;
- Consolidated assets at end of financial year of $500 million or more; and/or
- More than 250 employees.

3. Group 3: must report from 1 July 2027 if entity meets two of three reporting thresholds:
    - Consolidated gross revenue/financial year of $50 million or more;
    - Consolidated assets at end of financial year of $25 million or more; and/or
    - More than 100 employees.

The legislation includes both a voluntary standard (*General Requirements for Disclosure of Sustainability-related Financial Information*) and a mandatory standard (*Climate-related Disclosures*). 'The climate-related financial disclosures are divided into four key pillars, being governance, strategy, risk management, and metrics and targets, and include required disclosures on scenario analyses and greenhouse gas emissions (Scope 1, 2 and 3)' (KPMG 2025). These reporting requirements may increase demand for environmental market scheme credits, given the social licence to operate pressures.

Social licence is increasingly influencing the agricultural sector, which accounted for 18.4% of Australia's total greenhouse gas emissions in the year ending December 2023 (DCCEEW 2024i), with the livestock industry being the primary contributor (McDonald et al. 2023). In response, the Australian red meat sector has set an ambitious goal of achieving net-zero emissions by 2030 (McDonald et al. 2023). Reaching this target involves adopting grazing management practices that lower emissions and/or enhancing carbon sequestration in soils and vegetation, while also promoting environmental stewardship, improving profitability, and sustaining social licence to operate (McDonald et al. 2023).

Voluntary purchases unrelated to compliance with regulatory requirements (e.g. Safeguard Mechanism) of environmental market credits is rising as investors, including individuals, businesses and governments, are increasingly drawn to environmental market schemes for a range of reasons including ethical or moral considerations, alignment with environmental and social responsibility goals, responsiveness to customer expectations, marketing advantages, and a desire to support local ecosystems and communities (Slegers et al. 2023; Terrain NRM 2024; Baumber et al. 2020). For example, in 2024, voluntary purchases were made of 1.1 million ACCUs (CER 2025).

3.1.2 Government regulation and policies

Currently, in Australia, demand for improved environmental standards in agricultural production is voter driven and implemented through government funding programs, policy initiatives and regulatory frameworks (De Valck et al. 2022). In 1992, Australia became a party to the United Nations Framework Convention on Climate Change, and in 1997, signed the Kyoto Protocol, which entered into force in 2005. In essence, the Kyoto Protocol actions the United Nations Framework Convention on Climate Change by committing industrialised nations to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets (UNFCCC n.d.). The Paris Agreement, to which Australia is party, came into force in 2016 and seeks to enhance the global response to climate change by aiming to keep the rise in global average temperature below 2°C above pre-industrial levels, while also striving to limit the increase to 1.5°C (DFAT n.d.). The Australian Government legislated the targets of net zero GHG emissions by 2050 and 43% below 2005 levels by 2030 via the *Climate Change Act 2022* (Cth) (DCCEEW 2025c). Similarly, the Queensland Government has legislated emissions targets through the *Clean Economy Jobs Act 2024* (Qld) including a reduction in net GHG emissions of

30% below 2005 levels for Queensland by 2030, a reduction in net GHG emissions of 75% below 2005 levels for Queensland by 2035, and net zero GHG emissions by 2050. In addition to government, key agricultural industry bodies have committed to achieving carbon neutrality, including Meat & Livestock Australia (MLA) whose target is net zero by 2030 (MLA 2025), National Farmers Federation, and Grain Growers (Kingwell 2021).

The Australian Government's policy to reduce emissions of Australia's largest industrial facilities is the Safeguard Mechanism. The Safeguard Mechanism requires industrial facilities (such as mining, manufacturing, transport, oil, gas and waste sectors) that emit more than 100,000 tonnes of carbon dioxide equivalent per year to keep net emissions at or below a specified baseline, and the baseline level will typically decrease by 4.9% each year to 2030. In the 2023-2024 financial year, there were 219 facilities covered by the Safeguard Mechanism (CER 2025g). The Safeguard Mechanism has increased demand for ACCUs due to the legislated emissions reduction targets of industrial facilities, which rely on the ACCU scheme to offset some of their emissions (Pudasaini et al. 2024a). As of 31 December 2024, 60% of ACCU holdings were safeguard or safeguard-related entities as of 31 December 2024.

In addition to the greenhouse gas emissions targets, the Australian and Queensland Governments have sought to protect and preserve biodiversity through regulation (such as the *Environment Protection and Biodiversity Conservation Act 1999* (Cth)), policies, programs and investment. The Australian Government established its Nature Positive Plan, whereby it has committed to work towards zero extinctions, 'protect 30% of Australia's land and seas by 2030, create a nature repair market, establish an independent Environment Protection Agency (EPA) and work in partnership with First Nations people, including to develop standalone cultural heritage legislation' (DCCEEW 2022). As discussed earlier in this report, both the Australian and Queensland Governments have made commitments to improving and protecting biodiversity and the environment such as the Reef 2050 Long-Term Sustainability Plan and have made significant investments into programs like the Grazing Resilience and Sustainable Solutions (GRASS) program and the Landscape Repair Program. Furthermore, the Australian government has implemented the Environmentally Sustainable Procurement Policy and Reporting Framework, which aims to reduce the impact of Australian Government procurements on the environment by requiring that products purchased by the government 'minimise GHG emissions, are safe for the environment, and retain their value for longer' (DCCEEW 2024h). Evidently, the Australian and Queensland Governments have committed to lowering greenhouse gas emissions to net zero by 2050 and have committed to protecting and improving biodiversity in Australia. These government policies, funding programs and regulatory frameworks all stimulate demand for environmental services.

3.1.3 Consumer preference for sustainability

Consumer demand for food produced according to higher environmental standards can drive adoption of changed agriculture management practices (De Valck et al. 2022). The two key options of enhancing demand signals for environmentally responsible production through markets include: (1) ecolabels, where consumers can choose to buy differentiated products (the price may be higher for goods with ecolabels), and (2) environmental standards, where consumers can opt for higher standards, typically at a higher price (Rolfe et al. 2023). 'Price premiums can pass through supply chains to provide positive incentives for farmers, linking farmers more closely with consumer demands and providing the financial incentive for uptake of higher standard practices' (De Valck et al. 2022).

There is strong evidence that consumers favour food produced according to higher environmental standards; for example, Australian consumers are increasingly paying more for ethically produced free-range eggs and wine labelled as organic (Rolfe et al. 2023). However, the extent to which consumers are willing to pay for higher environmental standards is less understood, as is the relative importance of credence factors such as animal welfare, health, and environmental concerns to consumers (Rolfe et al. 2023). Four studies have looked at these issues in relation to different Australian food products, including avocados produced in the GBR catchment (Rolfe et al. 2023), two meat studies (Rolfe et al. 2023a and De Valck et al. 2023), and sugar produced in the GBR catchment (De Valck et al. 2022). The findings of these studies are set out below.

The study by Rolfe et al. (2023) involved an online survey of 1,100 Australian households to ascertain the level of consumer support for avocados to be produced at higher standards in the GBR catchment. Rolfe et al. (2023) found that consumers were willing to pay a price premium of $0.22/avocado (7.2% premium) regardless of whether the higher standard was captured by an ecolabel regarding five star water quality improvements or an environmental standards option. These results contrasted to the findings of Li and Kallass (2021) that consumers were willing to pay 29.5% more for sustainable foods (Rolfe et al. 2023). PwC's 2024 Voice of the Consumer Survey of 20,000 consumers across 31 countries found that consumers are willing to spend an average of 9.7% more on sustainably produced or sourced goods (PwC 2024).

The study by Rolfe et al. (2023a) aimed to assess the influence of greenhouse gas (GHG) emissions on meat consumption preferences in comparison to other credence factors—such as animal welfare, health, and environmental concerns—as well as to price and taste considerations. The study involved a survey of 1,101 Australian households and found that health-related concerns are the primary factor influencing meat purchasing decisions, followed by considerations of quality and price. In comparison to price, there was limited consumer interest in GHG emissions, which aligns with the literature (Rolfe et al. 2023a). The study further found:

> 'Analysis of the counting data reveals that approximately 14.6% of participants viewed GHG from meat production as an important issue (selecting it as the most important statement). In comparison, 38.1% of participants selected it as a least important statement. Analysis showed that female and younger respondents are more likely to consider GHG emission as an important determinant of their utility' (Rolfe et al. 2023a).

The study by De Valck et al. (2023) involved a survey to which 1,200 responses were collected, to determine the impact of GHG emissions considerations on consumer preferences with respect to meat purchases. Similar to Rolfe et al. (2023a), this study found that price was a more important consideration than GHG emissions. Furthermore, the results from the study revealed limited interest by Australian consumers in considering carbon footprint when purchasing meat whereas other credence factors including animal welfare and health are important (De Valck et al. 2023). The authors expressed surprise at the result 'given the support in Australia for reducing greenhouse gas emissions, and perhaps [the result] reflects some level of cognitive dissonance between environmental concerns and consumption behaviour' (De Valck et al. 2023). Count data in the study did however find that approximately 16% of consumers considered emission factors to be important (De Valck et al. 2023).

The study by De Valck et al. (2022) involved a survey of Australian households to which there were 1,100 responses, to determine whether consumers would pay a premium for sugar sustainably produced in the GBR catchment to improve water quality. The study found that 'personal health considerations are more important than sustainability and environmental factors, including impacts on the GBR' and 'respondents are more likely to pay a premium to support Reef-friendly sugar if they are living in urban areas, plan to visit the GBR in the future, think that the GBR condition has declined, and are generally concerned about keeping a healthy diet' (De Valck 2022). Furthermore, the study found that the average willingness to pay was $24.50/year/household. De Valck et al. (2022) noted that a limitation of the study was that 'there is some potential for biases in CVM experiments, where respondents' answers to the instructed choice task do not necessarily match what they might do in more complex shopping situations in real life' (De Valck et al. 2022).

The results observed in the four studies identified above align with the survey results of MLA's community sentiment research (2024), which involved a survey of 1,501 Australians aged between 18 and 64 across five Australian capital cities (Adelaide, Brisbane, Melbourne, Perth and Sydney) (MLA 2024a). The survey found that, compared to one year ago, 58% of consumers had not changed their meat consumption, 18% had increased their consumption and 24% had decreased their consumption (MLA 2024a). Of the 24% of consumers who had reduced their consumption of red meat, the main reason was 'too expensive' (58%), followed by 'health concerns' (19%), then 'environmental concerns' (6%) and finally 'animal welfare concerns' (3%) (MLA 2024a).

In summary, there is appetite among consumers for food produced in accordance with higher health and environmental standards, but as was identified by the four studies described above and MLA's community sentiment research, price is the primary consideration for consumers, followed by health considerations. Furthermore, the extent of the willingness to pay varies between products and consumers, as do the importance of credence factors for consumers.

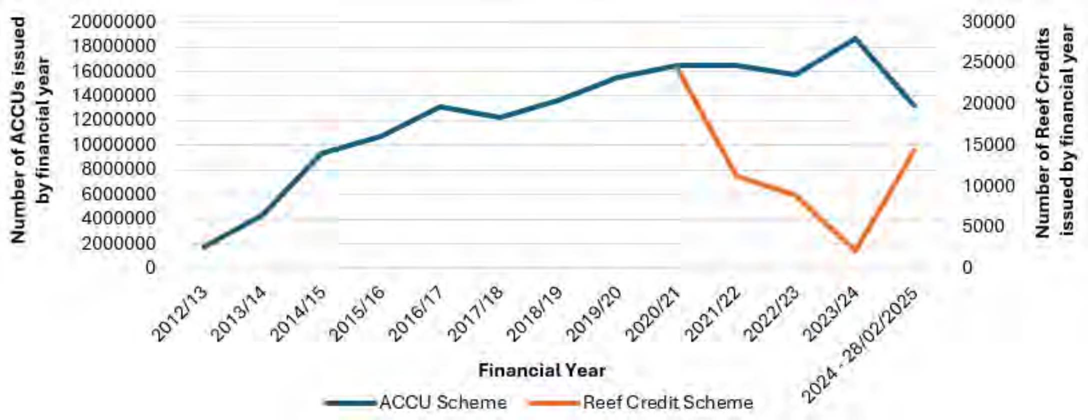
3.1.4 Summary of demand drivers

In conclusion, demand for environmental market credits is driven by government regulation and policies, social licence to operate and ESG factors, and consumer preferences. Government regulation such as the Safeguard Mechanism has been a primary driver of demand for ACCUs with 60% of ACCU holdings being by safeguard and safeguard-related entities in December 2024. Furthermore, legislated environmental targets and government funding programs have also been key demand drivers. In parallel, growing expectations for corporate accountability, driven by ESG and social licence considerations, are increasing demand for environmental credits, particularly the ACCU scheme, which in 2024, saw 1.1 million ACCUs cancelled by non-Safeguard related entities, i.e. the abatement has been used either as an offset or inset (CER 2025). While consumer preference for sustainably produced goods is evident, price sensitivity remains a dominant influence in purchasing decisions. The combination of these factors indicates growing, albeit nuanced, demand for environmental market credits, with government regulation and policy currently providing the strongest market signals.

3.2 Drivers of Supply

This section identifies the drivers of supply of environmental market credits. The supply of ACCU scheme credits and the Reef Credit scheme credits by financial year is illustrated in Figure 16 below. The data for the current financial year 2024 – 2025 is incomplete. The '2025 new supply outlook expected to be between 19 and 24 million ACCUs' (CER 2025). Disregarding the partial data point for the current financial year, an upward trend can be observed for the supply of ACCUs over time. In comparison, the supply of reef credits has been volatile. However, it is difficult to identify trends in the market for reef credits given that there are not large amounts of data.

Figure 16: Supply of ACCU scheme credits and Reef Credit scheme credits by financial year



Supply of environmental market credits is understood through analysing primary producer's decision making and the factors that are facilitators and barriers to entry into environmental credit markets.

First, a primary producer's decision to implement a conservation practice depends on their expectation that it will allow them to better achieve their goals, and if they expect the practice will not meet their goals, it will not be adopted (Pannell et al. 2006). Goals vary widely amongst individual producers. Researchers have summarised several common goals of landholders and farmers as:

- increase material wealth and financial security;
- environmental protection and enhancement (beyond that related to personal financial gain);
- social approval and acceptance, and to be a respected member of the community;
- personal integrity and high ethical standards;
- balance of work and lifestyle;
- farm well and be recognised for this;
- improve the physical state and appearance of the farm;
- to have good quality animals and crops in good condition;
- acquire extra land or to control a larger business for the future and for heirs;
- to have a reasonable but not profligate standard of living that compares reasonably with others in farming and society at large;
- to earn enough profit to be able to improve and develop the farm so as not to have to work so hard in old age; and
- educate children well (Pannell et al. 2006).

Whilst maximising profit is not the core goal for many primary producers, it is an important tool for achieving higher order goals such as a secure family lifestyle or keeping the farm property in the family (which means that economic return is still an important influence on their behaviour) (Pannell et al. 2006).

Second, primary producers' participation in environmental markets is relatively low, and primary producers are not fully aware of the federal and state government schemes encouraging the move to more sustainable practices (Kaufman and Meis-Harris 2022). In comparison to the core goals of primary producers, in relation to environmental market schemes, the primary motivation for producer participation is financial gain (Baumber et al. 2021; Kaufman and Meis-Harris 2022). The factors that influence the decision by primary producers to participate in environmental markets include the costs and financial viability of participating, the management demands of a project, timeframe, risk and uncertainty associated with a project, social norms, credibility of schemes, access to information and knowledge, extension and networking, and farmer's attitudes, beliefs, skills and age. The same factors can positively and negatively impact a primary producer's decision to participate in environmental markets. Table 18 below summarises the key factors that facilitate entry into environmental markets, followed by Table 19 summarising the key barriers to entry.

Table 18: Facilitators to entry into environmental markets

Facilitators	Key Findings
Environmental orientation and identity	• Early adopters' motivations can be largely environmental • Stronger motivators for farmers include stewardship values and blending farming productivity with sustainability and longevity
Neighbours	• Neighbours are considered positive social role models • Neighbours can help to share information to help others access the tools needed to examine environmental markets and access biodiversity protection policies
Experience and skills	• Many landholders have capacity for change and are willing to learn new things • Increasing interest in diversification of business models • Existing skills and knowledge are transferable to environmental market participation
Price/ benefits/ incentives	• Linking programs to economic benefits was essential for farmers as it helped set an expectation of financial return, thus leading to intrinsic rewards • Transaction costs that are low or shared among farmers and landholders • Cost and profitability of the traditional practice that is replaced by environmental market projects • Reduced input costs including fuel and labour- techniques that can reduce costs for farmers and landowners
Stacking	Stacking credits increases the value of credits. Allowing stacking increases participation in environmental markets and thereby the supply of environmental services and credits (Lankoski et al. 2015; Woodward 2010).
Diversification/access to off-farm income	Increased financial security from diversified income can incentivise participation in environmental markets.
Information and assistance	Information and technical assistance facilitates participation, as it improves understanding of environmental goods and services and the potential they have on farms, including all the requirements and implications
Extension and networking	• Best outcomes in interventions may be facilitated in existing farmer groups, not alone • Increased social role modelling and mentors; farmers and landholders can be more intrigued to hear from other people with the same or similar roles rather than an expert in the field

	• In-person events and services are more beneficial for information dissemination
Values alignment with scheme	• Value alignment with the environmental scheme, such as 'stewardship' • Ensuring that compatibility is present between new practice and already existing beliefs and values (including social, economic and environmental)
Younger age/ long-term outlook	• Younger age can be a positive driver in adopting new practices • Generational change and having different values, including adopting an environmental value, are a part of participating in environmental markets • Where the long-term goal is for the farm to be passed down to the generations, and the benefit of implementing a conservation practice will be enjoyed by that family, landholders may be more willing to adopt new practices.
Intermediaries	Intermediary participation in environmental markets may induce increased supply because of lower transaction costs. 'Intermediaries influenced the cause of the transaction costs primarily through the provision of information and core offset services that are time and information intensive (negotiation, monitoring and reporting) [and their] specialisation in these areas meant that it is likely that the intermediaries could provide these services at a cost lower than the buyers and sellers would face if they performed these tasks themselves' (Coggan et al. 2013).
Ecosystem Co-benefits	Projects can potentially provide ecosystem co-benefits such as enhanced farm productivity, 'soil erosion control, soil structure improvement, water quality improvement, and biodiversity and habitat conservation' (Pudasaini et al. 2024). 'Studies have shown that the co-benefits of carbon farming projects are important motivating factors for farmers to engage in projects' (Pudasaini et al. 2024).
Concessional tax treatment	Concessional tax treatment can stimulate supply of environmental services. In July 2022, legislative changes were introduced so that, in certain circumstances, income from the sale of ACCUs can qualify as primary production income for the purposes of the farm management deposit (FMD) scheme and primary production averaging scheme (Slegers et al. 2023).

Source: Adapted from Kaufman and Meis-Harris (2022); Pannell et al. (2006); Slegers et al. (2023); Lankoski et al. (2015); Woodward (2010); Coggan et al. (2013); Pudasaini et al. (2024).

Table 19: Barriers to entry into environmental markets

Barriers	Key Findings
Costs	'Cost per unit of sequestration remains a barrier for some technologies' (Fitch et al. 2022). Cost factors that can inhibit participation in environmental markets include:- • Opportunity costs • Impact on property value and business • Large upfront costs including measuring, reporting and validating the data

	• Costs of ongoing measurement and monitoring • Costs of auditing and reporting • Costs relative to size of farm/operation. Larger benefits from innovation adoption are typically generated from larger property sizes, however, this is not always the case.
Financial viability	• Lack of financial viability is expected to inhibit participation. • Low price of environmental market credits. • Few examples of successful projects.
Management demands	• Projects that involve greater management demands may inhibit participation • Perception that participation in environmental markets would require onerous and costly administrative requirements, including both record keeping and reporting compliance
Time frame	Concerns relating to contractual obligations incurred through participation in markets, and the time period of the obligations, as well as the impact on ability to sell the property
Risk/ uncertainty	• Externally imposed uncertainty and risk is more of an issue than internal risk appetite • Present concern/doubts about the longevity of policies, funding and scheme arrangements • Fear of inflexibility in arrangements, which can lead to extra opportunity costs • Risk of unexpected climate that can prevent planned environmental goods and services production or maintenance • Long-term contract obligations • Uncertainty about size of production co-benefits or impacts • Uncertainty about the amount of carbon sequestration available and fluctuations over time • Lack of cash flow on annual basis • Lack of transparency and accuracy to understand carbon flows • Restrictions placed on land management practices
Social norms/ known participants	The presence or absence of neighbours or familiar stakeholders (farmers are more likely to observe neighbouring workers in their work; they are trustworthy and would support their operations).
Values misalignment	Values/expectations/goals of farmers misaligned with outcomes of specific scheme
Distrust/ low credibility of scheme and intermediaries	• Lack of trust for specific scheme managers and intermediaries such as carbon brokers • Poor credibility of schemes
Lack of information/ knowledge	• Limited knowledge of environmental markets limits participation, and can translate into lack of interest in participating in environmental markets • Conceptual difficulty and complexity of environmental markets, including lack of understanding of property rights, current policies and longevity of obligations, and carbon credits, carbon offsetting and the general Australian environmental portfolio complex capacity of gathering environmental data. For example, ‘the [ACCU scheme] was referred to as science-heavy, and as indicated by one participant, most landholders may not have a formal background in science,

	making it difficult to understand the fundamentals of carbon sequestration' (Jassim et al. 2022) • Landholders with higher levels of education typically adopt beneficial innovations more quickly. However, in circumstances where a complex technology or practice that is disadvantageous, education may tend to reduce or delay adoption, and less educated landholders may mistakenly adopt a practice because they did not recognise its limitations • Program details and language are hard to understand • Lack of knowledge about legal requirements and taxation
Farmer's capacities and skill set	• Farmers are specialised commodity producers, and most do not have technical knowledge about carbon sequestration issues and potential • Lack of system-based carbon agronomists and other specialist consultants for farmers to use
Age/ short-term outlook	Where there is a time delay between the implementation of a conservation practice and its payoff, age can be relevant. If a farm is not to be passed on to the farmer's children, and if the benefits of conservation practices are not expected to be fully reflected in the sale price of the farm, then older farmers may have less incentive to invest in something that will be primarily of benefit to the subsequent owner.

Source: Adapted from Kaufman and Meis-Harris (2022); Pannell et al. (2006); Waltham et al. (2024); Pudasaini et al. (2024).

3.2.1 Stacking

Stacking occurs when a single agri-environmental practice generates multiple environmental benefits and earns credits across different environmental markets (Lankoski et al. 2015). For example, if a farmer adopted a conservation practice that both sequestered carbon and improved biodiversity, then if stacking was allowed, the farmer could sell credits generated by the single practice change in both a carbon market and a biodiversity market (Woodward 2010). It has been debated whether stacking should be allowed (Woodward 2010; Lankoski et al. 2015). One reason for this is the strict provisions of most environmental markets that require credits to be "additional", meaning that they must result from the new incentive created by the environmental market (Woodward 2010).

Lankoski et al. (2015) identified the advantages and disadvantages of stacking as follows:

> 'The stacking of environmental credits has both advantages and disadvantages. On the one hand, allowing stacking may increase farmers' participation in government conservation programmes and environmental markets, since multiple payment and credit revenues are more likely to cover farmers' opportunity costs of environmental practice adoption. Moreover, allowing stacking may provide incentives for a more optimal combination of various environmental outputs and encourages higher quality environmental practices that may not be profitable with a single payment or credit revenue stream. On the other hand, allowing stacking may also complicate interpretations of additionality in the context of multiple environmental markets. If the credit revenue from the primary environmental market already compensates adoption costs of the practice, then a question arises whether the environmental co-benefits of the given practice can be considered environmentally additional in secondary markets since due to jointness they are already provided through incentives created by the primary ecosystem credit market' (Lankoski et al. 2015).

Overall, allowing stacking increases participation in environmental markets and thereby increases the supply of environmental services and credits (Lankoski et al. 2015; Woodward 2010; Baumber et al. 2020; Fitch et al. 2022). In the case of Australian environmental markets where participation rates are low, allowing stacking presents an opportunity to increase participation. However, Woodward (2010) cautioned that if multiple environmental markets do not coordinate policies, then allowing stacking may not lead to the greatest net benefits to society (Woodward 2010).

The term 'stacking' is often used to refer to a situation where two projects under two different schemes are undertaken on the same area of land, but additionality requirements of both schemes must be met.

Regardless of the technical meaning of 'stacking', the question of whether a primary producer can undertake multiple environmental market scheme projects on the same area of land to generate more credits is of key interest. Table 20 below summarises the additionality rules of the different schemes and provides commentary on whether stacking is allowed (in terms of both the strict definition and if two projects can run on the same area of land provided the additionality requirements are met).

Table 20: Environmental Markets in Queensland and Australia

Environmental Market	Additionality requirement?	Is stacking allowed?
ACCU Scheme	ACCU scheme methods should result in carbon abatement that is unlikely to occur in the ordinary course of events (disregarding the effect of the Act) (s133 *Carbon Credits (Carbon Farming Initiative Act 2011* (Cth)). Furthermore, the ACCU scheme projects are subject to the newness requirement (that the project has not begun to be implemented) (s27 *Carbon Credits (Carbon Farming Initiative Act 2011* (Cth)).	Yes. ACCUs can be stacked with a Nature Repair Market biodiversity credit, provided that the project under the ACCU scheme is registered first. ACCUs can also be stacked with reef credits and cassowary credits, provided that the project under the ACCU scheme is registered first and the Reef Credit scheme project/Cassowary Credit scheme project involves an **additional** action to generate the credits. ACCUs can be bundled with biodiversity credits generated under the LRF scheme.
Reef Credit Scheme	'All reef credit generated pollutant reductions and removals must be over and above: (a) legal requirements […]; and (b) **reductions that would have occurred without the Reef Credit Project**' (Eco-Markets 2024).	Yes, stacking is possible for ACCUs with reef credits provided that the **additionality requirements** are met under both schemes and the ACCU project is registered first (Terrain NRM 2024).
Nature Repair Market	There is not mention of the words 'newness' or 'additionality' in the *Nature Repair Act 2023*	Yes, stacking with ACCUs is allowed provided that the project under the ACCU scheme was registered first

	(Cth). Furthermore, on its website, the CER states: 'Stacking means undertaking a biodiversity and carbon project on the same area of land. This means you could earn a biodiversity certificate and ACCUs for the **same activities**' (CER 2025b). Section 57(a) of the *Nature Repair Act 2023* (Cth) provides, 'a biodiversity project carried out in accordance with the methodology determination must be designed to result in enhancement or protection of biodiversity in native species (whether the effect on biodiversity occurs within or outside the project area) that would be ***unlikely to occur if the project was not carried out***'.	followed by the project under the Nature Repair Market.
Cassowary Credits	'Additional: Benefit would not have occurred in the absence of the project' (Eco-Markets Australia 2024c).	Yes, stacking is possible for ACCUs with cassowary credits provided that the **additionality requirements** are met under both schemes and the ACCU project is registered first (Terrain NRM 2024).

Under the LRF scheme, co-benefits are ***bundled*** with ACCUs as one commodity (rather than stacked). LRF projects are contracted for ACCUs and co-benefits as a bundle at the same time. There is not an additionality requirement for the LRF co-benefit activities, provided projects deliver environmental, socio-economic and First Nations co-benefits in addition to ACCUs and meet the requirements of the LRF co-benefits standard.

3.2.2 Summary of supply drivers

In conclusion, participation rates by primary producers in environmental markets remains low and although supply of ACCUs is trending upwards, that is not the case for other environmental markets. Limited participation can be addressed by understanding and targeting the underlying decision-making drivers of primary producers and the facilitators and barriers that impact market entry. While financial gain is a primary motivator, primary producers also consider several other factors including (but not limited to) long-term business sustainability, generational factors, ecosystem co-benefits and personal beliefs and values. Stacking provides a key opportunity to improve the financial viability of environmental market projects and drive supply. There are many barriers to entry including high project costs and lack of financial viability of projects as well as uncertainty, scheme complexity, cumbersome management requirements and long project time frames. Furthermore, the results from the Investment Analysis section 4 of this report suggest that at the current ACCU price level of ~$35, projects are more likely than not to be financially unviable. Targeting the facilitators and barriers to entry, such as improving primary producers' knowledge and understanding environmental markets and the opportunities for stacking through extension, can support participation and increase supply.

3.3 Benefits

Undertaking a project under an environmental market scheme can potentially provide benefits including providing a diversified source of income from the sale of credits, ecosystem co-benefits such as ecosystem co-benefits such as enhanced biodiversity, expanded habitat availability, improved soil health, structure, and water retention, better management of erosion and salinity, and improved water quality, potential access to green loans, and potential marketing opportunity for products as carbon neutral or environmentally sustainable. These potential benefits are discussed in detail below.

3.3.1 Income and diversification

First, an increase in income and a diversified source of income is a potential benefit that may be generated by undertaking a project under an environmental market such as the ACCU scheme, Reef Credit scheme, LRF grant scheme, Nature Repair Market scheme and Cassowary Credit scheme (Thorpe et al. 2023). Increased income provides landholders with broader investment opportunities to improve their farming business (such as hiring labour or purchasing farm equipment) or off-farm investments and can assist landholders with succession planning and inter-generational farm management (Baumber et al. 2020; Slegers et al. 2023). Such benefits can have positive flow-on effects for surrounding towns and communities (Baumber et al. 2020). Financial resilience and security can also have mental health benefits (Baumber et al. 2020).

3.3.2 Ecosystem Co-benefits

Second, undertaking an environmental market project can potentially provide ecosystem co-benefits such as enhanced farm productivity, biodiversity, habitat conservation, improved water quality, soil erosion control, and enhanced soil health, water holding capacity and structure (Baumber et al. 2020; Pudasaini et al. 2024). These factors have potential to support the long-term sustainability and resilience of farms (Baumber et al. 2020). Potential co-benefits from environmental market projects are key motivators for farmer participation (Pudasaini et al. 2024).

Co-benefits can potentially improve farm productivity. For example, tree plantings can create a shelterbelt on farms that can benefit productivity by providing a wind break that protects crops and livestock (Fitch et al. 2022). This was seen in a case study conducted by CSIRO, Private Forests Tasmania and The University of Tasmania across four sites in northern Tasmania that planted commercial plantation trees (*Pinus radiata*) on existing farms. The study found that the plantings reduced wind speed by 20-50%, decreased evaporation decreased by 15–20%, and pasture in sheltered areas produced 30% more biomass compared to open paddocks (Fitch et al. 2022).

Battaglia et al. (2022) summarised the potential co-benefits that may be generated by ACCU scheme methods, which is depicted in the following schematic. Many of these benefits can potentially be generated by projects under the other environmental market schemes.

Table 21: Matrix of co-benefits and dis-benefits associated with ACCU scheme methods

Co-benefit/dis-benefit	Soil carbon	Savannah fire management	Reforestation by environmental plantings	Reforestation and afforestation	Plantation forestry	Avoided clearing of native regrowth	Blue carbon
Farm productivity							
Improved crop/pasture yields and farm productivity	✓✓✓		✓✓	✓✓			
Improved/diversified income streams	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	
Improved animal welfare (e.g. shelter, reduced stress)			✓✓	✓✓			
Soil Health							
Improved soil health via increased SOC	✓✓✓						
Increased soil stability/reduced soil surface erosion	✓✓✓	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	
Mediation of dry-land salinity			✓✓✓	✓✓		✓✓	
Biodiversity/conservation							
Increased biodiversity & ecosystem function/resilience	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Reduced biodiversity e.g. mono-cultures/homogenisation					✓		
Improved conservation outcomes	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓✓	✓✓✓
Water quality/quantity							
Reduced nitrogen/ phosphorus/ pesticide leakage	✓✓✓		✓✓	✓✓	✓✓	✓✓	
Reduced water yields			✓	✓	✓	✓	
Improved water quality	✓✓		✓✓	✓✓	✓✓	✓✓	✓✓
Socio-economic							
Conflict/competition with other land uses			✓	✓	✓	✓	✓
Emissions offsetting (e.g. bioenergy, product substitution				✓✓	✓✓✓		
Reduced air pollution (e.g. particulates)		✓✓✓					
Employment creation		✓✓✓			✓✓		
Poverty alleviation		✓✓✓					
Introduction of new/diversified products to market			✓✓	✓✓	✓✓		
Promotion of new technical innovations	✓	✓					
Promotion/enhancement/expansion of an industry		✓✓✓					
Harmonisations/improved efficiency of land use	✓		✓✓	✓✓	✓✓	✓✓	
Recognition/assimilation/respect of local/Indigenous knowledge		✓✓✓					
Promotion of equity in access to land, decision-making, knowledge		✓✓✓					

Co-benefit/dis-benefit	Soil carbon	Savannah fire management	Reforestation by environmental plantings	Reforestation and afforestation	Plantation forestry	Avoided clearing of native regrowth	Blue carbon
Increased community resilience		✓✓✓					
Enhanced capacity for Indigenous communities to meet land stewardship		✓✓✓					
Improved/clarified land tenure/use rights for local communities		✓					
Total number of ticks	24	37	29	30	26	22	9

Legend: Marginal/potential disbenefit (✓); Marginal/potential co-benefit (✓✓); Strong co-benefit (✓✓✓)

Source: Adapted from Battaglia et al. (2022)

3.3.3 Green Loans

Third, some financial institutions are offering lower interest rate loans, or 'green loans', for activities aimed at improving environmental outcomes. For example, the National Australia Bank (NAB) have an Agribusiness Emissions Reduction Incentive Program that offers a 1.15% interest rate discount per annum to eligible customers (NAB 2024). On their website, NAB describe the projects that may be eligible for support under the Agribusiness Emissions Reduction Incentive Program as: 'purchase of fertiliser with nitrification inhibitors; purchase of methane inhibitors; reforestation; pasture rejuvenation with legumes; and solar and battery projects' (NAB 2024). Another example includes the Business Green Loan and Agri Green Loan offered by the Commonwealth Bank of Australia (CBA), which have a lower interest rate compared to CBA's other commercial finance options (CBA 2025). On their website, CBA note projects involving environmentally sustainable management of living natural resources and land use qualify for the Business Green Loan (CBA 2025). Furthermore, projects that qualify for the Agri Green Loan include 'soil sequestration and development of carbon sinks, converting degraded land to improve soil quality, planting trees or installing shelter belts, improving management of waste, switching to regenerative farming practices, and deploying precision use of fertilisers' (CBA 2025).

3.3.4 Marketing opportunity

Fourth, participation in an environmental market scheme may provide primary producers with an opportunity to market products as environmentally sustainable. For example, primary producers can undertake an ACCU scheme project and instead of selling their ACCUs, they can hold the ACCUs for 'insetting' purposes (offset their own emissions) and claim carbon neutrality or reduced carbon footprint of their business operation (Slegers et al. 2023). Carbon neutral beef has emerged as a product in Australia and is available at retailers such as Coles (Coles 2025) and some restaurants including Melbourne's Vue de Monde and Stokehouse restaurants (Australian Beef Sustainability Framework 2025). Coles is charging a premium for its carbon neutral beef products. However, whether a price premium is available for all distinguished products is unclear. In 2024, Queensland primary producers, Christophe and Sylvie Bur, marketed their feeder steers as carbon neutral at the Biggenden saleyards and were unable to secure a premium for their cattle (Goodwin 2024).

3.3.5 Summary of benefits

In conclusion, participating in environmental market schemes such as the ACCU scheme, Reef Credit scheme, LRF grant scheme, Nature Repair Market or Cassowary Credit scheme, can offer primary producers a range of potential benefits. These include increased and diversified income from the sale of environmental credits, which can enhance farm investment capacity, succession planning, and community wellbeing. Projects may also deliver valuable ecosystem co-benefits like improved biodiversity, soil health, water quality, and overall farm resilience. In addition, landholders undertaking environmental improvements may access preferential financing through ‘green loans’ offered by institutions such as NAB and CBA. Participation in these schemes can also open marketing opportunities, allowing producers to brand their products as carbon neutral or environmentally sustainable, although price premiums for such products is not guaranteed. Ultimately, the potential benefits of participating in environmental market schemes are not guaranteed, and it has been suggested that the low participation rates in the ACCU scheme may be because ‘economic benefits are too limited to drive major practice change’ (Pudasaini et al. 2024).

3.4 Costs

Costs are incurred when participating in environmental market schemes such as the ACCU scheme, Reef Credit scheme, LRF grant scheme, Nature Repair Market or Cassowary Credit scheme, including the cost of undertaking the project and the opportunity cost of competing primary production activities.

First, there are many costs involved in undertaking an environmental market scheme project. The costs of a project will depend on which environmental market scheme the project proponent is participating in, the methodology undertaken, and the size and complexity of the project. Costs that are common to all environmental market scheme projects are the costs of investigating the project’s feasibility including legal and accounting advice, project set up costs, project running and maintenance costs, project record keeping, monitoring, measuring and reporting costs, and auditing costs. The scale of these costs in relation to the ACCU Scheme was explored at the Investment analysis section 4 of this report.

Depending on the method adopted by the project, the associated costs will vary. For example, the cost of measurement and verification will be lower for projects that can use remote sensing mechanisms like FullCAM (e.g. reforestation by environmental planting projects) compared to projects that require on site measurements (e.g. soil carbon projects).

A study by Coggan et al. (2013a) investigated the extent of private transaction costs incurred by landholders participating in water quality improvement programs for the GBR (this study did not look at the environmental market schemes addressed in this report, but the findings are nevertheless relevant). Coggan et al. (2013a) assessed the Australian Government Reef Rescue program that provided funding support to landholders to implement improved farming activities. The transaction costs analysed were the costs generated by ‘the payment of government funds to the farmer in exchange for the provision of a public good’ (Coggan et al. 2013a). Coggan et al. (2013a) found that ‘the average total transaction costs per farm as a percentage of the average funding provided was 38 per cent’. Given that environmental market scheme projects involve adoption of alternative land management practices, the transaction costs may be similar to those identified by Coggan et al. (2013a).

Some methodologies are known for having high project costs, such as the ACCU scheme soil carbon method, which requires project proponents to undertake soil sampling at the beginning of the project for the baseline measurements, and then throughout the project to measure sequestration (Fitch et al. 2022). Soil sampling is estimated to cost approximately $30/ha –

$100/ha[53]. Similarly, a high cost is incurred by projects that involve tree plantings (Fitch et al. 2022), such as the ACCU scheme reforestation by environmental or mallee plantings method and the rainforest replanting method under the Cassowary Credit scheme, where the cost of purchasing seeds or tube stock and planting trees is estimated at $3,000/ha - $7,500/ha. This cost can be even higher and the study by Waltham et al. (2025) estimated the cost at $55,000/ha for high density rainforest tree planting in northern Queensland.

Conversely, other methods are known for involving low project costs. For example, the ACCU scheme savannah burning methods are typically lower costs, as are the now closed HIR method projects and avoided clearing of native regrowth method projects (Fitch et al. 2022).

Second, project proponents must consider the opportunity cost of participating in an environmental market scheme. Most methods that are nature based compete for land and water use to varying degrees (Fitch et al. 2022). Methods that involve competing for agricultural land use present primary producers with high opportunity costs. For example, Kath et al. (2025) observed that converting land in Queensland from cropping production into environmental market scheme projects is not financially attractive in most regions due to the high opportunity costs involved. Examples of projects that are in competition for land use and resources like water include environmental planting projects, HIR projects, avoided land clearing projects, and blue carbon projects (Fitch et al. 2022). Methods that have lower opportunity costs because they complement primary production businesses and productivity include soil carbon methods and the suspended beef cattle herd management method.

Table 22 below summarises the potential enablers, barriers, co-benefits, risks and costs of projects by method type including the HIR method, savannah burning methods, avoided land clearing method, soil carbon method, permanent planting method, and the blue and teal carbon method. The information is adapted from Fitch et al. (2022). The methods from the environmental market schemes other than the ACCU scheme were not included in the analysis due to the limited available information regarding the enablers, barriers, co-benefits, risks and costs of those methods. It is noted that the costs per tonne are likely out of date given the report by Fitch et al. (2022) is now a few years old, but nevertheless it gives a good indication of which methods involve higher project costs and which methods are cheaper to run.

[53] 'Anecdotally, estimates of cost of soil sampling and analysis vary from as high as $100/ha to as low as $30/ha, depending on the size of the area and sampling strategy' (White et al. 2021). 'The cost of baseline sampling is typically high for soil carbon projects, varying from $30 to $100/ha depending on area, spatial homogeneity, fraction of gravels and sampling strategy' (Pudasaini et al. 2024).

Table 22: Summary of potential enablers, barriers, co-benefits, risks and cost of projects by ACCU scheme method type

Project Type	Enablers	Barriers	Co-Benefits	Risks	Cost
HIR method	• Targeted investigation and quantification of the social and environmental impacts and risks • Increased credit price • Low project costs • Reduced cost of measurement and verification (FullCAM)	• Concerns with change of conventional land use and potential impacts on communities • Concerns with measurement and verification of sequestration • Competing for agricultural land use and resources	• Biodiversity benefits • Improved soil condition • Reduced erosion • Diversification of farm income	• Disruption of traditional land use • Potential for increased exotic species and pests • Concerns with increased fire risk • Sequestration rates affected by drought and fire • Climate change • Reduced production on land that is regenerating • Risk of reversal	$5 per tonne
Savannah burning methods	• Research into determining current barriers to uptake • Increased credit price	• Possible concern by landholders to maintain sequestration for 100 years	• Employment opportunities for indigenous communities • Increased ground cover • Reduced erosion • Reduced mortality of flora and fauna • Reduced invasive woody veg. and grasses • Diversification of farm income	• Sequestration impacted by water stress • Climate risk • Risk of reversal	$5 per tonne
Avoided land clearing	• Further analysis of barrier to uptake, including a broader range of carbon process and relaxing land availability constraints • Increased credit price • Low project costs • Reduced cost of measurement and verification (FullCAM)	• Competing for agricultural land use and resources • Concerns with change of conventional land use and potential impacts on communities • The low uptake suggest that some incentive/policy settings are unfavourable	• Biodiversity benefits • Improved soil condition • Reduced erosion • Diversification of farm income	• Reduced production on land that is managed for regrowth • Potential for increased fire risk • Risk of reversal	$5-$10 per tonne

Soil carbon methods	• Low opportunity cost, as can increase productivity of primary production business (Fitch et al. 2022). • Direct subsidy to limit practices that run-down soil carbon • Payment to sequester soil carbon Market or value change mechanisms that reward practices that build soil carbon • Increased credit price	• High cost of soil sampling • Uncertainty and risk of sequestration length of storage • Onus on future managers to maintain	• Sustaining and improving productivity • Reducing the need for fertiliser inputs • Reducing drought impacts • Reducing externalities such as dust storms • Diversification of farm income	• Increased nitrous oxide emission due to higher level of inorganic nitrogen in the soil • Reduced future land use options • Risk of reversal	$7-$13 per tonne
Permanent planting methods	• Expanded supply chains for seeds or tube stock • Expansion of skilled workforce • Better quantification of co-benefits • Innovative methods for cost reduction • Increased credit price • Reduced cost of measurement and verification (FullCAM)	• High cost of seed/tube stock and planting • Availability of suitable land • Limited available and cost of seeds or tube stock • Limited skilled workforce • High cost of planting • Competing for agricultural land use and resources	• Potential productivity improvements (e.g. shelter belt plantings) • Biodiversity enhancement and restoration of native cover • Improved soil health, soil carbon and reduced erosion • Improved climate resilience • Diversification of farm income	• Large scale can impact water resources • Potential increased fire risk • Drought and fire effect sequestration rate and length of storage • Climate change • Reduced production on land that is planted with trees • Risk of reversal	$20-$30 per tonne
Blue and teal carbon	• Innovative business models • Better estimates of life cycle costs • Estimates of feasible sequestration • Reduced cost of measurement and verification (BlueCAM) • Increased credit price	• Can involve high costs to remove barriers to tidal flows • Project complexity • Complex land tenure and permitting • Poor estimates of potential and feasible sequestration	• Sustaining and improving fisheries • Pollutant removal • Ecosystem services • Diversification of farm income	• Risks to sequestration length of storage • Climate risk – sea level rises, increased temperatures and changes in rainfall • Risk of reversal	$18 - $30 per tonne

Source: Adapted from Fitch et al. (2022)

In summary, participating in environmental market schemes involves a range of costs that landholders must consider. These include direct project costs, such as feasibility assessments, legal and accounting advice, ongoing monitoring and audits (with audit costs alone ranging from $7,000 to $30,000 per audit for the ACCU scheme), and costs tied to the specific methodology used. Some methods, like projects involving tree plantings, are particularly expensive, with tree planting costs varying from $3,000/ha to $55,000/ha. In contrast, methods such as savannah burning or avoided clearing tend to be lower cost. In addition to upfront and ongoing costs, opportunity costs must be considered, especially for methods that compete with primary production for land and resources, such as environmental plantings or blue carbon projects. Methods that integrate with existing farming operations, like soil carbon projects, generally pose lower opportunity costs.

4 Investment analysis

The economic performance of an environmental market project is a key determinant of adoption by landholders. This section aims to identify, measure and compare the benefits and costs of a project using four ACCU scheme methods. The analysis is focussed on the ACCU scheme because it is the largest environmental market in Australia with the highest participation rates. Four ACCU scheme methods are investigated, including the estimating soil organic carbon sequestration using measurement and models method (soil organic carbon measurement method), reforestation by environmental or mallee plantings FullCAM method 2024 (environmental plantings method), beef cattle herd management method, and tidal restoration of blue carbon ecosystems method (blue carbon method). The current soil organic carbon measurement method and environmental plantings method were chosen for investment analysis because they have the highest number of projects registered of all currently open agricultural and vegetation methods respectively, both Australia wide and in Queensland. The beef cattle herd management method (now suspended) was selected for investment analysis due to its relevance to beef producers, and a summary of the investment analysis completed by Waltham et al. (2025) of the blue carbon method was included because of its relevance to the Queensland east coast, which hosts the GBR.

To conduct the analysis of the first two ACCU scheme methods, the current soil organic carbon measurement method and the environmental plantings method, a literature review was initially completed to identify the key factors that impact sequestration, followed by an investment analysis of a hypothetical project. The modelling of returns in both methods was based on the representative Fitzroy farm model created by Bowen and Chudleigh (2018).

The analysis of the beef cattle herd management method was completed by looking at three representative scenarios implementing a beef cattle herd management method project. The first project involved planting improved pastures of leucaena to optimise steer growth in the Fitzroy region (scenario 1). The second and third projects involved supplementing cattle with phosphorus during the wet season in phosphorus deficient country in the Fitzroy region (scenario 2) and acutely phosphorus deficient country in the Burdekin region (scenario 3). Scenarios 1 and 2 were based on the representative Fitzroy farm model created by Bowen and Chudleigh (2018). Scenario 3 was based on the acutely phosphorus deficient representative Burdekin farm model set out in DAF (2024).

The analysis of the blue carbon method was completed by summarising the study completed by Waltham et al. (2025).

To avoid repetition, the following section summarises the cost benefit methodology utilised for the investment analysis, Bowen and Chudleigh's (2018) representative Fitzroy farm model used in the investment analysis of the current soil organic carbon measurement method, the environmental plantings method and the beef cattle herd management method (scenarios 1 and 2), and the constant sequestration rate assumption relevant to the current soil organic carbon measurement method and environmental plantings method analyses.

4.1 Method and key assumptions

4.1.1 Investment analysis method

Investment analyses were undertaken by completing discounted cashflow analyses to assess the economic viability for primary producers to implement projects for four different ACCU scheme methods. In this report, the analysis was conducted from the perspective of primary producers, so social benefits and costs have been excluded.

Farm level economics of carbon farming projects are heterogeneous and vary depending on the region, season, farm and even paddocks within a farm (Thamo et al. 2020). The investment analyses of the four ACCU scheme methods contained in this report does not reflect the potential outcomes for all farms across Queensland, rather is simply a general indication of the economic viability of undertaking a project using this method.

Net Present Value (NPV) was used to assess the project investment and can be considered an approximation of the change in profit for the project period compared to the base case (without the project). A positive NPV indicates that primary producers would be made better off by undertaking the project. Conversely, a negative NPV means that primary producers would be made worse off by undertaking the project. NPV is the difference between the present value of the net benefits and net costs, calculated by:

$$NPV = PV\ net\ benefits - PV\ net\ costs$$

Present values are obtained by multiplying the net benefits and net costs by a discount factor, 1/(1+r), where *r* is the discount rate (Campbell and Brown 2003). Discounting accounts for the opportunity cost of the money invested into the ACCU scheme project, namely the loss of income that could have been generated by that money if it was invested elsewhere (e.g. stock market or another farm business investment) (Thamo 2017). Discounting also reflects the time preference of money (a dollar today is worth more than a dollar tomorrow) (Thamo 2017). Additional reasons for discounting include 'to allow for a predicted increase in wealth in the future, resulting in lower marginal utility from additional income; and to reflect risk and uncertainty surrounding the future' (Thamo 2017). In this report, a discount rate of 5% has been applied.

To complete the investment analysis, it was necessary to make several assumptions, which are detailed at sections 4.2.2, 4.3.2, 4.4 and 4.5. These include key assumptions regarding the ACCU price, opportunity cost of changing the current land use to a carbon abatement project, and the rate of carbon sequestered by the project (not relevant to the beef cattle herd management method, which involves an emissions reduction project). It was assumed that these factors remained constant throughout the ACCU scheme project, however, this may be a limitation of the analysis because variation in these factors throughout a project is expected (Thamo et al. 2017).

Investment analysis should consider the impact of risk and uncertainty that is associated with future predictions (Campbell and Brown 2003). However, the true risk of implementing the management changes analysed are not known. One method of estimating the impact of risk on the investment analysis is to conduct sensitivity analysis by varying the value of key inputs (Campbell and Brown 2003), which is the approach adopted in this report, where the rate of sequestration, price of ACCUs and costs of projects have been varied. However, there are additional parameters impacted by uncertainty and risk. Risk is typically accounted for using probabilistic concepts, however, in circumstances where the probability of a risk occurring is unknown, it is difficult to quantify the element of risk (Campbell and Brown 2003).

Limitations of the investment analysis contained in this report include:

1. Sensitivity analysis has been conducted only for variation of key parameters including sequestration rate, price of ACCUs and project cost. This means the element of risk and uncertainty associated with other parameters has not been accounted for because there is not enough information to estimate the probability of risk occurring;
2. Investment analysis may not be the most suitable method to account for the impact of all risk. For example, sovereign risk that governments might change the parameters, settings or rules governing environmental market schemes with consequent impacts on prices and conditions has not been accounted for in the current analysis. Techniques such as real options analysis could be applied to provide a more detailed analysis of potential scenarios to account for the impact of risk and uncertainty; and
3. Only one discount rate of 5% was used to complete the investment analysis; 'sensitivity analysis should also be applied to the level of the discount rate, to accommodate uncertainty concerning the opportunity cost of capital over the project period' (Department of Finance 1991).

Therefore, a limitation of the investment analysis arises because the true risks of the management changes are not known, and a primary producer considering implementing an environmental market scheme project would need to think through their complete risk profile prior to making an investment decision. Furthermore, the investment analysis assumes that the project proponent has the required capital to invest, which may not be the case for all landholders. It is important that prospective project proponents conduct their own investment analysis on an individual basis to account for their unique circumstances. The investment analysis contained in this report was completed by making assumptions that may not be applicable to all landholders.

4.1.2 Representative Fitzroy farm

Bowen and Chudleigh (2018) constructed a representative farm model located in the Fitzroy region based on data from that region for the purpose of conducting their analysis of economic implications of various management decisions relating to drought resilience, including planting leucaena. The Fitzroy region in Queensland accounts for 25% of Queensland's cattle numbers and encompasses 12.2 million ha of grazing land (Bowen and Chudleigh 2018).

The Fitzroy Base Model

Using the Breedcow and Dynama herd budgeting software, Bowen and Chudleigh (2018) constructed a 30-year analysis of a representative case-study beef cattle enterprise. Characteristics of the property and herd were based on research and recent industry surveys (Bowen and Chudleigh 2018), and the key assumptions include:

- 8,700 ha (21,498 acres) property located near Rolleston consisting of both native and sown grass pastures, with a carrying capacity of 1,500 adult equivalents (AE)[54];
- The property had a mixture of land types including higher-quality Brigalow softwood scrub cleared of timber and developed to sown pasture (mostly buffel grass), and poorer quality country, such as open eucalypt woodlands;
- The baseline strategy of the beef cattle enterprise was maintaining a self-replacing breeding herd and growing weaner steers to be sold to the feed-on (feedlot entry) market. Details of the herd structure and strategy were:
    - Heifers were retained to maintain the breeder herd. Surplus heifers aged 2 to 3 years were sold to abattoirs. Replacement heifers were kept separately from the breeder herd until they were joined at 2 years of age, and whilst separated, were grazed on buffel pastures;
    - Breeding cows were culled on reproductive performance and age. Cull cows were sold to abattoirs. The breeding herd was grazed on less productive, non-arable land types, such as the open eucalypt woodlands;
    - *Bos indicus* crossbred steers were grazed on 1,031 ha buffel pasture from weaning (200kg in May) until 27 months old and 495kg liveweight in the paddock, when they could be sold to the feed-on (feedlot) entry market (the feedlot entry market was identified as the most profitable market target by Bowen and Chudleigh (2018));
    - Herd bulls were retained for 5 years; and
    - Average weaning rate was 77.6% for all cows mated.

The Fitzroy Model with Leucaena planting

Bowen and Chudleigh (2018) demonstrated that 'optimising steer growth path performance with investment in leucaena-grass pastures, planted in strips into existing buffel grass pastures, substantially improved the profit of the beef business [...] when the breeder herd was phosphorus adequate'. Leucaena is a highly palatable perennial leguminous shrub that increases live weight gain (Conrad et al. 2017). Bowen and Chudleigh (2018) looked at a strategy of establishing a leucaena-grass pasture for steers to graze and reach their feed-on target paddock weight of 495 kg.

Bowen and Chudleigh (2018) made several assumptions to conduct their analysis of the impact of establishing leucaena-grass pastures to optimise steer growth, which they compared to the base case (detailed above). The key assumptions include:

- The breeder herd was assumed to run on the properties' poorer country, predominantly open eucalypt woodlands. The strategy was to grow the steer herd on the leucaena-grass pasture. With the improved dry matter production and higher digestibility of the leucaena-grass pasture, less pasture area was required to grow the steer herd. Prior to planting, 1,031 ha of buffel pasture was required to grow 239 head of steers to feed-on weight (495kg at 27 months old). In comparison, only 340 ha of leucaena-buffel pasture was required to grow 239 head of steers to feed-on weight, which reached 501kg by 21 months old. This enabled an additional 690 ha of land to be grazed by the breeder herd. As the breeder herd increased, the number of steers weaned increased, and

[54] Adult equivalent (AE) is 'defined in terms of the forage intake of a 2.25 year old, 450 kg *Bos taurus* steer at maintenance, consuming a diet of the specified DMD and walking 7 km/day' (Bowen and Chudleigh 2018).

accordingly, the amount of leucaena-grass pasture required increased. To strike a balance between the expanding breeder herd and the leucaena-grass paddock size for the steers, the authors elected a paddock size of 433 ha;

- A 433 ha fenced and watered buffel grass paddock already existed and was capable of being planted to leucaena. 5 m wide strips across the paddock on 10 m centres were cultivated, and the leucaena seed was planted in double rows in the centre of the 5 m strips. No buffel grass seed was sown on the basis it was assumed that seed would spread from existing buffel grass;
- There were adequate levels of soil phosphorus, and no additional phosphorus was required to maintain the leucaena's productivity;
- The leucaena was mechanically cut every 10 years from planting at a cost of $81.50/ha on each occasion;
- The timeline of the leucaena-grass pasture development is outlined in Table 23 below. By year 4, the leucaena-grass pasture was fully established and grazed by the steers from weaning until they reached the feed-on target weight (they were assumed to gain half of the anticipated year 5 weight gain). By year 5, the steers grew 40% faster annually compared to steers grazing only buffel pasture.

Table 23: Leucaena development process for buffel grass in the Fitzroy

Year 1	Year 2	Year 3	Year 4	Year 5
9 months fallow; plant after Christmas	Year of sowing; no grazing	Spell until end of the wet season then graze at 50% of stocking rate for fully established pasture	100% stocking rate; half extra weight gain per head anticipated from Year 5	Full stocking rate; full weight gain

Source: Adapted from Bowen and Chudleigh (2018)

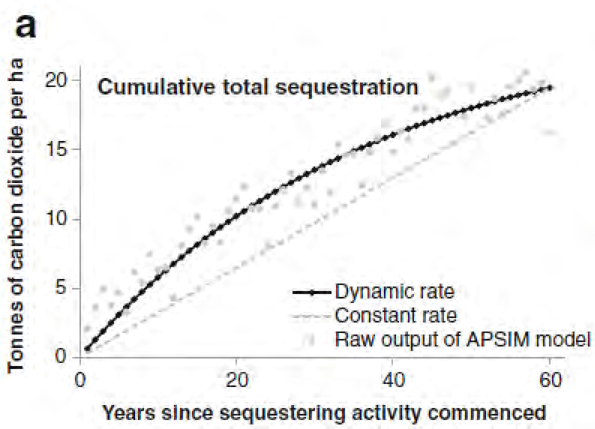
- From year 5 onwards, the steers gain the full amount of extra weight and are sold at 21 months of age weighing 502kg (compared to 27 months old and 495kg in the base case).

Adopting a 5% discount rate, Bowen and Chudleigh (2018) identified that the annualised net present value (NPV) (increase in annual profit) from planting leucaena was $40,336, and the NPV (total profit) over the 30-year period was $620,063. The peak deficit was -$145,772, which occurred in year 4 and the payback period was 7 years.

4.1.3 Constant sequestration rate assumption

For the investment analysis of projects using the soil organic carbon measurement method and environmental plantings method, it was assumed that the carbon sequestration rate was constant, rather than dynamic. However, carbon sequestration rates in both soil and vegetation are typically higher early on during a project after the sequestration activity has been undertaken and declines over time as the environment approaches a new steady state (Thamo et al. 2017). 'Consequently, the dynamic rate of sequestration in any particular year can differ appreciably from the constant (average) rate over the full term, particularly at the beginning and end of the sequestration period' (Thamo et al. 2017). Figure 17 below was taken from Thamo et al. (2017) and illustrates the difference between the dynamic and constant sequestration rates, where (a) illustrates the total accumulation of sequestered carbon and (b) shows the annual rate of sequestration. The dynamic rate of sequestration is initially faster but then falls below the constant or average rate.

Figure 17: (a) Total accumulation of sequestered carbon; (b) annual rate of sequestration



Source: Adapted from Thamo et al. (2017)

Bowen and Chudleigh (2021) analysed the conversion of a proportion of a beef or goat property located in the Mulga Lands to carbon farming and noted:

> 'The economic value of carbon sequestration can be impacted by whether a dynamic or long-term constant rate of sequestration is applied in the analysis [...]. Although the total carbon sequestered is the same at the end of the period, the discounting procedures applied in the economic analyses will change the value of the carbon sequestered depending upon whether dynamic or constant sequestration is assumed.'

Bowen and Chudleigh (2021) used a constant carbon sequestration rate of 1.2 t CO_2e/ha/yr for 25 years on the basis that modelling a dynamic sequestration rate was not possible due to the lack of data (Bowen and Chudleigh 2021). Similarly, in this study, a constant rate has been adopted due to the lack of data available to model a dynamic rate for soil organic carbon sequestration. This is, however, a limitation of the results contained in the cost-benefit analysis.

FullCAM can be used to model dynamic sequestration rates in vegetation growth, and use of FullCAM to estimate sequestration generated by a project adopting the environmental plantings method would strengthen the analysis. In this report, FullCAM was not utilised which is a limitation of the results.

4.2 Soil organic carbon measurement method

This section contains a literature review of soil organic carbon sequestration and an investment analysis of a project using the ACCU scheme soil organic carbon measurement method.

4.2.1 Literature review

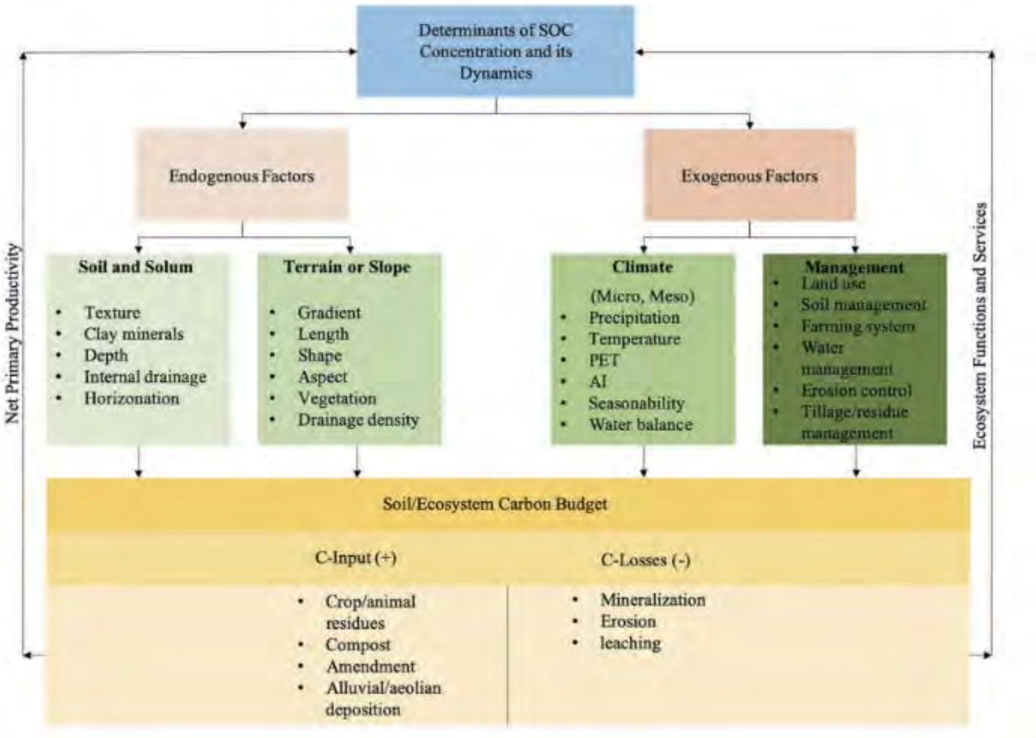
Agriculture (including grazing native vegetation, grazing modified pastures and cropping, excluding timber production) accounts for 55% of land use in Australia (ABARES 2025b). The top metre of soil holds the largest reserve of terrestrial organic carbon globally at approximately three times more than the carbon stored in vegetation and twice that in the atmosphere (McDonald et al. 2023; Jing et al. 2025). Over the past two centuries, there has been a significant loss of soil organic carbon (SOC) stocks caused by land use changes in cultivated soils and intensified anthropogenic land management practices (Jing et al. 2025; Viscarra Rossel et al. 2014).

There is an opportunity to sequester SOC in agricultural soils by changing land use or land management strategies (Godde et al. 2016; Viscarra Rossel et al. 2014). There are two important characteristics of SOC sequestration:

> 'First, when a sequestering practice is adopted, carbon storage typically increases, but at a diminishing rate through time until it plateaus at a new steady-state equilibrium. Consequently, only a limited amount of sequestration is possible on any piece of land. Furthermore, this limited opportunity can only be exploited once; if the same management practice is delayed and implemented at a later date, it will ultimately sequester the same amount of carbon. Second, sequestration is reversible. To retain stored carbon the sequestering (or an equivalent) practice must be continued; reverting to the previous practice re-emits [all or part of] the carbon' (Thamo et al. 2020).

Quantifying SOC stocks is complex as there are many factors that influence SOC sequestration, which are illustrated in Figure 18 below, and discussed in this section.

Figure 18: Factors affecting the soil organic carbon (SOC) concentration and its dynamics



Source: Adapted from Lal (2020) (PET = potential evapotranspiration, AI = aridity index or precipitation)

Co-benefits of increased soil carbon

Increasing SOC has co-benefits including increased water-holding capacity and fertility, improved soil structure and nutrient retention and reduced soil erosion, which may boost agricultural yields (Pudasaini et al. 2024; Dynarski et al. 2020; Godde et al. 2016; Bray et al. 2016). These co-benefits are of particular importance for Australian soils, which are ancient and have intrinsically low levels of organic matter in their surface layers (Godde et al. 2016). For example, the amount of SOC stored in the top 0-0.3m layer of soil is about 29.7 t/ha in Australia, half that found in France (59.9 t/ha) and approximately two thirds of the amount found in Brazil (about 44 t/ha) (Godde et al. 2016).

Recently, an increasing number of farmers have adopted soil carbon sequestration practices to promote long-term soil health, and research has demonstrated that co-benefits to soil health is an important motivating factor for farmers to engage in SOC sequestration projects (Pudasaini et al. 2024; Dynarski et al. 2020).

How to increase soil organic carbon

Organic carbon makes up around 58% of soil organic matter, which consists of root exudates, plant residues, and microbial and larger soil fauna biomass (Henry 2023). Plants' leaves absorb atmospheric carbon dioxide (CO2) in photosynthesis and convert it into organic molecules that support plant growth and function, while also supplying energy to soil microbes and larger soil organisms (Henry 2023). Although most of the carbon cycles back into the atmosphere as CO2 through the processes of respiration and decomposition, a small portion (10% or less) can remain stored or 'sequestered' in the soil for over a century, representing a net removal of CO2, a major greenhouse gas, from the atmosphere (Henry 2023).

There are essentially two mechanisms of increasing SOC levels, including increasing the inputs of carbon-containing biomass into the soil, and reducing the decomposition of soil organic matter and the rate of loss of SOC back to the atmosphere (Thamos et al. 2020; Henry 2023; Rabbi et al. 2015). These processes are linked and not independent. Factors determinant of the amount of SOC stored within an ecosystem include the quality and quantity of organic matter returned to the soil and the soils ability to retain it (a function of texture and cation exchange capacity), and biotic influences of both precipitation and temperature (Grace et al. 2006).

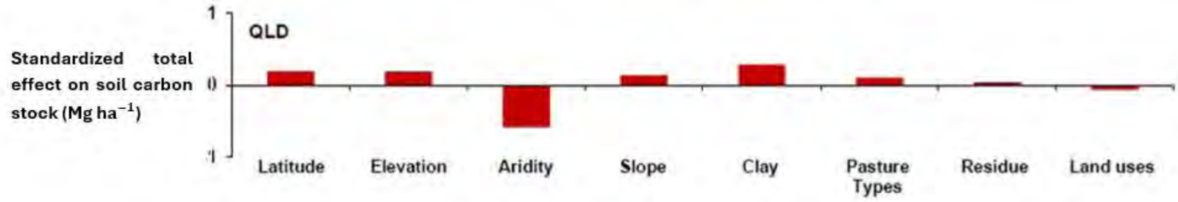
Increasing carbon inputs into soil can support efficient microbial metabolism (Dynarski et al. 2020). The maximum amount of carbon that can enter the soil is dependent on the net primary productivity (NPP) of plants, which is limited by factors such as solar radiation, climate conditions, and the availability of soil water and nutrients (Rabbi et al. 2015). Increased carbon inputs into the soil can occur by increasing plant biomass inputs to the soil (living plants or their organic residues), which increases resources available to soil microbes, by adding partially decomposed organic amendments such as compost and manure to the soil, and by maintaining nutrient availability via the decomposition of carbon inputs releasing nutrients or by applying supplementary fertiliser (Dynarski et al. 2020).

Reducing disturbances to the soil can avoid disruptions to biological and physicochemical interactions (Dynarski et al. 2020). The decomposition of organic matter in soil is influenced by climate, the soil's physical, chemical, and biological properties, and the organic material's properties (Rabbi et al. 2015). The rate of loss of carbon from the soil can be minimised by avoiding repeated soil disturbances, such as frequent tillage and erosion (Dynarski et al. 2020) which can encourage microbial breakdown and organic matter oxidation. There is less disruption to soil aggregates and reduced loss of carbon from infrequent and/or less destructive tillage practices (Dynarski et al. 2020).

What affects soil carbon sequestration

Soil carbon sequestration can be affected by various factors, including changes in rainfall patterns, temperature, different soil types, and management practices through their effects on the inputs of carbon from roots and plant litter (Mitchell et al. 2024; Meyer et al. 2018). A soil's capacity to store carbon in stable forms is finite and the rate of increase typically slows towards a steady state (Dynarski et al. 2020). The primary determinants of SOC stocks are aridity (or conversely, moisture availability) and soil properties (Rabbi et al. 2015; Henry 2023). Similarly, Hobley and Wilson (2016) noted that rainfall is the primary driver of surface SOC, which they attributed to the 'influence of water availability on plant growth'. Rabbi et al. (2015) found that aridity had the largest impact on SOC stocks, followed by clay content, latitude and elevation, whereas the impacts of land management were small, as is depicted in Figure 19 below which illustrates the standardized total effect (direct plus indirect) of aridity, clay percentage, latitude, topographic (i.e. slope and elevation) and land uses and soil management (i.e. pasture types and residue management) variables on carbon stock of 0–30 cm soil for Queensland.

Figure 19: Variables impacting carbon stock of 0–30 cm soil for Queensland



Source: Adapted from Rabbi et al. (2015)

Australia, particularly in the tropical north, has the highest rainfall variability globally (McDonald et al. 2023). The primary driver of variability in Australia's carbon cycle is rainfall variability (Mitchell et al. 2024). Seasonal, annual and decadal rainfall variability impacts plant productivity and composition, carbon inputs, and carbon losses from microbial activity (Mitchell et al. 2024). Higher annual rainfall generally results in increased levels of SOC due to increased plant productivity (Mitchell et al. 2024; Meyer et al. 2018).

Depending on the impact on plant productivity, changes in temperature can result in increased or decreased SOC stocks; for example, 'in some locations [higher] temperature [and available soil moisture] will increase pasture productivity, [thereby] increasing SOC inputs' (Meyer et al. 2018), but higher temperatures also stimulate higher rates of microbial decomposition of soil organic matter (Rabbi et al. 2015).

Different soil types have different potential for carbon storage, and the most suitable soils are those which have capacity to sequester large amounts of carbon and are currently depleted of soil organic matter (Dynarski et al. 2020). The soil's capacity to store carbon in stable forms is finite and the rate of increase typically slows towards a steady state (Dynarski et al. 2020). Soils with high clay content have greater capacity to store SOC because 'clay-organic matter complexes are protected from microbial decomposition' (Rabbi et al. 2015). Mitchell et al. (2024) explained:

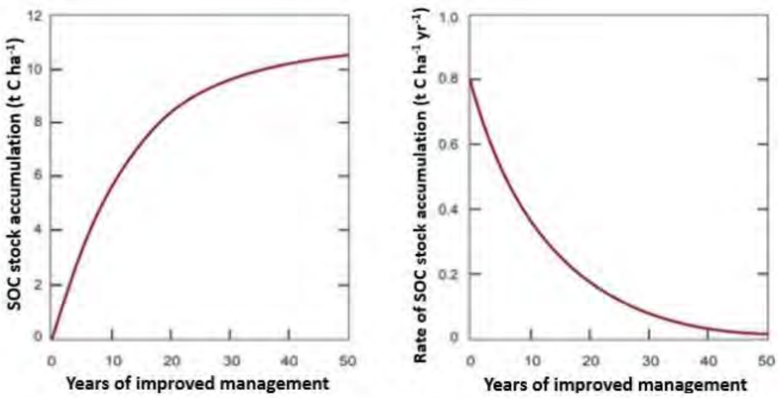
> 'The capacity of soil to retain additional carbon inputs will largely depend on the ability of the soil to "protect" added organic material, which in turn depends on clay content and mineralogy, soil structure (micro and macro aggregation), location within the soil profile, chemical nature and composition of organic matter inputs, the occupancy of mineral surfaces by pre-existing carbon compounds, i.e. the degree of SOC saturation, and the pedoclimatic conditions and management practices at the particular site'.

Hobley and Wilson (2016) observed that clay content was positively associated, whereas sand and silica content was negatively associated, with subsurface SOC retention. Additionally, bulk density is negatively correlated with SOC stocks. 'If enhancing SOC concentration is a goal, it is advisable to limit soil compaction' (Hobley and Wilson 2016).

Rate of soil organic carbon sequestration over time

Soil organic carbon stocks reach an equilibrium level determined by location-specific climate and soil characteristics and management practice or factors that influence disturbance, turnover and aeration (Henry 2023). When a positive change is implemented (for example, a land management change), initially, SOC levels will respond rapidly due to the ready turnover of labile particulate organic carbon, however, the response slows as balance emerges of soil organic matter inputs and losses under the new management and a new equilibrium level is reached (Henry 2023). The rate of SOC accumulation is generally highest on average during the first 5 to 10 years, and then slowing and approaching zero over time, typically leveling off after 20 to 40 years (it can be longer) (Henry 2023). This trend is illustrated in Figure 20 below which shows the pattern of increase in SOC stocks (left-hand graph) and soil carbon sequestration (right-hand graph) following implementation of improved management in a landscape with baseline SOC well-below natural steady state.

Figure 20: Pattern of increase in SOC stocks (LH graph) and soil carbon sequestration (RH graph)



Source: Adapted from Henry (2023)

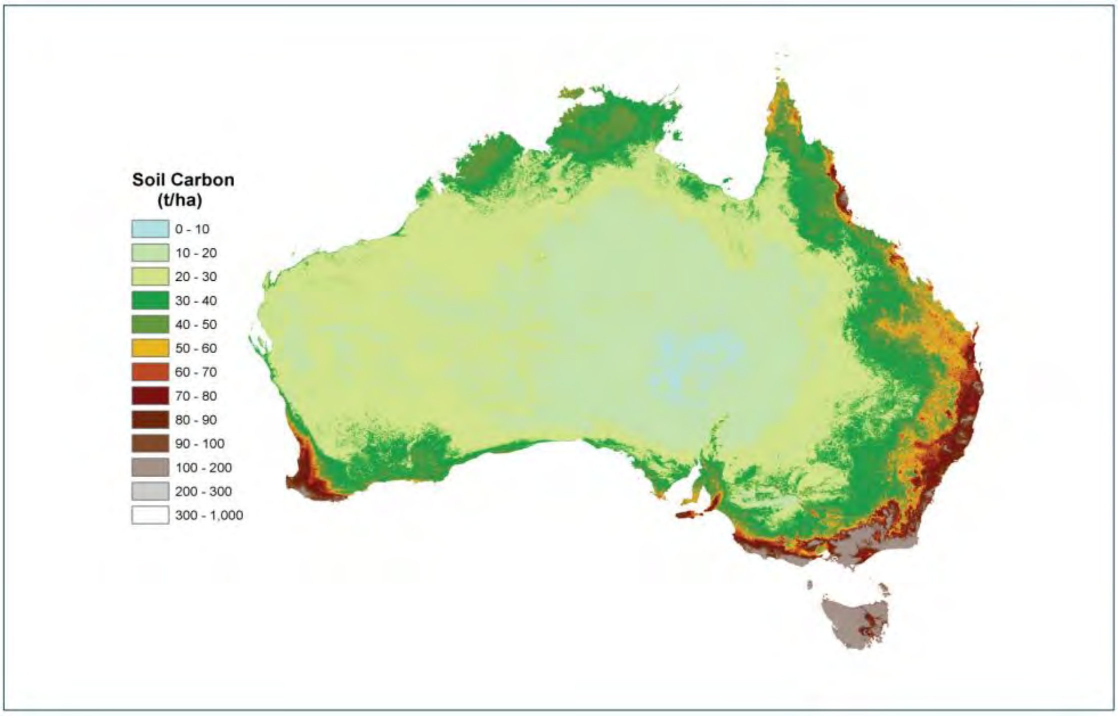
Soil organic carbon stocks vary with depths

The is larger amounts of SOC stocks in the top layer of soil (0–10cm) compared to greater soil depths, ‘potentially attributed to greater organic matter input (e.g., plant litter, straw, manure) and favourable environmental conditions (e.g., warm soil temperature and high humidity) due to the direct interactions between soil surface and atmosphere’ (Jing et al. 2025). Soil organic carbon stored deeper in the soil (30–100cm depth) has an average turnover time four times slower than newly accumulated carbon in topsoil (0–30cm depth) (Balesdent et al. 2017; Dynarski et al. 2020). Soil organic carbon is more stable at greater soil depths because in most soils, as the depth from the surface increases, microbial activity decreases (Dynarski et al. 2020, Hobley and Wilson 2016).

Soil organic carbon stocks across Australia

The stock of SOC across Australia was estimated by Viscarra-Rossel et al. (2014), which they achieved ‘through the assembly and harmonisation of data from Australia’s National Soil Carbon Research Program (SCaRP), the National Geochemical Survey of Australia (NGSA) and the Australian Soil Resource Information System (ASRIS) to produce the most comprehensive set of data on the current stock of organic carbon in soil of the continent’ (DCCEEW 2024c). Viscarra-Rossel et al. (2014) estimated the average SOC stocks in Australian topsoil layer 0–30cm as 29.7 t/ha. Figure 21 below is a map of the baseline SOC stocks in Australia at soil depth of 30cm.

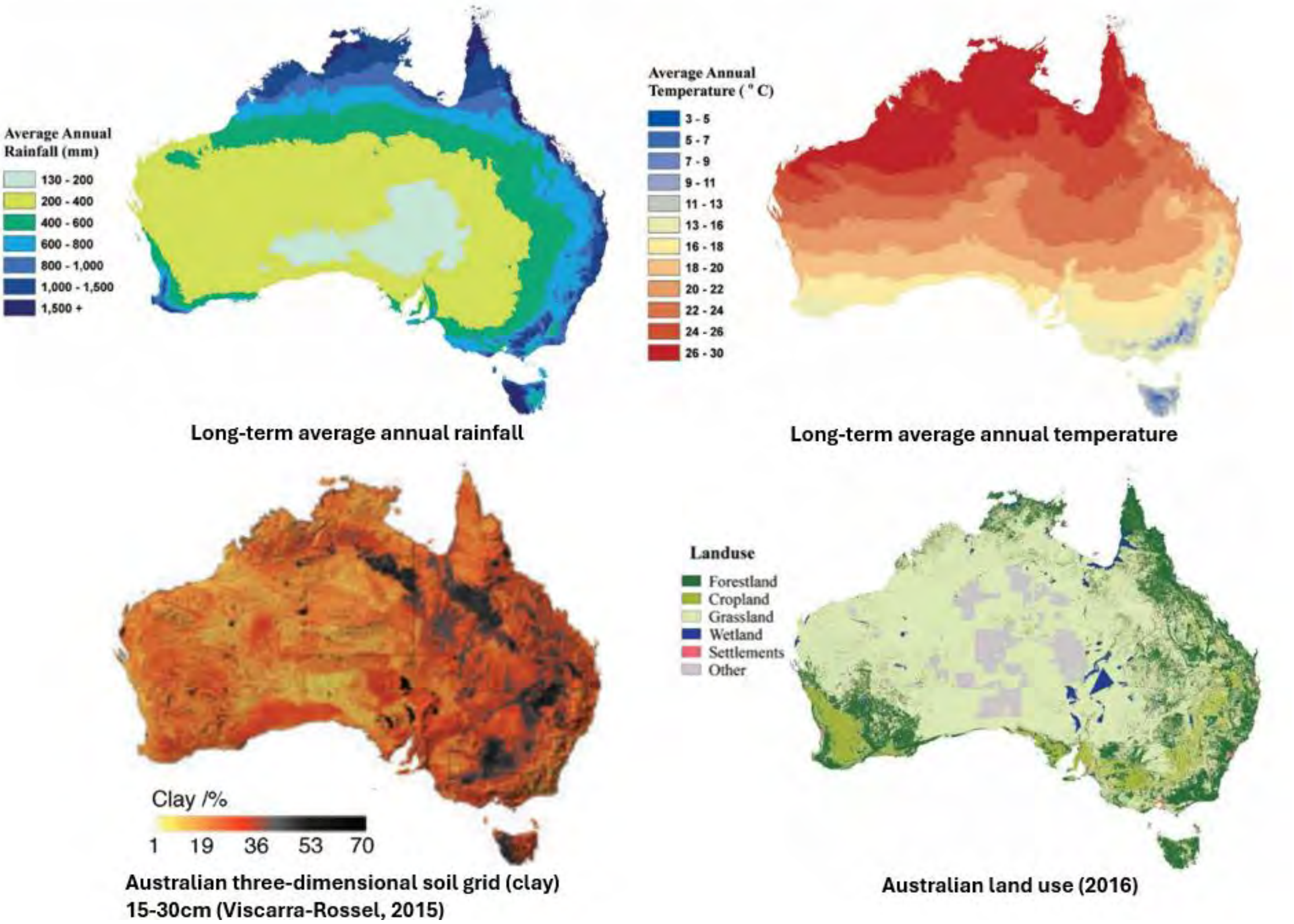
Figure 21: Baseline map of organic carbon in Australian soil (30cm depth)



Source: Adapted from DCCEEW (2024c); Henry (2023).

Henry (2023) noted that the key drivers of the SOC stocks in Australia are long-term average annual rainfall and temperature, soil type and land use. These factors are illustrated in Figure 22 below, and visually, a similar trend can be identified between the areas of Australia with higher levels of SOC, and the areas of Australia that receive more rainfall, experience lower temperatures, have a higher clay content, and crop and forest land uses.

Figure 22: Key drivers of differences in soil organic carbon stocks



Source: Partially adapted from Henry (2023)

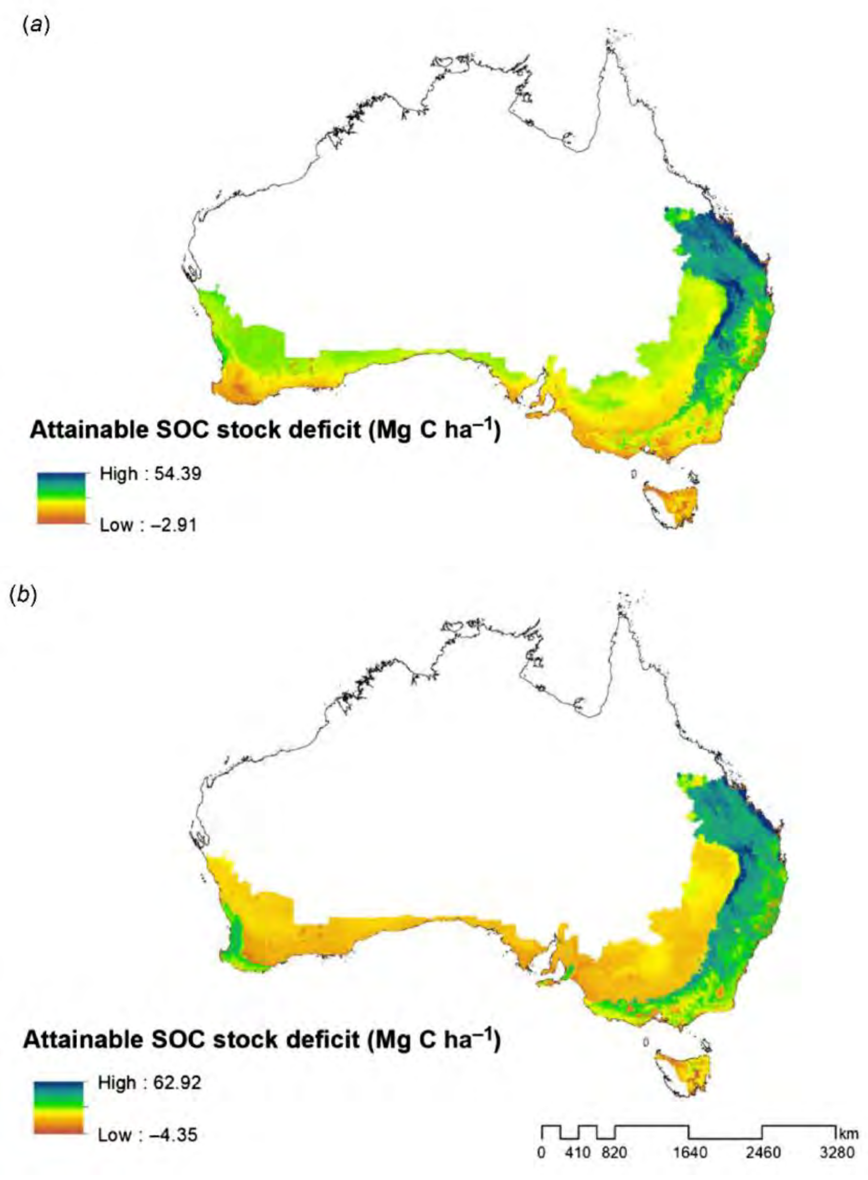
Australia has been historically cleared of native vegetation and developed for agricultural purposes, which typically resulted in a loss of soil organic carbon stocks in the order of 20% to 60% from pre-clearing levels (Fitch et al. 2022). In Australia, two primary factors have resulted in many soils having lower SOC stocks compared to pre-clearing and pre-agricultural development, including: (1) change in resistance to decomposition of organic matter inputs (both in terms of less sclerophyllous material with less lignin and hemicellulose, and also the increase N:C ratio of legume rich pasture); and (2) increased disturbance due to activities such as tilling.

Karunaratne et al. (2024) sought to answer the following question faced by landholders: 'what is the quantity of SOC that can be added to soils and retained for the long-term through improved land management practices for a given land parcel/location?'. In their study, Karunaratne et al. (2024) focussed on estimating the quantity of actual soil organic carbon stocks (the existing stock of soil organic carbon under current management practices) and the attainable level of soil organic carbon stocks (meaning the stock of soil organic carbon 'that would be achieved for a soil if the input of organic carbon is constrained to that associated with maximum plant productivity that can be achieved on that soil'). Where there is a discrepancy between the actual and attainable level of soil organic carbon stocks (actual is less than attainable), then there is an opportunity for sequestering additional atmospheric carbon within the soil (Karunaratne et al.

2024). (Note: this study did not focus on the ***potential*** level of soil organic carbon, defined as the 'maximum plausible stock of carbon that can be stored within the soil when carbon inputs remain unconstrained' (Karunaratne et al. 2024)).

Karunaratne et al. (2024) identified the areas in major agricultural production regions across Australia that have soil organic carbon deficits (actual soil organic carbon stocks are less than attainable soil organic stocks) for both 0-10cm and 10-30cm which are illustrated in Figure 23 below. Values are in Mg C/ha. Positive values indicate that there is still capacity to increase stable forms of soil organic carbon, whereas negative values mean attainable stable forms of soil organic carbon have been reached. The estimates refer to the *stable* forms of soil organic carbon (half-life >10 years) rather total soil organic carbon.

Figure 23: Distribution of SOC attainable deficit stocks: (a) 0–10cm; and (b) 10–30cm



Source: Adapted from Karunaratne et al. (2024)

Risk of loss of soil carbon sequestration and relinquishment of ACCUs

Soil carbon sequestration projects are subject to several risks, including climate change, drought and fire, and scientific uncertainty on the long-term SOC dynamics. Of all the vegetation methods and agriculture methods available under the ACCU scheme, soil carbon sequestration was assessed as having the highest risk from climate change impacts by CSIRO in its 2020 review[55] (Henry 2023). 'The dominant threats identified were associated with decreased rates of organic matter input to soil, and increased rates of loss through changes to soil respiration and the microbial biota at higher temperatures' (Henry 2023). Furthermore, a fire or drought can cause a reversal of soil carbon sequestration. Additionally, there is scientific uncertainty surrounding the long-term SOC dynamics due to 'the scarcity of long-term, repeated SOC sampling across different soil types, depths (>30cm), climates, and management scenarios, [which] results in low confidence, both in Australia and globally, in predicting the climate [change mitigation] benefits of SOC sequestration and determining the most effective methods for achieving it' (Mitchell et al. 2024). Additional biophysical risks include: SOC stocks may be saturated and therefore has limited additional storage capacity; the priming effect (increased carbon inputs into the soil stimulates an increase in soil microbial activity which accelerates decomposition of existing SOC stocks); and the impact of nitrogen levels and other macro nutrient constraints on soil carbon sequestration rates. Further research is needed to understand the variations in SOC stocks. For example, the study by Badgery et al. (2020) spanned four agricultural land management treatments in low rainfall cropping environments located in central-west New South Wales and observed that total SOC stocks increased for the first 12 years. However, in year 15, unexpected losses of SOC were observed and the SOC gains were reversed to the starting level. Badgery et al. noted that the result 'show a dramatic loss of total organic carbon between 2012 and 2015 across all farming systems and this may have been due to the enhanced mineralization of SOC, particularly particulate organic carbon, in the cropping systems. While mean monthly maximum temperature was 5% above average and mean monthly rainfall was 16% below (but not the lowest period) the long-term mean during this period this did not appear to be a strong influence' (Badgery et al. 2020). Biophysical factors that result in reversal of soil carbon sequestration can prevent a project from meeting its 'permanency' requirement, thereby compromising the number of credits able to be earned (Henry 2023). Furthermore, if SOC sequestration is reversed during the project, project proponents may be required to relinquish credits.

Strategies and rates of soil organic carbon sequestration

Under the ACCU scheme rules for estimating SOC sequestration using the measurement and models method, several different project activities can be undertaken such as planting legumes, converting to reduced or no tillage practices or promoting vegetation growth by altering the stocking rate, duration or intensity of grazing (see full list below[56]). The rate of SOC sequestration varies significantly between strategies, and it is posited by a large body of

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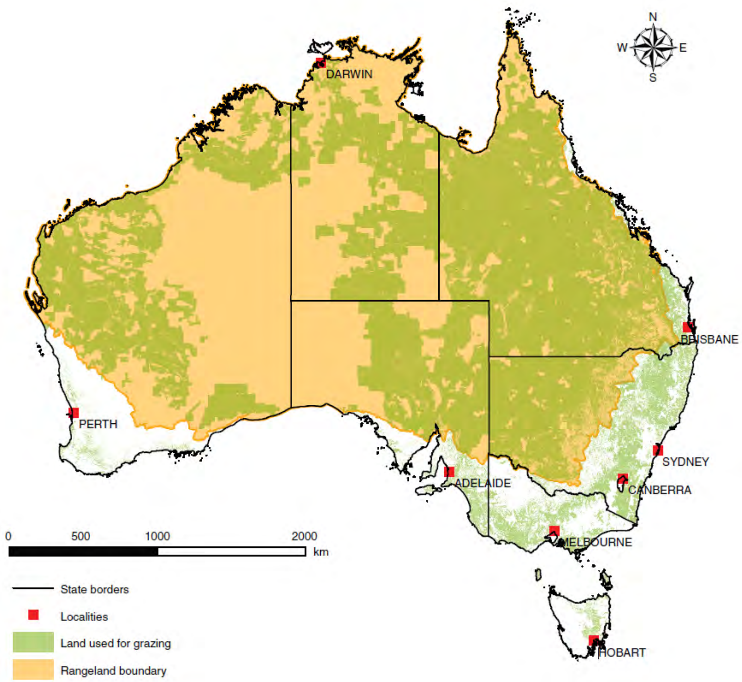
[55] Fitch P, Battaglia M, Lenton A, Feron P, Gao L, Mei Y, Hortle A, Macdonald L, Pearce M, Occhipinti S, Roxburgh S, and Steven A (November 2022) *Australia's carbon sequestration potential,* CSIRO, accessed on 10 January 2025.

[56] ***Land management activities*** include applying nutrients to the land in the form of a synthetic or non-synthetic fertiliser to address a material deficiency (e.g. compost or manure); applying lime or other ameliorants to remediate acid soils; applying gypsum to manage sodic or magnesic soils; undertaking new irrigation; re-establishing or rejuvenating a pasture by seeding or pasture cropping; establishing, and permanently maintaining, a pasture where there was previously no or limited pasture, such as on cropland or bare fallow; altering the stocking rate, duration or intensity of grazing (or any combination of such activities) to promote soil vegetation cover or improve soil health, or both; retaining stubble after a crop is harvested; converting from intensive tillage practices to reduced or no tillage practices; modifying landscape or landform features to remediate land (e.g. practices implemented for erosion control, surface water management, drainage/flood control, or alleviating soil compaction. Practices may include controlled traffic farming, deep ripping, water ponding or other means); using mechanical means to add or redistribute soil through the soil profile (e.g. clay delving, clay spreading or inversion tillage); using legume species in cropping or pasture systems; and using a cover crop to promote soil vegetation cover or improve soil health, or both (s7, *Methodology Determination 2021).*

literature that most of the variation in soil carbon stocks is caused by climatic factors like vapour pressure deficit and rainfall and soil type rather than land use and management effects (Rabbi et al. 2015). Climate mechanisms may also limit any positive effects from land use on SOC sequestration (Rabbi et al. 2015). Furthermore, there is a lack of empirical large-scale studies analysing the relative importance of climate, soil properties and land management on SOC storage (Rabbi et al. 2015). Nevertheless, current research suggests that under the right conditions (suitable combination of climate, soil and land management practices), SOC sequestration is achievable (Mitchell et al. 2024). If soil carbon stores are initially low, there is an increased likelihood of carbon accumulation when a management change is implemented (White et al. 2021). This section examines the research into the rates of SOC sequestration generated by different land management strategies. The results vary between the different research studies, which have been conducted over varying time periods and across different parts of Australia.

Henry et al. (2024) conducted a review of published field trials and modelling studies of soil carbon sequestration in Australian rangeland soils managed for livestock grazing. 'Rangelands are commonly described as lands that are grazed, or have the potential to be grazed, by livestock and wildlife, with vegetation dominated by grasses, grass-like plants, forbs or shrubs, although they may also contain trees as in grazed woodlands and savannas' (Henry et al. 2024). The 'rangeland' land types assessed by Henry et al. (2024) are depicted in Figure 24 below which illustrates that rangelands span over 75% of Australia's land area (769 Mha) and that 283 Mha is grazed by domesticated livestock.

Figure 24: Rangelands span 769 Mha and domesticated livestock grazing occupies 283 Mha



Source: Adapted from Henry et al. (2024)

Henry et al. (2024) reviewed 23 publications identified as providing reliable data on how management strategies impact SOC sequestration in Australian rangelands. Significant variation of the quality of data and details of the management intervention was found between studies which hindered comparisons and efforts to link soil carbon sequestration to management strategies (Henry et al. 2024). Henry et al. (2024) concluded, 'analysis results have high uncertainty due to the small number of long-term studies, non-standard methods for quantifying soil carbon sequestration, and inconsistencies in the implementation of grazing management strategies'.

Henry et al. (2024) examined studies involving various management strategies relevant to the ACCU scheme soil carbon sequestration method, including grazing management strategies (rotational grazing versus continuous grazing, and varying grazing intensity); pasture management strategies (sowing more productive grasses into grass pastures, sowing legumes into grass pastures, and waterponding in scald areas); and land conversion strategies (conversion from cropland to permanent pastures, conversion from forest cover to grassland, and conversion from grass land to forest cover). The results from Henry et al.'s review (2024) are contained in Table 24 below. Publications without shading have SOC sequestration data consistent with data quality criteria based on internationally accepted accounting for SOC sequestration and ACCU scheme method requirements. Publications shaded grey 'have credible observations of the response of SOC stocks to new rangeland management strategies, but do not satisfy one or more requirements for soil carbon sequestration quantification' (Henry et al. 2024).

Table 24: Summary of studies with reliable data on SOC changes following implementation of new management strategy in Australian rangelands

Study reference	Study region	Av. Ann. rainfall (mm)	Management change	Monitoring period (years)	Sampling depth (cm)	SCS (t C/ha/yr)	SCS converted to t CO_2e/ha/yr
Grazing management strategies							
Grazing intensity							
Bray et al. (2014)	Charters Towers region, QLD	640	Moderate vs high	16	0–30	0.087	0.32
Pringle et al. (2014)	Julia Creek region, QLD	429	Low vs mod/high	26	0–30	0.004–0.035 (n.s.)	0.015 – 0.13
Clewett (2015)	Condamine, QLD	668	Low vs mod/high	18	0–30	0.03–0.13	0.12 – 0.48
Clewett (2015)	Condamine, QLD	668	Low vs mod/high	10	0–30	0.5–0.9	1.83 – 3.30
Young et al. (2016)	Walcha region, NSW	900–1200	Low vs high	>20	0–50	0.1 (n.s.)	0.37
Rotational vs continuous grazing							
Allen et al. (2013)	QLD rangelands	256–1138	Rotation/cell vs continuous	~10	0–30	0 (n.s.)	0
Schatz et al. (2020)	Northern NT	1209	Intensive rotation vs continuous	5	0–30	−0.03 (n.s.)	−0.11
Sanderman et al. (2015)	Upper, mid-north SA	310–570	Rotation vs continuous	7+	0–30	−0.07	−0.26
Orgill et al. (2017)	Brewarrina, NSW	292	Rotation vs continuous	8+	0–30	−0.11 to 0.01 (n.s.)	−0.40 to 0.04
Badgery et al. (2014)	Central West Slopes and Plains, NSW	300–650	Increasing intensity of rotational grazing	Various	0–30	NR	NR

Study reference	Study region	Av. Ann. rainfall (mm)	Management change	Monitoring period (years)	Sampling depth (cm)	SCS (t C/ha/yr)	SCS converted to t CO_2e/ha/yr
Chan et al. (2010)	Central & South NSW, North-East VIC	600–800	Rotational vs traditional	>10	0–30	−0.07 (n.s.)	−0.26
Cowie et al. (2013)	Northern Tablelands, NSW	792	Rotational vs continuous	>5	0–30	−1.36 (n.s.)	−4.99
Orgill et al. (2018)	South-east NSW (Berridale region)	582	Rotational vs tactical (set-stock)	4	0–40	−0.85 (n.s.)	−3.12
Orgill et al. (2014)	South-east NSW (Boorowa Region)	610	Rotational vs continuous	15	0–70	−0.28	−1.03
Pasture management strategies							
Sowing more productive grasses into grass pastures							
Chan et al. (2010)	Central-southern NSW	600–800	Introduced vs native pastures	≥10	0–30	0.02 (n.s.)	0.07
Clewett (2015)	Condamine, QLD	672	Sown vs native pastures	50	0–30	0.11	0.40
Chan et al. (2010)	Central- southern NSW	600–800	Perennial vs annual pasture	≥10	0–30	0.4 (n.s.)	1.47
Chan et al. (2011)	Wagga Wagga NSW	650	Perennial vs annual pasture	13	0–30	0 (n.s.)	0
Sowing legumes into grass pastures							

Study reference	Study region	Av. Ann. rainfall (mm)	Management change	Monitoring period (years)	Sampling depth (cm)	SCS (t C/ha/yr)	SCS converted to t CO_2e/ha/yr
Conrad et al. (2017)	Gayndah region, QLD	691	Leucaena-grass vs native pastures	40	0–30	0.28	1.03
Wochesländer et al. (2016)	South-west WA	498	Tagasaste vs native grass	22	0–30	0.72	2.64
Clewett (2015)	Condamine, QLD	672	Sown grass-legume vs native pastures	50	0–30	0.38	1.39
Harrison et al. (2015)	Tropical rangelands, QLD	600–800	Leucaena-grass vs grass pastures	~10	0–30	0.27 ± 0.12	0.99 ± 0.44
Radrizzani et al. (2011)	Gayndah, QLD	691	Leucaena-grass vs native pastures	20–38	0–15	0.08–0.27	0.29 – 0.99
Radrizzani et al. (2011)	Banana, QLD	667	Leucaena-grass vs crop	14	0–15	0.76	2.79
Waterponding in scald areas							
Read et al. (2012)	Central-west catchment, NSW	400	Waterponding vs scalded	20–25	0–30	0.28	1.03
Land conversion strategies							
Conversion from cropland to permanent pastures							
Badgery et al. (2020)	Condobolin, NSW	424	Perennial pasture vs cropping	15	0–30	0.48	1.76
Jones et al. (2016)	South-west QLD	583	Cropping to grass pasture	20	0–30	0.18	0.66
Wilson et al. (2011)	North-west NSW	690–880	Cultivation to pasture	15–20	0–30	0.06–0.15	0.22 – 0.55

Study reference	Study region	Av. Ann. rainfall (mm)	Management change	Monitoring period (years)	Sampling depth (cm)	SCS (t C/ha/yr)	SCS converted to t CO_2e/ha/yr
Badgery *et al.* (2021)	Central-west NSW	~600	Reduced-till cropping vs pasture	5	0–30	0.92	3.37
Skjemstad *et al.* (1994)	Narayan, S QLD	716	Cropping to perennial pasture	11	0–15	0.21–0.44	0.77 – 1.61
Young et al. (2009)	Liverpool Plains, NSW	684	Zero-till cropping to perennial pasture	7	0–20	0.17	0.62
Conversion from grassland to forest cover							
Allen et al. (2016)	Brigalow Belt, QLD	NR	Pasture to brigalow regrowth	16–76	0–30	0 (n.s.)	0
Paul et al. (2002)	Australia	NR	Pasture to planted forest	25	0–30	0.07–0.40	0.26 – 1.47
Paul et al. (2002)	Australia	NR	Pasture to plantation trees	30	0–30	0.14	0.51
Guo *et al.* (2008)	Billy Billy, ACT	623	Native pasture to conifer plantation	16	0–100	-1.02	-3.74

Source: Adapted from Henry et al. (2024:24-27) (n.s. means ‘not significant’; NR means ‘not reported’; SCS means ‘soil carbon sequestration’)

Evidence of soil carbon sequestration as a result of grazing management strategies

Grazing management strategies can affect soil organic carbon in several ways including: '(1) herbivory removes plant biomass that could otherwise be incorporated in soil organic matter; (2) altering the allocation to below-ground (root) biomass; (3) changing plant growth rates and species composition; (4) trampling affects soil compaction and the rate of litter breakdown; (5) modifying carbon and nutrient cycling, including through adding dung and urine; and (6) exposing soil to accelerated respiratory loss and increased risk of erosion (particularly at prolonged high stocking rates)' (Henry et al. 2024). However, the impact of grazing management strategies on soil carbon sequestration are typically relatively minor and may be difficult to detect (Henry 2023).

Henry et al. (2024) identified research looking at the impact of altering grazing intensity on SOC stocks, which found varying results of soil carbon sequestration rates ranging from 0.004t C/ha/yr to 0.9t C/ha/yr (0.015t CO_2e/ha/yr to 3.3t CO_2e/ha/yr) (see Table 24 above). The review determined 'in contrast with conservative stocking, high grazing pressure in rangelands has been associated with a decline in SOC reflecting net soil organic matter loss resulting from lower inputs as a result of herbivory and higher rates of mineralisation and/or erosion due to higher disturbance and exposed soil surface' (Henry et al. 2024). Furthermore, Henry et al. (2024) reviewed the research conducted into the potential for soil carbon sequestration as a result of changing from continuous grazing to rotational grazing and concluded that 'of the four studies assessing the response of soil carbon sequestration to implementation of grazing rotation strategies [in Australia's rangelands], none showed a significant impact of managing the timing of grazing and rest periods on SOC stocks' (Henry et al. 2024). There are anecdotal reports of large positive impacts of rotational grazing on SOC sequestration, however, they are not substantiated by reliable evidence (Henry 2023). Henry et al. (2024) acknowledged, however, that there was high uncertainty around the potential for soil carbon sequestration with grazing management strategies 'because no studies had dynamic baseline monitoring across decadal time periods, and almost all studies reviewed lacked an initial SOC stock measurement before implementation of the new management practice'.

Furthermore, Henry (2023) posited that the rate of soil carbon sequestration caused by grazing management strategies is contested. 'As in global research, results from Australian studies comparing different grazing strategies have been inconsistent, variously finding a small decrease (Allen et al. 2013, Hawkins 2017), no or non-significant effect (Sanjari et al. 2008, Allen et al. 2013, Pringle et al. 2014, Pringle et al. 2016, Sanderman et al. 2015, Rabbi et al 2015, Raiesi and Riahi 2014) or an increase in soil C (Orgill et al. 2017, Waters et al. 2017)' (Henry 2023). Other research has found that soil carbon stocks are higher under more moderate stocking rates compared to overgrazing which typically results in lower soil carbon levels (Meyer et al. 2018).

Byrnes et al. (2018) analysed impacts of grazing strategies on SOC sequestration by reviewing 64 studies from around the world, including Australia. In contrast to the review by Henry et al. (2024), these studies were not confined to rangelands but included higher productivity grazing lands. Byrnes et al. (2018) found that SOC stocks increased under rotational grazing compared to continuous grazing, and reduced grazing intensity improved SOC stocks. Additionally, 'several international studies demonstrate relatively large long-term SOC gains in grazing systems, e.g. the adoption of the adaptive multi-paddock (AMP) grazing method[57] resulted in

[57] Adaptive multi-paddock grazing method is a rotational grazing method that uses 'short-duration rotational grazing at high stocking densities' (Mosier et al. 2021).

SOC gains of 0.6t C/ha/year (0-100cm) to 2.3t C/ha/year (0-100cm)' (Mitchell et al. 2024). Nevertheless, Mitchell et al. (2024) cautioned, 'the use of international studies to extrapolate expected SOC sequestration rates in Australia must be applied with caution, as it is likely that sequestering SOC under Australia's typically low soil fertility, high temperatures, and highly variable rainfall patterns is more challenging than in temperate climates'.

Ultimately, scientific uncertainty remains around long-term SOC dynamics, largely due to the limited availability of high-quality time-series data tracking paired control and treatment sites across diverse agricultural settings (Mitchell et al. 2024).

Despite current research suggesting grazing strategies will have little impact on soil carbon sequestration, out of the 575 projects Australia wide using the estimation of SOC sequestration using measurement and models method, 26 projects have reported improved SOC stocks, and have been awarded ACCUs (11 projects are in Queensland). Details of the 11 Queensland projects that have been awarded ACCUs are listed in Table 25 below. All 11 projects have only received one issuance of credits. Notably, the sole change in management activity to sequester soil carbon for 2 of the 11 projects (highlighted in grey) is to alter the stocking rate, duration or intensity of grazing, and these 2 projects account for the largest number of ACCUs awarded.

Table 25: ACCU scheme projects using the SOC sequestration measurement method that have been awarded ACCUs (data as of 24/11/2024)

Project Proponent	Project ID	Project activity to increase SOC	Date Project Registered	Region	Total ACCUs issued	Year issued	Project Area (ha)	Estimated rate of SCS (t C/ha/yr)	CO_2e conversion (t CO_2e /ha/yr)
Bonnie Doone Enterprises Pty Ltd ATF GA & CD Burnham Family Trust	ERF108333	Altering the stocking rate, duration or intensity of grazing.	25/01/2017	North Burnett	94,666	2023/24	5,275	1.01[58]	3.7
Paringa Pasture Pty Ltd ATF Lawrie Family Trust	ERF105067	Altering the stocking rate, duration or intensity of grazing.	12/01/2017	Rockhampton	85,262	2022/23	3,554	1.63	5.98
Corporate Carbon Solutions Pty Ltd & Archer Pastoral Pty Ltd ATF Archer Pastoral Trust	ERF102074	Altering the stocking rate, duration or intensity of grazing and re-establishing or rejuvenating a pasture by seeding.	9/10/2015	Goondiwindi	66,050	2022/23	3,844	0.83	3.04
Agriprove Solutions Co No.1 Pty Ltd	ERF169446	Re-establishing or rejuvenating a pasture by seeding or pasture cropping and altering the stocking rate, duration or intensity of grazing.	4/03/2022	Banana	5,623	2023/24	329	2.91	10.67
Agriprove Solutions Co No.1 Pty Ltd	ERF169436	Re-establishing or rejuvenating a pasture by seeding or pasture cropping and altering the stocking rate, duration or intensity of grazing.	4/03/2022	Banana	5,009	2024/25	195	3.50	12.83

[58] 1t SOC equivalent to 3.67t CO_2e (Anderson et al. 2022). Estimated SOC rate calculated by: $94{,}666\ t\ CO_2 \times 1.25\ (discount\ rate) \div 3.67 \div 5{,}275ha \div 6yrs = 0.81t\ C/ha/yr$.

Agriprove Solutions Co No.1 Pty Ltd	ERF169476	Re-establishing or rejuvenating a pasture by seeding or pasture cropping and altering the stocking rate, duration or intensity of grazing.	4/03/2022	Banana	3,706	2024/25	194	2.60	9.53
Agriprove Solutions Co No.1 Pty Ltd	ERF169439	Re-establishing or rejuvenating a pasture by seeding or pasture cropping and altering the stocking rate, duration or intensity of grazing.	4/03/2022	Banana	3,591	2023/24	256	2.38	8.73
Agriprove Solutions Ptd Ltd	ERF143770	Re-establishing or rejuvenating a pasture by seeding.	12/06/2020	Gladstone	3,559	2023/24	893	0.33	1.21
Agriprove Solutions Co No.1 Pty Ltd	ERF168644	Applying nutrients to the land in the form of a synthetic or non-synthetic fertiliser to address a material deficiency, re-establishing or rejuvenating a pasture by seeding, and altering the stocking rate, duration or intensity of grazing.	1/03/2022	Rockhampton	3,176	2024/25	503	1.07	3.92
Agriprove Solutions Co No.1 Pty Ltd	ERF168650	Applying nutrients to the land in the form of a synthetic or non-synthetic fertiliser to address a material deficiency, re-establishing or rejuvenating a pasture by seeding, and altering the stocking rate, duration or intensity of grazing.	1/03/2022	Rockhampton	2,976	2024/25	244	1.66	6.09
Agriprove Solutions Ptd Ltd	ERF158470	Applying nutrients to the land, rejuvenating pastures and changing grazing patterns.	21/08/2020	Goondiwindi	1,362	2023/24	505	0.31	1.14

- grey highlight denotes the projects for which the sole project activity is to sequester soil carbon by altering the stocking rate, duration or intensity of grazing; - blue highlight denotes the five Queensland projects that were analysed in the study by Mitchell et al. (2024); ATF means 'as trustee for'; SCS means 'soil carbon sequestration'

The far-right column in Table 25 above includes an approximation of the project's SOC sequestration rate, calculated by dividing the number of ACCUs awarded (which is equivalent to the tonnes of CO_2e sequestered) by the project area and the period between the project commencement and ACCU issuance. The SOC sequestration rate estimates range from 0.31t C/ha/yr to 3.5t C/ha/yr (1.14 – 12.83t CO_2e/ha/yr), and the average of the rates is 1.66t C/ha/yr (6.08t CO_2e/ha/yr). These rates are higher than those observed by the studies reviewed by Henry et al. (2024) (see Table 24 above).

Mitchell et al. (2024) conducted an analysis of five projects in Queensland (highlighted in blue in Table 25 above) that were awarded ACCUs in 2023, including: 'ERF 108333 (94,666 ACCUs), ERF 105067 (85,262 ACCUs), ERF 102074 (66,050 ACCUs), ERF 143770 (3,559 ACCUs), [...] and ERF 158470 (1,362 ACCUs)'. Mitchell et al. (2024) suggested that increased rainfall was the primary driver of increases in SOC reported by the five projects, which were awarded approximately 250,000 ACCUs. The five projects have a 25-year permanence period and implemented improved grazing management strategies to sequester SOC. Mitchell et al. (2024) utilised Normalised Difference Vegetation Index (NDVI) to compare the soil carbon project areas to the control areas (nearby sites with no management change) and found that the 'implementation of these projects did not significantly increase NDVI relative to control sites' (Mitchell et al. 2024). Mitchell et al. (2024) concluded that the sequestration was climate driven, and the crediting of ACCUs was for a transient gain, which poses risks to farmers in relation to the permanence requirements of sequestration, and risk to the credibility of the ACCU scheme (Mitchell et al. 2024).

In conclusion, the studies that have investigated the impact of grazing management strategies on SOC sequestration in Australia have found varying results, however, it has mostly been concluded that there is an insignificant impact on SOC stocks. Confidence in this analysis is low due to the lack of long-term, repeated studies across various locations in Queensland. It has been argued that the reported gains in SOC stocks by Queensland project proponents in recent years was a result of climate factors, rather than grazing management strategies (Mitchell et al. 2024).

Evidence of soil carbon sequestration as a result of pasture management strategies

The interaction between pasture management strategies and the predominant determinants of NPP and soil organic matter inputs from above and below-ground plant biomass, namely climate, soil, landscape and vegetation, can impact upon SOC stocks (Henry et al. 2024). Henry et al. (2024) analysed the available data for three pasture management strategies: '(1) sowing more productive grasses; (2) sowing legumes into grass pastures; [and] (3) use of waterponding to rehabilitate scalds'.

First, in relation to the pasture management strategy of sowing more productive grasses, Henry et al. (2024) found that soil carbon sequestration was expected to rise because of higher grass biomass which increases soil organic matter inputs (the studies found SOC sequestration rates of 0.02t C/ha/yr, 0.11t C/ha/yr, 0.4t C/ha/yr and 0t C/ha/yr), however, achieving persistent SOC gains in rangelands is challenging due to poor nutrient levels and low and variable soil moisture. SOC may accumulate more rapidly in initial years if nutrients to promote growth were applied when the grass was sown, but longer-term results are more uncertain (Henry et al. 2024). This was observed in Chan et al.'s (2010) study in New South Wales where the increased SOC stocks due to sowing improved grass species did not persist after a decade, and in Clewett's (2015) study in the Condamine region of southern Queensland where SOC stocks increased by 0.5t C/ha/year due to sown grass for the first 10 years, but averaged only 0.11t C/ha/year over 50 years (Henry et al. 2024). Henry et al. (2024) noted that confidence in these simulated results was low due to a lack of in-field measurements, and a lack of field data spanning over a decade or longer for Australia's northern or arid rangelands. Other research has suggested higher rates of SOC sequestration; for example, in a study by Pudasaini et al. (2024), it was reported that soil carbon sequestration could increase at a rate of 0.02–1.3 t C/ha/yr from restoring degraded grasslands (the time period over which that sequestration rate occurred was not provided).

Second, the pasture management strategy of sowing legume forages into grass pastures was analysed. Large parts of the Australian rangelands have low levels of soil nitrogen which limits the productivity of grass pastures (Henry et al. 2024). Legumes, through nitrogen fixation, can provide higher feed quality, and in dry periods, legume-grass pastures can extend forage availability (Henry et al. 2024). 'Higher input and quality of soil organic matter from nitrogen fixing legumes is also beneficial for soil microbial activity and the production of microbial necromass carbon, which comprises 2–5% of total soil carbon, [and] can enhance soil carbon sequestration in rangelands' (Henry et al. 2024). Henry et al. (2024) identified research showing SOC stocks increased due to legume plantings into grasses, including Chad et al.'s (2017) 40-year study in southern Queensland of leucaena planted into grass that found SOC stocks consistently increased by 0.28 t C/ha/year. Additionally, 'in other studies where SOC was measured or modelled with various forage legumes and time periods, there was a consistent trend for increase in stocks, with estimated soil carbon sequestration rates of 0.14–0.72t C/ha/year (0–30 cm) (Clewett 2015; Harrison et al. 2015; Wocheslânder et al. 2016)', and further studies that used a measurement depth of 15 cm in leucaena-grass pasture found SOC stock increases of 0.08–0.76t C/ha/year (Henry et al. 2024). There is a lack of research into the impacts on SOC stocks of *Stylosanthes* spp. and *Desmanthus* spp. (Henry et al. 2024).

Third, the pasture management strategy of waterponding was analysed. Scalded areas or claypan that are eroded or sealed can be rehabilitated using waterponding, and as scalded land is typically degraded and low in SOC stock, waterponding can sequester SOC (Henry et al. 2024). In Read et al.'s (2012) study in New South Wales Central-West Catchment, which has extensive scalding, 'rates of soil carbon sequestration were found to be as high as 1.5t C/ha/year over the first 5 years before stabilising' (Henry et al. 2024). Research is required into the long-term SOC dynamics.

In summary, the research suggests there is evidence that pasture management strategies including sowing improved grasses and legumes and waterponding can increase SOC stocks, however, the number of studies conducted is limited, and the sowing improved grasses and legumes studies took place in less arid regions within the rangelands (Henry et al. 2024). To quantify the impact of pasture management strategies on SOC stocks in different locations, more research is required (Henry et al. 2024).

Evidence of soil carbon sequestration because of land conversion strategies

Henry et al. (2024) analysed the evidence of soil carbon sequestration capacity from the following land conversion strategies, including (1) Conversion from cropping to perennial pastures; and (2) Conversion from grassland to forest cover.

First, the land conversion strategy of converting cropping land to permanent pasture has potential to increase SOC stocks. Henry et al. (2024) analysed three studies that demonstrated that SOC stocks increased under perennial pastures compared to crops after periods of 15–20 years at sequestration rates of 0.06 to 0.48 t C/ha/year (Henry et al. 2024). Globally, sequestration rates for grasslands have been higher, which 'is not unexpected since the global analyses include studies in higher rainfall, more productive conditions than those that characterise Australian rangelands' (Henry et al. 2024). In a 20-year study based in the sub-tropical, semi-arid rangelands of south-west Queensland by Jones et al. (2016), the change in

SOC stocks in cropping land converted to perennial pasture was analysed and it was observed that SOC stocks increased by 0.09 t C/ha/year (Henry et al. 2024). On the land studied, historically, virgin forest was cleared for cropping which took place on the land for 20 years, and the SOC stocks during that time decreased by 9.97 t C/ha/year (Henry et al. 2024). Following the land conversion to perennial pasture, whilst the SOC stocks did increase, they did not reach the previous level (Henry et al. 2024). 'The study demonstrate[d] that long-term cropping limits the system's resilience, capacity to recover soil fertility, and to sequester SOC' (Henry et al. 2024). A 5-year study by Badgery et al. (2021) of land converted from cropping to permanent pasture, which took place in the Cowra Trough in the Central West region of New South Wales, found that SOC stocks increased by 1.2t C/ha/year (0-30cm). Mitchell et al. (2024) posited, in relation to the study by Badgery et al. (2021), that the study 'occurred over the short-term (5years) [...] where we expect relatively large SOC gains due to prior SOC depletion' (Mitchell et al. 2024). Furthermore, White et al. (2021) stated:

> 'The upper limit to soil carbon increase in soils of the Cowra region is close to 1t C/ha/year during the initial years of conversion of crop land to pasture. This rate is likely to decrease with time as the soil approaches a new steady-state equilibrium. For example, in a similar region of NSW, but for longer term trials of 13 and 25 years, Chan et al. (2011) reported increases of 0.40 and 0.26 t C/ha/year, respectively' (White et al. 2021).

Henry (2023) commented that 'soil carbon sequestration rates may be higher (possibly 0.3 to 0.6t C/ha/yr), when land is converted from cultivation to permanent pasture', however, noted that most of the available data was from wetter, temperate regions in Australia's south. Therefore, research demonstrates that conversion of cropping land to permanent pasture does increase SOC stocks at varying rates and there is uncertainty surrounding the long-term SOC dynamics.

Second, the land conversion strategy of converting from pasture to forest cover is 'widely recognised as a method of sequestering C in above- and below-ground biomass, [however,] there are very limited data on associated changes in SOC' (Henry et al. 2024). Henry et al. (2024) considered the study by Allen et al. (2016), which looked at brigalow regrowth on degraded pastures in Queensland rangelands and found that 'no significant soil carbon sequestration follows regeneration of forest cover in rangeland situations' (Henry et al. 2024). Other studies of land conversion from pasture to forest (Paul et al. 2022 and Guo et al. 2008) have produced inconsistent results, ranging from losses in SOC stocks to small increases (Henry et al. 2024). 'In summary, there were too few published data from rangeland sites to estimate soil carbon sequestration for land conversion from permanent pasture to forest cover, and investment in research is needed due to a growing interest in the prospects for SOC credits from establishing trees on areas of grazing land to add to opportunities for biomass C credits, ecosystem services payments and other possible environmental benefits' (Henry et al. 2024).

Evidence of soil carbon sequestration because of conversion from tillage to no till or reduced till

In addition to the management strategies analysed by Henry et al. (2024), conversion from tillage to no tillage or reduced tillage is a management change activity that may be undertaken under the estimation of SOC sequestration using measurement and models method. Research has indicated that this strategy can increase SOC stocks. Pudasaini et al. (2024) reported that SOC stocks can increase by a rate of 0.1–1.3t C/ha/year by converting from tillage to no till. The 5-year study by Badgery et al. (2021) which took place in the Cowra Trough in the Central West region of New South Wales, looked at the impact of converting to reduced tillage and found that SOC stocks increased by 0.28 t C/ha/year (0-30cm).

Conclusion

In summary, this literature review of soil carbon sequestration in Australia found both opportunities and challenges for carbon farming projects in agricultural systems. While increasing SOC can yield substantial co-benefits that can improve farm productivity (e.g. increased soil fertility and water retention), SOC accumulation is constrained by ecological, climatic, and biophysical factors (such as rainfall, temperature and soil type). Furthermore, land condition is a key factor with depleted soils having higher SOC sequestration potential compared to healthy soils. The potential for long-term sequestration is finite, site-specific, and reversible, and sequestration rates are higher early on, tapering off once it reaches a new equilibrium level. The depth of SOC also plays a role in its long-term sequestration. Henry et al.'s (2024) review found that the rate of SOC sequestration varies significantly depending on the land management strategy adopted; the highest rate observed was 0.92t C/ha/yr (3.37t CO_2e/ha/yr) generated by converting cropland to permanent pasture (Badgery *et al.* 2021) and the lowest sequestration rates were associated with grazing management strategies. Furthermore, there has been some suggestions that the SOC sequestered by ACCU scheme projects in Queensland was a result of climatic factors such as high rainfall rather than land management changes (Mitchell et al. 2024). Given the uncertainties surrounding long-term SOC dynamics, the risks of reversal of sequestration (especially in the face of climate change), and the variation of SOC sequestration rates depending on the land management strategy adopted, more high-quality, long-term research is essential to support uptake of carbon farming initiatives.

4.2.2 Investment analysis

This section details the investment analysis of a hypothetical project implemented on the representative Fitzroy farm model created by Bowen and Chudleigh (2018) using the ACCU scheme soil organic carbon measurement method[59]. The project activity to increase SOC stocks is planting leucaena into grass pasture.

The benefit of planting leucaena to the profitability of the cattle farming business and associated costs was already calculated by Bowen and Chudleigh (2018). Therefore, this investment analysis is limited to the cost and benefits of implementing and running the ACCU scheme SOC sequestration project. The benefit of the project is the income earned from the sale of ACCUs generated and the costs include opportunity cost and project establishment and running costs (White et al. 2021).

SOC sequestration rates

Four SOC sequestration rates, low, medium, high, and very high, have been adopted for the investment analysis. The first three rates have been determined based on the available data of SOC sequestration rates from planting legumes into pasture. The fourth rate used is 1.66 t C/ha/yr, which is the estimated average SOC sequestration rate of the 11 projects in Queensland that have been awarded ACCUs. The study by Henry et al. (2024), which was detailed previously in this report, reviewed three projects that analysed the impact of planting leucaena-grass pastures on SOC stocks and found the SOC sequestration rates were 0.28 t/C/ha/yr, 0.27 ± 0.12 t/C/ha/yr, and 0.08–0.27 t/C/ha/yr (Conrad et al. (2017), Harrison et al. (2015), and Radrizzani et al. (2011)). The study by Wocheslânder et al. (2016) observed a SOC sequestration rate of 0.72 t C/ha/yr and involved the planting of Tagasaste, and the study by

[59] See Appendix 9.1.1 for the method rules and current uptake.

Clewett (2015) observed a SOC sequestration rate of 0.38 t C/ha/yr and involved the planting of a grass-legume. A further study by Radrizzani et al. (2011) looked at the conversion of crop land to leucaena-grass pasture and observed a SOC sequestration rate of 0.76 t C/ha/yr. The results from those studies are summarised in Table 24 above under the heading 'sowing legumes into grass pastures' (Henry et al. 2024).

The available data assessing the impact of planting leucaena on SOC stocks is limited and the research projects that have been conducted have occurred over varying time periods and in different locations. As SOC stocks are impacted by many biophysical and environmental factors, the results from the experiments are not certain indicators of SOC sequestration outcomes across Queensland. Furthermore, there remains a large degree of uncertainty within the research as to long-term SOC dynamics. Therefore, to account for the variability in SOC rates, four rates of SOC sequestration as a result of planting leucaena have been adopted by this report to conduct the investment analysis, including: low rate of 0.08 t C/ha/yr (0.29t CO_2e/ha/yr); medium rate of 0.39 t C/ha/yr (1.43t CO_2e/ha/yr); high rate of 0.76t C/ha/yr (2.79t CO_2e/ha/yr); and very high rate of 1.66t C/ha/yr (6.09t CO_2e/ha/yr).

Key Assumptions

The principal assumptions used in the investment analysis include:

1. ACCU price is: $35, $50, and $100;
2. Discount rate is 5% (the discount rate reflects the opportunity cost of making an alternative investment, and has been adjusted for inflation);
3. SOC sequestration rates are: 0.08 t C/ha/yr, 0.39 t C/ha/yr, 0.76 t C/ha/yr and 1.66 t C/ha/yr (which convert to 0.29 t CO_2e/ha/yr, 1.43 t CO_2e/ha/yr, 2.79 t CO_2e/ha/yr and 6.09 t CO_2e/ha/yr);
4. Sequestration rate assumed to remain constant throughout project (see 3.0.3 above);
5. Permanence period is 25 years;
6. Project area is 433ha;
7. It is assumed that the entire 433ha paddock that was planted with leucaena in strips experienced the increase in SOC stocks;
8. The soil is tested for SOC levels every 5 years, and reported to the CER every 5 years; and
9. As the leucaena is planted in year 2 of the project (according to the Fitzroy farm model), the SOC sequestration begins in the second year.

Benefits

Using the principal assumptions listed above, the amount of SOC sequestered by the 25-year project using the four different sequestration rates was calculated and the results are summarised in Table 26 below.

Table 26: SOC sequestration at different rates over 25-year project

Project Year	SOC sequestered using low sequestration rate 0.29t CO_2e/ha/yr	SOC sequestered using medium sequestration rate 1.43t CO_2e/ha/yr	SOC sequestered using high sequestration rate 2.79t CO_2e/ha/yr	SOC sequestered using very high sequestration rate 6.09t CO_2e/ha/yr
1 (baseline)	0	0	0	0

5	502[60]	2,477	4,832	10,548
10	628[61]	3,096	6,040	13,185
15	628	3,096	6,040	13,185
20	628	3,096	6,040	13,185
25	628	3,096	6,040	13,185
Total (t CO_2e)	**3,014**	**14,861**	**28,994**	**63,287**

ACCU Scheme Discounts

Table 27 below identifies the tonnes of carbon dioxide equivalent that would be credited as ACCUs after the ACCU scheme discounts have been applied (permanence period discount of 20%, risk of reversal discount of 5%, and temporary withheld credits – 25% of second round sampling, returned on third round sampling).

Table 27: ACCUs awarded after discount rates have been applied

Project Year	Discount Applicable (all include permanence period discounts (20%) and risk of reversal (5%)).	SOC sequestered using low sequestration rate 0.29t CO_2e/ha/yr	SOC sequestered using medium sequestration rate 1.43t CO_2e/ha/yr	SOC sequestered using high sequestration rate 2.79t CO_2e/ha/yr	SOC sequestered using very high sequestration rate 6.09t CO_2e/ha/yr
1 (baseline)	-	0	0	0	0
5	Temporarily withheld credits (25%)	283[62]	1,393	2,718	5,933
10	Temporarily withheld credits returned	565[63]	2,786	5,436	11,866
15		471[64]	2,322	4,530	9,889
20		471	2,322	4,530	9,889
25		471	2,322	4,530	9,889
Total (t CO_2e/ACCUs)		**2,260**	**11,145**	**21,745**	**47,465**

Change in emissions from livestock

The net abatement amount is calculated by measuring the difference between the amount of carbon in the soil after the project has been implemented and the baseline amount of carbon in the soil, less any net increase in emissions in the crediting period compared to emissions in the baseline period.

Using the beef cattle herd management method calculator, the emissions from the steer herd of cattle run on the 433ha paddock of leucaena grass pasture from the representative Fitzroy model was estimated. The calculations indicated that the emissions from the livestock during the project were less than the baseline emissions for the steer herd. This is a result of the steer herd being run on a smaller area of land under the project compared to before the leucaena was planted, and the steers were sold 6 months earlier once they grazed the leucaena

[60] $0.29 \text{ t } CO_2e/\text{ha/yr} \times 433\text{ha} \times 4 \text{ years} = 502.28 \text{ t } CO_2e$
[61] $0.29 \text{ t } CO_2e/\text{ha/yr} \times 433\text{ha} \times 5 \text{ years} = 627.85 \text{ t } CO_2e$
[62] $(502.28 \times 75\%) - (502.28 \times 75\% \times 25\%) = 282.53\text{t } CO_2e/\text{ACCUs}$
[63] $(627.85 \times 75\%) + (502.28 \times 75\% \times 25\%) = 565.07\text{t } CO_2e/\text{ACCUs}$
[64] $627.85 \times 75\% = 470.89\text{t } CO_2e/\text{ACCUs}$

compared to the base Fitzroy model. Therefore, in this case, the herd emissions do not increase after the project is implemented and there is no deduction for livestock emissions. The calculations indicated that the emissions from the livestock during the project were less than the baseline emissions for the steer herd (for example, the total baseline emissions for the steer herd were 653.6t CO2e compared to total reporting year emissions of 415.2t CO2e for year 11, when the herd numbers reached new steady state in the Bowen and Chudleigh (2018)'s representative Fitzroy farm model with leucaena planted on a 433ha area.

Costs

The costs of undertaking a soil organic carbon measurement method project are largely unknown. Pudasaini et al. (2024) identified the major costs of undertaking a SOC sequestration project under the ACCU scheme as, 'collection of historical information from five to seven years; developing a land management strategy; initial site survey and developing a sampling plan; baseline soil sampling by qualified technicians; analysis of samples to identify baseline carbon levels and assembling these materials into a baseline report'. Table 28 below contains the estimated costs of undertaking a SOC sequestration project. Where possible, costs were based upon peer reviewed data, however, for many costs there was no research available, so estimates from experienced stakeholders were sought. It has been assumed that a carbon service provider is engaged to deliver some services that involve complexities, such as the preparation of the offset reports, and this has been identified in the third column titled 'Party delivering service'.

Table 28: Costs of SOC sequestration project for 25-year project period

Cost Description	Frequency over 25-year project	Party delivering service	Cost/unit	Total Cost for 25 years
Legal advice, accounting advice, feasibility advice (optional)	1	Lawyer, Accountant, carbon service provider	-	$10,000
Project establishment cost (mapping of project area, preparing Land Management Strategy, preparing carbon baseline report, completing submission to ACCU Scheme for project registration)	1	Carbon service provider	$50/ha	$21,650
Soil sampling and analysis (to be prepared by qualified person)	6	Qualified person	$30/ha – $100/ha[65]	$77,940 – $259,800
Offset report (site visit and preparing report)	5	Carbon service provider	$21/ha	$45,465
Monitoring requirements *(assumed to be 1-2 days' work each year, using hourly rate of $35)*	25	Farmer	$560/year	$14,000

[65] 'Anecdotally, estimates of cost of soil sampling and analysis vary from as high as $100/ha to as low as $30/ha, depending on the size of the area and sampling strategy' (White et al. 2021). 'The cost of baseline sampling is typically high for soil carbon projects, varying from $30 to $100/ha depending on area, spatial homogeneity, fraction of gravels and sampling strategy' (Pudasaini et al. 2024).

Audit	3	Independent auditor	$7,000/audit – $30,000/audit[66]	$21,000 – $90,000
Total				**$190,055 – $440,915**

Investment analysis results

The investment analysis of implementing a soil organic carbon measurement method project involving planting leucaena on Bowen and Chudleigh's (2018) Fitzroy representative farm model produced the results set out in Table 29 below. The red font denotes negative numbers.

Table 29: Net Present Value of 25-year soil organic carbon measurement method project

ACCU Price / Sequestration rate	ACCU Price = $35	ACCU Price = $50	ACCU Price = $100
0.29t CO_2e/ha/yr	-$221,255 to -$78,860	-$204,585 to -$62,190	-$149,020 to -$6,625
1.43t CO_2e/ha/yr	-$68,355 to $74,040	$13,844 to $156,238	$287,838 to $430,232
2.79t CO_2e/ha/yr	$114,053 to $256,447	$274,425 to $416,820	$809,001 to $951,396
6.09t CO_2e/ha/yr	$556,658 to $699,053	$906,719 to $1,049,114	$2,073,589 to $2,215,983

The results demonstrate that the NPV can be positive or negative depending on the ACCU price and the SOC sequestration rate. Negative NPVs indicate the primary producer would be worse off by undertaking the project, whereas positive NPVs mean the primary producer would be better off. In 29% of the 24 scenarios tested, a negative whole-of-project NPV was generated ranging from -$221,255 to -$6,625. In the remaining 71% of scenarios tested, a positive whole-of-project NPV was generated ranging from $13,844 to $2,215,983. Positive NPVs were dependent on SOC sequestration rates of 1.43t CO_2e/ha/yr and above.

For the low SOC sequestration rate of 0.29t CO_2e/ha/yr, a negative NPV was generated for all ACCU prices. For the medium SOC sequestration rate of and 1.43t CO_2e/ha/yr, a positive NPV was generated for all ACCU prices except for $35 under the higher cost scenario. For the high SOC sequestration rate of 2.79t CO_2e/ha/yr and very high SOC sequestration rate of 6.09t CO_2e/ha/yr, a positive NPV was generated at all ACCU prices under both cost scenarios.

Bowen and Chudleigh's (2018) report identified that the annualised NPV from planting leucaena was $40,336, and the total NPV over the 30-year period was $620,063. The peak deficit was -$145,772 which occurred in year 4. The payback period was 7 years. The total NPV of the 25-year project identified in Table 29 above is ***in addition*** to the profits identified in Bowen and Chudleigh (2018).

The results from the investment analysis of a project using the soil organic carbon measurement method illustrate that, at the medium, high and very high rates of SOC sequestration, there is potential to generate a positive NPV. At the current ACCU price of $35, the positive NPV ranged from $74,040 to $699,053, which translates to a range of $2,961/year and $27,962/year on average.

The results demonstrate that for soil carbon projects, there is greater opportunity for primary producers to generate a net gain from an ACCU scheme project if the rate of SOC sequestration is medium or above. The benefit of SOC sequestration projects is that they can complement agriculture production businesses.

[66] Waltham et al. (2024) estimated the audit cost as $7,000 - $11,000. Audit cost was estimated as $30,000 by AgriWebb (ArgiWebb 2021) and in an article published in the Financial Review (King 2024). Audit cost was estimated by Agriprove as $12,000-$24,000 (Agriprove n.d.).

Table 21 above is a matrix of co-benefits associated with ACCU scheme projects and indicates that soil carbon projects are most likely to deliver improved farm productivity. Soil carbon projects also do not necessarily compete with agricultural production for land use, which was demonstrated in this investment analysis of the Fitzroy case study involving planting leucaena to increase SOC stocks, which at the same time increased the liveweight gains of the steer herd and thereby increased farm profitability.

Nevertheless, these results do still align with the investment analysis results of the study by Pudasaini et al. (2024a) that found, 'the returns from soil carbon projects on grazing lands are not necessarily positive under the different scenarios', and, 'to some extent, this reflects the high costs of thorough monitoring, management, and verification every five years with measure-remeasure approaches' (Pudasaini et al. 2024a).

4.3 Vegetation-based carbon farming methods

This section contains a literature review of vegetation-based sequestration and an investment analysis of a project using the ACCU scheme environmental plantings method.

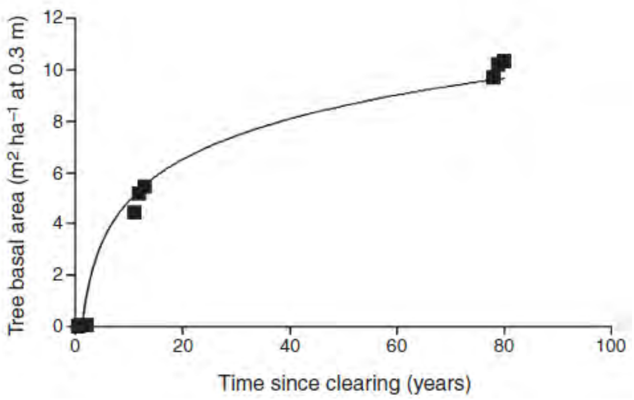
4.3.1 Literature review

During the last 200 years, forests have declined by an estimated 16.4 million km^2 globally, which has resulted in losses of biodiversity, emissions of carbon into the atmosphere, and reduced capacity for carbon storage (Cunningham et al. 2015). Since European colonisation, over 40% of Australia's woodlands and forests have been cleared (Reside et al. 2017). Queensland landholders can potentially undertake land restoration projects to sequester carbon in vegetation, by discontinuing regular clearing or by planting trees (Paul and Roxburgh 2020; Comerford et al. 2015).

Planting trees and facilitating regeneration present opportunities to reverse the loss of native forests (Cunningham et al. 2015). Forests can sequester more carbon than agricultural plants such as pasture grasses and crops because of their substantially greater biomass and lifespan (Cunningham et al. 2015) and woody long lasting structure. Globally, forests have double the net primary production than that of improved pastures and croplands (Cunningham et al. 2015) (of course, NPP is primarily controlled by soil moisture and soil fertility, so this may have limited applicability to all of Queensland).

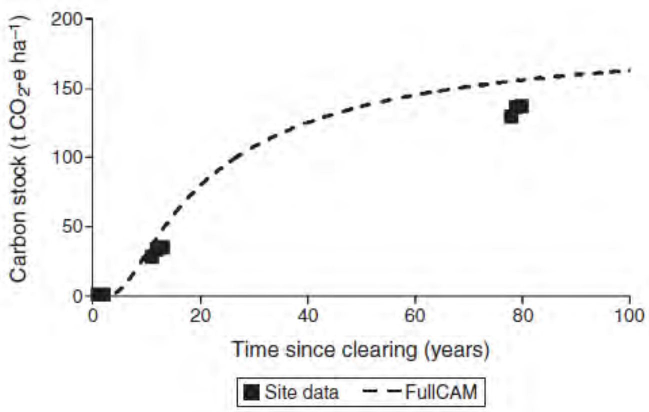
Trees absorb atmospheric carbon dioxide through photosynthesis, and during that process, the carbon component of the atmospheric carbon dioxide is used by the plant to grow and is stored in above-ground biomass (vegetation), below-ground biomass (roots) and soil organic matter (Harper and Sochacki 2019). Forests function as carbon stores, with their carbon carrying capacity constrained by the specific climate, soil characteristics, and hydrological conditions of a given area (Harper and Sochacki 2019). Biomass growth rate is key to estimating sequestered carbon, and woody regrowth rates vary with age, species mix, climate, soil, and management practices (Whish et al. 2016). The amount of carbon sequestered by trees varies widely, as it is impacted by many biophysical factors including the age of the tree, tree species, planting design, soil type, rainfall, temperature, slope, and environment, death and decomposition rates (MLA 2023; Macintosh et al. 2024a; Whish et al. 2016). Carbon sequestration is highest in a tree's early growth (ages 4–11, depending on species) and levels off as the tree matures (MLA 2023). The rate of sequestration is not linear for reforestation, typically peaking at ~10 years post planting and thereafter declining as the tree matures (Henry et al. 2015). 'When annualised over 20 years, the rate is more than double that over a 100-year timeframe (2.6–2.7 times)' (Henry et al. 2015). Figure 25 below depicts the relationship between the tree basal area and time since clearing of brigalow regrowth from a study in Central Queensland (assumed remnant vegetation was 80 years old), followed by Figure 26 that illustrates the relationship between tree carbon stocks and time since clearing for the same study (Gowen and Bray 2016). The dashed line in Figure 26 depicts FullCAM modelled growth and the squares are the site data. Remnant vegetation was assumed to be 80 years old

Figure 25: Relationship between time since clearing and tree basal area



Source: Adapted from Gowen and Bray (2016)

Figure 26: Relationship between tree carbon stock and time since clearing



Source: Adapted from Gowen and Bray (2016)

In addition to the age of vegetation, environmental factors like soil type, rainfall, temperature, and nutrient availability also affect the carbon sequestration rate of trees, which is positively linked to forest productivity and increases with water and nutrient availability, and temperature (Cunningham et al. 2015). For example, in Western Australia, an area with 300–350mm annual rainfall reported a 30-year average sequestration rate of 3.79t CO_2e/ha/yr for Mallee vegetation (Shea et al. 1998), whereas in Tasmania, an area with 700mm annual rainfall and primarily shining gum and radiata pine plantations, reported a sequestration rate of 35.1t CO_2e/ha/yr (Hall 2010; MLA 2023).

Furthermore, the species of tree affects the rate of carbon sequestration. 'Carbon sequestration rates vary depending on species, and an individual species is more likely to perform better on one site than another' (Singh et al. 2010). For example, in Central Queensland, an area with 653mm annual rainfall reported a sequestration rate of 1.4 – 2.1t CO_2e/ha/yr in eucalypt woodlands (Whish, Pahl and Bray 2016), whereas in northern New South Wales, an area with a lower annual rainfall of 470 – 600mm, grew river red gum woodlands and reported a sequestration rate of 9.3 ± 3.88t CO_2e/ha/yr (Smith, Renton and Reid 2017). Timber plantings, which typically involve monocultures of production trees, can usually sequester more carbon due to silviculture management and tree breeding compared to environmental plantings, which involve native mixed-species plantings (Cunningham et al. 2015; MLA 2023) (however, fast growing trees that are not necessarily planted as a monoculture can also sequester carbon at higher rates). If rapid carbon sequestration is the goal, timber plantings or plantings of fast growing trees may be preferable; however, native mixed-species plantings offer greater biodiversity benefits (Cunningham et al. 2015). When undertaking an environmental planting project, project proponents should consider the following steps to maximise the carbon sequestration of the planting:

1. ‘be informed of the most likely climate scenarios for a given afforestation/reforestation site;
2. choose species, especially natives, that are adapted to the current and predicted climate of a site and have characteristics for surviving changing and variable climates, drought and/or fire;
3. maximise diversity in genetic material, including for pest and disease resistance; and
4. favour species with high wood density (the wood density of a species has a significant bearing on carbon content in wood and wood products) and high growth rates’ (Singh et al. 2010).

Planting design can also impact carbon sequestration rates (MLA 2023). Sequestration rates are typically higher in plantings established in linear belt configurations compared to block configurations (MLA 2023; Paul and Roxburgh 2020). Soil water, nutrient, and light constraints can be mitigated by planting belts, allowing edge trees to access extra resources from adjacent land (Paul and Roxburgh 2020).

Carbon sequestration rates in vegetation

Varying rates of carbon sequestration in vegetation have been observed across Queensland and Australia. Table 30 summarises the rates of carbon sequestration observed by 13 field trials that involved field measurements, as well as some scientific studies that utilised FullCAM to estimate rates of carbon sequestration and involved varying time periods, species and ages of vegetation. The rates of carbon sequestration observed by these studies was 0.035 –12.49t CO_2e/ha/yr in Queensland and 0.035–18t CO_2e/ha/yr across Australia. As discussed above, the rate of carbon sequestration in vegetation is not linear and varies over the lifetime of the vegetation. However, to determine the significance of the rate of change in carbon stocks, many studies report an average, linear carbon sequestration rate, and Table 30 below summarises these average rates.

The rates of carbon sequestration observed in the Central Queensland field trials involving **eucalyptus species** was:

- **1.36** t CO_2e/ha/yr over a 14.14-year period and **2.57** t CO_2e/ha/yr over a 2.05-year period for trees that initially varied in age (Burrows et al. 2002); and

- **1.4 – 2.1** t CO_2e/ha/yr over a 20-year period for trees that were initially aged less than 3 years[67] (Whish, Pahl and Bray 2016).

The rates of carbon sequestration observed in the Central Queensland field trials involving **Brigalow** was:

- **1.4** t CO_2e/ha/yr over a 20-year period for trees that initially had recently been cleared (Bowen and Bray 2016); and
- **2.2** t CO_2e/ha/yr over a 100-year period for trees that initially varied in age (Dwyer et al. 2009 citing Moore et al. 1967).

[67] See Table 3 of Scanlan JC (1991) 'Woody overstorey and herbaceous understorey biomass in *Acacia harpophylla* (brigalow) woodlands', *Australian Journal of Ecology,* 16:521-529.

Table 30: Summary information from reviewed publications with data of carbon sequestration rates in varying vegetation types

Study reference	Study region	Av. ann. rainfall (mm)	Study details	Management change	Time period of study and age of vegetation	Sequestration rate (t CO_2e/ha/yr)
Comerford, Norman and Grand (2015)[68]	All of QLD	n/a	FullCAM modelling Highest sequestration rate of 12.49 t CO_2e/ha/yr with hardwood monoculture in high-rainfall areas of the coastal southeast such as Gold Coast City, and the lowest was 0.035 t CO_2e/ha/yr for managed regrowth in the arid west of the state such the Diamantina Shire.	Managed regrowth, environmental plantings and hardwood monoculture plantations.	Carbon sequestration rate over 100-year period	0.035 – 12.49 t CO_2e/ha/yr The average annual rate of carbon sequestration over 100 years across the whole of Queensland modelled using FullCAM was: • 1.54 t CO_2e/ha/yr for managed regrowth • 1.87 t CO_2e/ha/yr for environmental plantings • 2.07 t CO_2e/ha/yr for hardwood monoculture plantations
Burrows et al. (2002)[69]	Eucalypt woodland region of QLD ***See Figure 27 below***	Long term measurement period had below-average rainfall. Short term measurement period occurred during above-average rainfall.	57 sites across QLD dominated by Eucalyptus and/or Corymbia spp. were selected for analysis of woody vegetation growth and carbon stock change. Measurement time frame was on average 14.14 years for 30 long-term sites, and 2.05 years for the remaining 27 short-term sites. The initial average tree basal area (TBA) for live standing plants for the long-term sites was 11.86±1.38m^2/ha	Study estimated the above-ground annual increase in carbon for all 57 sites. The trees at the sites varied widely in size. The sites had not been subject to clearing activity either during or in the approximately 20 years prior to the observation period.	For the 30 long-term sites, over an average measurement period of 14.14 years, the mean total standing carbon stocks increased from 38.16tC/ha to 43.72tC/ha. Mean annual carbon increment was 1.36t CO_2e/ha/yr over 14.14 years. For the 27 short-term sites, over an average measurement period of	Average: 1.94 t CO_2e/ha/yr Long term: 1.36 t CO_2e/ha/yr Short term: 2.57 t CO_2e/ha/yr The higher growth rate of vegetation observed in the short-term sites, compared to the long term sites, may reflect the above-average

[68] Comerford E, Norman PL and Grand JE (2015) 'Is carbon forestry viable? A case study from Queensland, Australia', *Australian Forestry,* 78(3):169-179.
[69] Burrows WH, Henry BK, Back PV, Hoffmann MB, Tait LJ, Anderson ER, Menke N, Danaher T, Cater JO and McKeon GM (2002) 'Global and carbon stock change in eucalypt woodlands in northeast Australia: ecological and greenhouse sink', Global Change Biology, 8:769-784.

Study reference	Study region	Av. ann. rainfall (mm)	Study details	Management change	Time period of study and age of vegetation	Sequestration rate (t CO_2e/ha/yr)
			and for short term sites was 10.71±0.86m^2/ha.		2.05 years, the mean total standing carbon stocks increased from 36.99 tC/ha to 38.58 t C/ha. Mean annual carbon increment was 2.57 t CO_2e/ha/yr over 2.05 years.	rainfall during the measurement period.
Whish, Pahl and Bray (2016)[70]	Central QLD	653mm	Eucalypt woodlands Case study property consisted of 10,150ha of predominantly box (*Eucalyptus populnea*), narrow-leaved and silver-leaved ironbark (*E. crebra, E. melanophloia*) and bulloak (*Alloccasuarina luehmannii*) land types. The tree basal area (**TBA**) was estimated from the foliage cover spatial dataset and on ground assessment. Regrowth occurred on 49% of the property and the initial TBA for the regrowth sites ranged from 0.1 to 2.5m^2/ha.	Retaining woody regrowth for C sequestration. This research paper used a case study property in Central Queensland to assess 5 farming scenarios simulated over a 20 year period where 0%, 25%, 50%, 75% and 100% of the property regrowth was retained for carbon sequestration.	20 years Tree regrowth C stocks (t CO_2e/ha) were calculated on the area of regrowth retained on the property. The initial TBA of regrowth paddocks varied from 0.1 to 2.5m^2/ha.	1.4 – 2.1 t CO_2e/ha/yr
Gowen and Bray (2016)[71]	Rolleston, Central QLD	621mm (Bowen and Chudleigh 2018)	Brigalow Case study property was 2,100 ha property located ~210km south-west of Rockhampton and dominated by brigalow land type. The property had small areas of remnant forest and had	This research paper used a case study property in Central Queensland to assess 3 scenarios simulated over a 20 year period where 0%, 25%, 50%, 75% and 100% of	20 years Tree regrowth C stocks (t CO_2e/ha) were calculated using a TBA growth function, where the initial TBA of regrowth	1.4 t CO_2e/ha/yr[72]

[70] Whish G, Pahl L and Bray S (2016) 'Implications of retaining woody regrowth for carbon sequestration for an extensive grazing beef business: a bio-economic modelling case study', *The Rangeland Journal,* 38:319-330.
[71] Gowen R and Bray SG, (2016) 'Bioeconomic modelling of woody regrowth carbon offset options in productive grazing systems', *The Rangeland Journal,* 38: 307-317.
[72] Whish, Pahl and Bray (2016): 327.

Study reference	Study region	Av. ann. rainfall (mm)	Study details	Management change	Time period of study and age of vegetation	Sequestration rate (t CO_2e/ha/yr)
			otherwise been cleared and managed for regrowth. Measurements were taken from sites that: (1) had been recently re-cleared and had TBA of approximately 0m²/ha; (2) had been cleared roughly 20 years previously and had TBA of between 4 and 6m²/ha; (3) were 80 year old remnant vegetation and had TBA of about 10 m²/ha. The TBA growth function based on the measurements and the FullCAM prediction was used to estimate the carbon sequestration rate for above and below-ground biomass.	the property regrowth was retained for carbon sequestration.	paddocks was approximately 0m²/ha.	
Dwyer et al. (2009)[73] citing Moore et al. (1967)[74]	Meandarra QLD	560mm	Field measurements were taken from a mature Brigalow forest. Samples of vegetation material (including litter and dead standing trees) were taken and weights of dry matter were reported, as well as macronutrients, sodium, and trace elements. Various tree sizes were measured.	Dwyer et al. (2009) estimated the amount of carbon sequestration potential for a 5,500ha property that retained previously cleared Brigalow.	Dwyer et al. (2009) used sequestration rate of 0.6t C/ha/yr, which was based on a 100-year average rate derived from 50% of above-ground living biomass estimated by Moore et al. (1967)	2.2 t CO_2e/ha/yr

[73] Dwyer JM, Fensham RJ, Butler DW, and Buckley YM (2009) 'Carbon for conservation: Assessing the potential for win–win investment in an extensive Australian regrowth ecosystem', *Agriculture, Ecosystems and Environment,* 134:1-7
[74] Moore AW, Russell JS, and Coaldrake JE (1967) 'Dry matter and nutrient content of a subtropical semiarid forest of *Acacia harpophylla* F. Muell (brigalow)' *Australian Journal of Botany,* 15:11–24.

Study reference	Study region	Av. ann. rainfall (mm)	Study details	Management change	Time period of study and age of vegetation	Sequestration rate (t CO_2e/ha/yr)
Witt et al. (2011)[75]	South-west QLD (mulga (*Acacia aneura*) lands)	290mm – 469mm	The primary objective of the study was to ascertain how the removal of grazing pressure affects C sequestration (above and below-ground). Nine grazing exclosure sites were selected for this study in the mulga lands. The exclosures were erected between 1966 and 1996, and the field measurements were taken in 2009. The study involved measurements taken from inside and outside of the exclosure sites and any differences in C were assumed to represent either a gain or loss resulting from the reduction in grazing.	The study found that above-ground woody biomass increases with the exclusion of grazing due to the regeneration of mulga, but the response was highly variable across the study sites. The carbon sequestration rate of above-ground woody biomass was estimated based on the difference between the average of all small trees (<15cm diameter at 30cm height) inside and outside of the exclosures.	The study found that the carbon sequestration rate was 0.56 t CO_2e/ha/yr over approximately 28 years for above-ground woody biomass (dominated by mulga species).	0.56 t CO_2e/ha/yr
Macintosh et al. (2024a) and Macintosh et al. (2024b), citing Larmour et al. (2018)[76]	Semi-arid regions of WA, NSW and QLD (59% of measurements taken near Bourke and Charleville)	Moderate-low rainfall in semi-arid regions of Australia	The aim of this study was to explore the relationship between the above-ground biomass of a stand of woody vegetation and the canopy cover in semi-arid regions of Australia.	The study analysed 1,677 data sets of individual shrubs, multi-stemmed trees or single-stemmed trees where stem diameter and crown area were measured in semi-arid regions of QLD, NSW and WA.	The study involved various ages, sizes and species of vegetation. The carbon sequestration rate is for a period of 10 to 14 years.	0.94 – 2.02 t CO_2e/ha/yr (This level of sequestration is likely to be achieved after 10–14 years)[77]

[75] Witt GB, Noel MV, Bird MI, Beeton RJS, and Menzies NW (2011) 'Carbon sequestration and biodiversity restoration potential of semi-arid mulga lands of Australia interpreted from long-term grazing exclosures', *Agriculture, Ecosystems and Environments,* 141:108-118.
[76] Larmour J, Davies M, Paul K, England J and Roxburgh S (2018) Relating canopy cover and average height to the biomass of the stand, CSIRO, Canberra.
[77] Rate of sequestration was derived from the following statement: 'The forest cover attainment rule was informed by an empirical relationship between tree and debris biomass in forest regeneration and crown cover in the forest systems where most HIR projects are located, which suggests forest cover should be achieved in stands of even-aged regeneration when biomass reaches 7.2–11 tonnes of dry matter per hectare (equivalent to 13.2–20.2 t CO2 ha−1) (Larmour et al. 2018). For most HIR projects, this level of sequestration is likely to be achieved after 10–14 years of unhindered modelled regeneration'.

Study reference	Study region	Av. ann. rainfall (mm)	Study details	Management change	Time period of study and age of vegetation	Sequestration rate (t CO_2e/ha/yr)
Smith, Renton and Reid (2017)[78]	Lower Namoi catchment, Northern NSW	600mm – 470mm (decreasing east to west) Rainfall during the study was average to above-average owing to La Nina˜ weather conditions.	This study reported results of a 4-year study into growth, above-ground biomass accumulation and C sequestration in riparian and floodplain river red gum communities in semi-arid Australia, and found that river red gum growth rates declined with age but were generally higher than most published studies of eucalypt species in Australia. However, while diameter growth slowed with age, biomass accumulation rates may increase with tree size. This highlights the significance of old-growth riparian ecosystems in sequestering large amounts of carbon during periods of average to above-average rainfall, especially in La Niña conditions in inland eastern Australia. Furthermore, studies show the positive relationship between water availability and river red gum growth, health, biomass accumulation and therefore C sequestration in riparian and floodplain woodlands in southeastern Australia.	Regenerating river red gum woodlands in south-eastern Australia. River red gums (Eucalyptus camaldulensis) occur in the riparian zone of most arid and semi-arid inland river systems in all mainland Australian states and can live up to 1,000 years and attain a diameter of 4 m.	In 2008, initial diameters at breast height were measured, and repeat measurements were taken in 2012. In 2008, the diameter at breast height (**DBH**) of the trees measured ranged from 28.3±2.9cm to 141.6±6.7cm. These initial DBH measurements indicate the trees in the study were mature trees. The site with the highest C sequestration rates in this study had a range of tree sizes, shallow ground water (approximately 5m below the soil surface) and wide spacing of trees (low competition).	9.3 ± 3.88 t CO_2e/ha/yr Given the high rainfall owing to La Nina˜ conditions during this study, aboveground growth and C sequestration rates are likely to be at a maximum. The C sequestration rates for river red gum riparian forests measured in this study may be amongst some of the highest recorded for remnant ecosystems in the world.
Roxburgh et al. (2006)[79]	Kioloa, southern forest zone region of NSW.	1,235mm	This study used in field measurements from 17 forest sites that had previously been logged together with modelling to estimate	This study looked at the carbon sequestration potential of forest sites	Across the 17 study sites, the ages of the trees varied. Large diameter trees (greater than	8.48 t CO_2e/ha/yr

[78] Smith R, Renton M, and Reid N, 'Growth and carbon sequestration by remnant Eucalyptus camaldulensis woodlands in semi-arid Australia during La Nina˜ conditions' (2017) *Agricultural and Forest Meteorology,* 232:704-710.
[79] Roxburgh SH, Wood SW, Mackey BG, Woldendorp G, and Gibbons P (2006) 'Assessing the carbon sequestration potential of managed forests: a case study from temperate Australia', *Journal of Applied Ecology,* 43:1149-1159.

Study reference	Study region	Av. ann. rainfall (mm)	Study details	Management change	Time period of study and age of vegetation	Sequestration rate (t CO_2e/ha/yr)
			carbon sequestration potential within a forested landscape. A large component of the study area had changed recently from state forest to national park. Landscape-scale vegetation patterns follow a gradient from rainforest, through tall open *Eucalyptus* forest, to heath on the poorer drained, higher acidity soils.	that had previously been subject to logging.	100cm DBH) were recorded in 14 sites and comprised less than 5% of trees greater than 20cm DBH across all sites. The study found that the current carbon stocks in logged forests was 200t C/ha, and the carbon carrying capacity for the forests was 341-386t C/ha (average 363.5t C/ha). Furthermore, the study predicted an average forest plot would take approximately 53 years to exceed 75% of the carrying capacity. Therefore, the carbon sequestration rate for the first 53 years is 8.48 t CO_2e/ha/yr. (363.5tC/ha - 200tC/ha) x 75% ÷ 53years x 44/12 = 8.48 t CO_2e/ha/yr	
Henry, Butler and Wiedemann (2015)[80]	Armidale, NSW (representing the high-rainfall zone)	Armidale, NSW: 789mm Darkan, WA: 534mm	Seven sheep grazing properties were selected as case-study farms, 3 south of Armidale, and 4 west and south west of Darkan. A scenario was run in FullCAM where a mixed-species	FullCAM was used to estimate the carbon sequestration rate for planted mixed native tree species.	The trees were planted at the beginning of the modelled period. Rates of carbon sequestration were annualised over	Carbon sequestration rate annualised over **20** years: • NSW: 7.9 t CO_2e/ha/yr WA: 3.6 t CO_2e/ha/yr

[80] Henry BK, Butler D and Wiedemann SG (2015) 'Quantifying carbon sequestration on sheep grazing land in Australia for life cycle assessment studies', *The Rangeland Journal,* 37:379-388.

Study reference	Study region	Av. ann. rainfall (mm)	Study details	Management change	Time period of study and age of vegetation	Sequestration rate (t CO_2e/ha/yr)
	Darkan, WA (representing the sheep-wheat zone)		environmental planting event occurred in 2015, and growth over a period of 100 years was simulated.		both 20 years and 100 years.	Carbon sequestration rate annualised over **100** years: • NSW: 3 t CO_2e/ha/yr • WA: 1.4 t CO_2e/ha/yr
Hobbs et al. (2013)[81]	Dryland agriculture zones of SA	250mm – 650mm	The objective of this study was to provide reliable estimates of carbon sequestration rates from revegetation activities using Australian native plants in the low to medium rainfall (250 - 650mm/year) dryland agriculture zones of South Australia. The study involved 301 sites, including: • 264 sites were revegetation sites including: (a) 132 woodlot sites, trees aged 5 to 131 years, average age of 26 years; (b) 132 environmental planting sites, trees aged 3 to 36 years, average age of 17 years; • 37 remnant sites, trees aged between 13 and 225 years, average age of 82 years. ***Woodlots* -** Blocks containing monocultures of typical woodlot species, including Sugar Gum (*Eucalyptus cladocalyx*), River Red Gum (*E. camaldulensis*), and SA Blue Gum (*E. leucoxylon*). Monoculture plantations	Total above-ground plant biomass and carbon content of 264 revegetation sites and 37 remnant vegetation sites in the agricultural regions of South Australia were assessed using measurements of 36 (monoculture) or 60 (mixed species) plants at each site and applying non-destructive DEWNR allometric models.	The average age of all revegetation sites was 22 years (n=264; range 3 to 131 years) with average of woodlots being 26 years (n=132; range 5 to 131 years) and environmental plantings averaging 17 years (n=132, range 3 to 36 years). Estimated average age of remnant sites was 82 years (n=37; range 13 to 225 years). The average above-ground carbon sequestration rate of all revegetation sites was 9.5t CO_2e/ha/yr (mean annual rainfall 429mm/year), 11.4t CO_2e/ha/yr in woodlots (441mm/year) and 7.6t CO_2e/ha/yr in environmental plantings (418mm/year).	Above-ground carbon sequestration rate: • 11.4t CO_2e/ha/yr for woodlots; • 7.6t CO_2e/ha/yr for environmental plantings; • 5.8 t CO_2e/ha/yr for remnant vegetation.

[81] Hobbs TJ, Neumann CR, Tucker M, and Ryan KT (2013) Carbon sequestration from revegetation: South Australian Agricultural Regions, DEWNR Technical Report 2013/14, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide & Future Farm Industries Cooperative Research Centre.

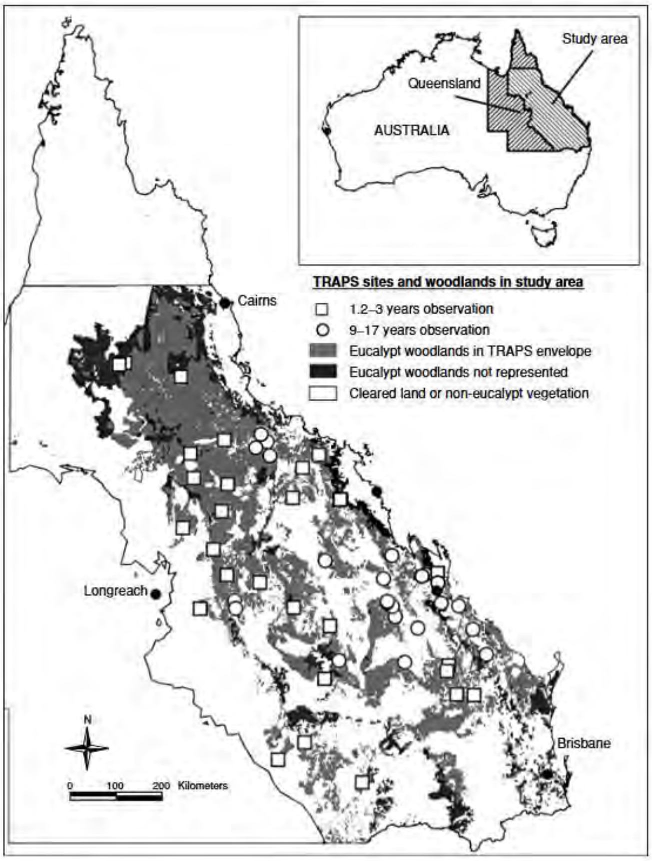
Study reference	Study region	Av. ann. rainfall (mm)	Study details	Management change	Time period of study and age of vegetation	Sequestration rate (t CO_2e/ha/yr)
			represented 58% of surveyed revegetation sites. ***Environmental Plantings -*** Blocks containing predominately mixtures of native species for biodiverse/habitat plantings intended for environmental services.			
Kramer et al. (2024)[82]	North-central VIC	Not reported	This study compared predictions of carbon in above-ground biomass using both the IPCC Tier 2 modelling approach and Australia's carbon accounting model, FullCAM, to independent validation data from ground-based measurements. The study involved data collected from 14 sites in Victoria, which were selected based on the following criteria: (a) plantings were at least 20 years old (representing the oldest environmental plantings in south-eastern Australia); (b) the planted species assemblages were consistent with widespread woodland assemblages in inland south-eastern Australia (i.e., mixes of box–ironbark–gum *Eucalyptus* and/or *Acacia* species, and (c) the plantings had been previously measured, providing scope for examining carbon-stock trends.	Carbon sequestration rates observed in plantings of mixes of box-ironbark-gum *Eucalyptus* and/or *Acacia* species.	The trees assessed ranged in age from 21 to 35 years and the sites were based in locations where environmental conditions were representative of box-ironbark-gum with acacia native vegetation in north-central Victoria.	3.89 – 18 t CO_2e/ha/yr for vegetation aged between year 21 and 26. 8.80 t CO_2e/ha/yr for vegetation aged over 30 years.

[82] Kramer K, Bennett LT, Borelle R, Byrne P, Dettman P, England JR, Heida H, GalamaY, Haas J, van der Heijden M, Pykoulas A, Keenan R, Krishnan V, Lindorff H, Paul KI, Nooijen V, van Veen J, Versmissen Q, and Asjes A (2024) 'Site-Level Modelling Comparison of Carbon Capture by Mixed-Species Forest and Woodland Reforestation in Australia', *Forests,* 15:990.

Study reference	Study region	Av. ann. rainfall (mm)	Study details	Management change	Time period of study and age of vegetation	Sequestration rate (t CO_2e/ha/yr)
Cunningham et al. (2015)[83]	Northern VIC	570mm – 715mm (climate in this region is temperate and a winter-dominant rainfall pattern)	This study investigated changes to stocks among C pools following reforestation of agricultural land in the medium rainfall zone temperate Australia. The study involved 39 sites including 36 tree planting sites and 3 remnant woodland sites.	The sites were planted with a mixture of 2–15 regionally endemic trees and shrubs from the genera Acacia Mill., Allocasaurina L.A.S. Johnson, Callistemon R. Br., Eucalyptus L'Her, and Melaleuca L., and were dominated by eucalyptus species.	The plantings ranged from ages of 5 to 45 years.	The rate of carbon sequestration over a period of 45 years was: • 11.33 ± 3.11 t CO_2e/ha/yr in aboveground biomass • 0.66 ± 0.18 t CO_2e/ha/yr in plant litter

[83] Cunningham SC, Cavagnaro TR, Nally RM, Paul KI, Baker PJ, Beringer J, Thomson JR and Thompson RM (2015) 'Reforestation with native mixed-species plantings in a temperate continental climate effectively sequesters and stabilizes carbon within decades', *Global Change Biology,* 21:1552-1566.

Figure 27: Map of study area by Burrows et al. (2002)



Source: Adapted from Burrows et al. (2002)

Potential impacts of carbon sequestration in vegetation projects: co-benefits and disbenefits

In addition to carbon sequestration potential of different land restoration activities, land managers and policymakers need information on trade-offs and co-benefits to support decision making (Paul and Roxburgh 2020). Vegetation-based carbon projects can generate co-benefits in addition to carbon sequestration, 'including reduced erosion, reduced risk of waterlogging and flooding, mitigation of dryland salinity, improved water quality, benefits for biodiversity, provision of shade and shelter for livestock, and increased farm sale value' (Paul and Roxburgh 2020). However, facilitating regrowth of cleared vegetation across large areas of farms could also result in a loss of productive farming land (e.g. due to a potential reduction in recharge of ground water) and potentially reduce the property value of the land (Gameren et al. 2023).

Carbon sequestration may be maximized by planting high wood-density trees at high stand densities in long, narrow belt plantings (<40 m wide) with ≥40 m of non-planted land on either side, such as two- or three-row shelter belts of mallee eucalypt species, however, biodiversity benefits are optimized when mixed trees and shrubs are planted in wider block configurations (>40 m) (Paul and Roxburgh 2020).

Jassim et al. (2022) conducted a study in the Mulga Lands of Queensland identifying 'broader community perception and potential impacts of [carbon farming that results in] changes in land use and management'. At the time of the study in 2022, carbon farming projects covered 30% of the area in the Mulga Lands bioregion (Jassim et al. 2022). The majority of projects in the Mulga Lands utilised the human induced regeneration of a permanent even-aged native forest method (now closed) (Jassim et al. 2022). That method involved avoiding the suppression of native tree regrowth to sequester carbon (Jassim et al. 2022). Jassim et al. (2022) conducted interviews with local landholders with carbon projects, community members with no carbon farming projects, non-government industry organisations and government representatives. The study found that local community participants perceived carbon farming as reducing farming productivity and impacting biodiversity due to the transformation of the landscape from open and grassy to a mulga woodland monoculture (Jassim et al. 2022). However, some researchers have challenged the widely held local views on the perceived 'naturalness' of open woody vegetation and the tree-grassland balance in the Mulga Lands, citing empirical evidence (such as Ludwig Leichhardt's travel notes from 1844 to 1845[84] and rail survey plans dating from 1895 to 1900[85] (Jassim et al. 2022). 'Broadly, properties with dense mulga and non-active management were viewed as havens for pests and weeds, areas of higher fire risk, and areas of reduced biodiversity' (Jassim et al. 2022). Community members highlighted the impact of 'locking up' land on the social fabric, local businesses, and the economy (Jassim et al. 2022). One participant noted no direct economic losses but observed a decline in customers due to changes in land use activities (Jassim et al. 2022).

Jassim et al. (2022) found that amongst individual adopters of carbon farming, the key driver was additional income and income diversification that carbon farming offered. 'Some individual adopters noted that despite general disapproval from the community, the economic benefits presented by carbon farming were a primary driver of adoption, especially considering the existing financial and environmental pressures to their agricultural enterprises' (Jassim et al. 2022).

FullCAM

Under several ACCU scheme vegetation methods (including the avoided clearing of native regrowth method, plantation forestry method, and reforestation by environmental or mallee plantings FullCAM method 2024), project proponents are required to estimate sequestration using the Australian Government's Full Carbon Accounting Model (**FullCAM**). FullCAM is best suited to even-aged recovery from past disturbance (e.g., a clearing event) it is less suited to predicting change in woodland thickening from a mixed aged woodland (e.g., uncleared mulga or eucalypt woodlands).

For over two decades, FullCAM has been developed and improved, and it now covers all major plantation species and native vegetation in Australia (Forrester et al. 2024a). Initially, FullCAM was developed for monospecific, even-aged plantations (Forrester et al. 2024a), and was designed for use at very large spatial landscape-scales to calculate, for Australia's national greenhouse gas accounts, emissions and emissions abatement associated with deforestation and reforestation (Macintosh et al. 2024b). Despite this, FullCAM is now used locally, and because it was designed for large scale use, the 'local predictions are less precise with higher biases than when predictions are averaged across very large spatial scales' (Forrester et al. 2024a). Under the ACCU scheme methods, the application of FullCAM has been expanded to native vegetation, and it is now applied across a diverse range of vegetation types and climates (Forrester et al. 2024a).

Use of the FullCAM model to estimate sequestration, instead of in-field measurements, is designed to lower costs and promote participation in the scheme (Macintosh et al. 2024b).

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[84] Fensham RJ (2008) 'Leichhardt's maps: 100 years of change in vegetation structure in inland Queensland', *Journal of Biogeography,* 35:141-156.
[85] Fensham RJ, Powell O and Horne J (2011) 'Rail survey plans to remote sensing: Vegetation change in the Mulga Lands of eastern Australia and its implications for land use', *Rangeland Journal.*

Direct measurement of tree growth and carbon sequestration is expensive and could be a barrier to participation, whereas using modelling to calculate sequestration provides a lower cost option without necessarily substantially reducing integrity (Macintosh et al. 2022). The current version of FullCAM aims to reduce prediction bias across regions and Australia whilst maintaining its simplicity and useability and also incorporating the necessary complexity to capture the key factors impacting carbon stocks and fluxes (Forrester et al. 2024a). However, a consequence of modelling is the risk of inaccuracy that can result in overestimated sequestration (Macintosh et al. 2024b) or underestimated sequestration (Forrester et al. 2024a; Kramer et al. 2024).

The study by Macintosh et al. (2024b) looked at a sample of 116 projects using the HIR method (now closed) and found that the FullCAM sequestration estimates resulted in over crediting. Macintosh et al. (2024b) noted that, based on the amount of ACCUs awarded, the average canopy cover across the credited area of projects should have been ~20-60%, but in reality, the average canopy cover across the credited areas was 13.3%, significantly below the expected minimum. In contrast, a study by Kramer et al. (2024) that took place in Victoria and compared predictions of carbon in above-ground biomass using FullCAM to independently validated data from ground-based measurements, found that FullCAM had a negative bias of −24.6 tC/ha (−42.9% of the observed mean above-ground biomass).

FullCAM estimates the carbon stored in live and dead biomass, and accounts for disturbances such as burning, thinning or harvesting (Paul et al. 2022). Rather than being a statistical model relying on equations and parameters derived from data sets, or a process-based model that simulates the physiological processes that impact growth and how this is influenced by environmental factors, FullCAM adopts a hybrid approach and incorporates equations summarising decomposition, biomass allocation and growth processes with parameter values determined based on carbon pool and specific process observations (Forrester et al. 2024). Macintosh et al. (2024a) described how FullCAM operates:

> 'The model uses a simple tree yield formula to estimate above-ground biomass per hectare in regenerating forests. It assumes credited areas start with little woody biomass and grow towards their maximum woody biomass potential under native vegetation. Maximum above-ground woody biomass potential (M) is modelled spatially using a range of biophysical parameters calibrated against measurements of intact native vegetation. […] The above-ground biomass estimates from the model's tree yield formula are partitioned into biomass and debris pools via standardised allocation ratios (e.g. root-shoot), and turnover and decomposition rates, to calculate carbon accumulation in live above- and below-ground biomass and debris'.

The tree yield formula growth path is 'empirically constrained by parameters derived from a wealth of field data collected over many decades, while process-based inputs enable simulation of responses to conditions not adequately captured by empirical data, including non-average weather, locations not available in the empirical data set, and alternative climatic conditions' (Forrester et al. 2024). For example, 5,739 site-based measurements of above-ground biomass together with a Random Forest ensemble machine learning algorithm form the basis for the maximum above-ground woody biomass potential (M) parameter in the tree yield formula (Forrester et al. 2024a). In FullCAM, as per the typical growth of Australian native forests and plantations, the rate of growth of vegetation is assumed to be the highest between the ages 4 to 11 years (Forrester et al. 2024a).

Conclusion

In conclusion, this literature review of vegetation-based sequestration in Australia found both opportunities and challenges for carbon farming projects in agricultural systems. While the rate of carbon sequestration varies depending on the age of vegetation, species, planting design, soil type, rainfall, temperature, slope and environmental conditions, forests generally outperform other land uses (e.g. crops and pasture) in carbon storage due to their greater biomass and longevity. Carbon sequestration is typically highest in a tree's early growth between ages 4 to 11 years and levels off as the trees mature. Carbon sequestration rates in vegetation across Queensland ranges from 0.035t CO_2e/ha/yr (managed regrowth in the arid west) to 12.49t CO_2e/ha/yr (hardwood monoculture in high-rainfall areas of the coastal southeast Australia) (Comerford, Norman and Grand 2015). Vegetation-based carbon sequestration initiatives can deliver co-benefits, including enhanced biodiversity, improved water quality, and increased resilience to climate extremes. However, these benefits must be carefully balanced against potential trade-offs, such as the loss of productive agricultural land and potential reduction in land value. Accurate estimation of carbon sequestration is crucial to the integrity of such projects, and while FullCAM provides a cost-effective modelling tool for quantifying carbon stocks, its potential limitations at the local scale highlight the need for continuous model refinement and validation. Ultimately, well-designed and appropriately managed vegetation projects can contribute to Australia's climate goals.

4.3.2 Investment analysis

This section identifies and discusses the benefits and costs associated with the most utilised of the currently available vegetation methods, the environmental plantings method[86].

Key Assumptions

The principal assumptions used in the investment analysis include:

1. ACCU price is: $35, $50, and $100;
2. The discount rate is 5%;
3. FullCAM was ***not*** used to estimate the sequestration delivered by the project; instead three sequestration rates were used including: 1.4 t CO_2e/ha/yr, 1.8 t CO_2e/ha/yr, and 2.2 t CO_2e/ha/yr[87];
4. Sequestration rate assumed to remain constant throughout project (see 3.0.3 above);
5. Project permanence period is 25 years;
6. Two scenarios were analysed for two different project areas: scenario 1 is a project area of 4,350ha (50% of the farm size), and scenario 2 is a project area of 433ha (5% of the farm size);
7. It is assumed that the entire project area was planted;
8. Reports are completed and submitted to the CER every 5 years, and credits are issued every 5 years; and
9. The opportunity cost was estimated (see section below).

[86] See Appendix 9.1.2 for the method rules and current uptake.
[87] This investment analysis used sequestration rates instead of FullCAM modelling. This is a limitation of the results, because ACCU payments are based on the amount of sequestration a project can deliver, which is calculated using FullCAM.

Three rates of sequestration has been adopted based on the rates observed in central Queensland, including low rate of 1.4 t CO_2e/ha/yr, average rate of 1.8 t CO_2e/ha/yr and high rate 2.2 t CO_2e/ha/yr. Table 31 below contains the studies that these rates have been based upon.

Table 31: Central Queensland studies that observed rates of sequestration in vegetation

Study reference	Study region	Av. ann. rainfall (mm)	Vegetation type	Sequestration rate (t CO_2e/ha/yr)
Burrows et al. (2002)[88]	Woodland region of QLD, including Central QLD	-	Eucalyptus and/or Corymbia spp.	Average: 1.94 t CO_2e/ha/yr
Whish, Pahl and Bray (2016)[89]	Central QLD	653mm	Eucalypt woodlands	1.4 – 2.1 t CO_2e/ha/yr
Gowen and Bray (2016)[90]	Rolleston, Central QLD	621mm	Brigalow	1.4 t CO_2e/ha/yr
Dwyer et al. (2009)[91]	Brigalow belt bioregion in QLD and northern NSW	560mm	Brigalow	2.2 t CO_2e/ha/yr[92]

None of the above studies involved planted trees, and instead were observations of trees that varied in size across 57 sites that had not been cleared for approximately 20 years (Burrows et al. 2002) and observations of retained regrowth (Whish, Pahl and Bray 2016; Gowen and Bray 2016; Dwyer et al. 2009).

Benefits

The benefit of the project is the income earned from the sale of ACCUs generated. Table 32 below identifies the volume of ACCUs generated by the 25-year project for both project sizes (4,350ha and 433ha) at the three different ACCU prices and rates of sequestration, after the ACCU scheme discounts have been applied (permanence period discount of 20%, and risk of reversal discount of 5%).

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[88] Burrows WH, Henry BK, Back PV, Hoffmann MB, Tait LJ, Anderson ER, Menke N, Danaher T, Cater JO and McKeon GM (2002) 'Global and carbon stock change in eucalypt woodlands in northeast Australia: ecological and greenhouse sink', Global Change Biology, 8:769-784.
[89] Whish G, Pahl L and Bray S (2016) 'Implications of retaining woody regrowth for carbon sequestration for an extensive grazing beef business: a bio-economic modelling case study', *The Rangeland Journal,* 38:319-330.
[90] Gowen R and Bray SG, (2016) 'Bioeconomic modelling of woody regrowth carbon offset options in productive grazing systems', *The Rangeland Journal,* 38: 307-317.
[91] Dwyer JM, Fensham RJ, Butler DW, and Buckley YM (2009) 'Carbon for conservation: Assessing the potential for win–win investment in an extensive Australian regrowth ecosystem', *Agriculture, Ecosystems and Environment,* 134:1-7
[92] 'Sequestration rate of 0.6 t C ha/year (100 year average rate derived from 50% of the living AG biomass estimate of Moore et al., 1967)' (Dwyer et al. 2009)

Table 32: Benefits of 25-year project using the environmental plantings method

	Low sequestration rate 1.4 t CO_2e/ha/yr (t CO_2e)	Medium sequestration rate 1.8 t CO_2e/ha/yr (t CO_2e)	High sequestration rate 2.2 t CO_2e/ha/yr (t CO_2e)
Scenario 1: project area of 4,350 ha (50% of property area)			
Total t CO_2e sequestered over 25-year project (t CO_2e) ***less*** discounts (permanence period (20%) and risk of reversal (5%))	114,187.5 t CO_2e	146,812.5 t CO_2e	179,437.5 t CO_2e
Value of ACCUs if price = $35	$3,996,563	$5,138,438	$6,280,313
Value of ACCUs if price = $50	$5,709,375	$7,340,625	$8,971,875
Value of ACCUs if price = $100	$11,418,750	$14,681,250	$17,943,750
Scenario 2: project area of 433 ha (5% of property area)			
Total t CO_2e sequestered over 25-year project (t CO_2e) ***less*** discounts (permanence period (20%) and risk of reversal (5%))	11,366.25 t CO_2e	14,613.75 t CO_2e	17,861.25 t CO_2e
Value of ACCUs if price = $35	$397,819	$511,481	$625,144
Value of ACCUs if price = $50	$568,313	$730,688	$893,063
Value of ACCUs if price = $100	$1,136,625	$1,461,375	$1,786,125

Opportunity cost

Opportunity cost is a key determinant of the investment analysis assessment of carbon farming projects (Bowen and Chudleigh 2021). Efficient farm businesses will have a higher opportunity cost, compared to inefficient farms that have greater incentive to undertake a vegetation-based carbon farming project (Bowen and Chudleigh 2017). For example, Bowen and Chudleigh's (2021) study found that carbon farming was a viable option for farms located in the Mulga Land bioregion that is characterised by dry, semi-arid country with a low carrying capacity and hence low opportunity costs.

Undertaking an environmental plantings method project can reduce forage production on the project area due to tree growth, which can decrease carrying capacity (Gowen and Bray 2016). 'Cattle stocking rates must therefore be reduced in line with the reduced cattle carrying capacity to avoid a decline in land condition' (Gowen and Bray 2016).

Bowen and Chudleigh's (2018) representative Fitzroy farm model involved a 8,700 ha property with a carrying capacity of 1,500 AE (average carrying capacity of 0.17AE/ha). Bray and Golden's (2009) study involved a 4,000ha property located in the brigalow bioregion of southern-central Queensland that contained land cleared of brigalow that had a livestock carrying capacity of 0.4 AE/ha, which fell by 50% to 0.2 AE/ha if the land contained 20-year-old brigalow regrowth. In this study, it is assumed that the land is initially cleared of regrowth and has a carrying capacity of 0.17 AE/ha, and if a carbon sequestration project is commenced involving planting trees, the carrying capacity of the land will decline by 50% by year 20 (as was observed in the study by Bray and Golden (2009)).

Two scenarios were analysed for this cost-benefit analysis, namely:-

- **Scenario 1**: 50% of the Fitzroy farm model property area, 4,350 ha, is reserved for carbon sequestration and the carrying capacity declines linearly from 0.17AE/ha by 50% to 0.08AE/ha in year 20 and 0.06AE/ha in year 25; and
- **Scenario 2**: 5% of the Fitzroy farm model property area, 433ha, is reserved for a carbon sequestration and the carrying capacity declines linearly from 0.17AE/ha by 50% to 0.08AE/ha in year 20 and 0.06AE/ha in year 25.

Using the above assumptions, the opportunity cost of implementing an environmental plantings method project under scenarios 1 and 2 was calculated using the representative Fitzroy base model. The prices and variable costs were updated to 2025 values, and the fixed costs were assumed to remain the same. The carrying capacity was adjusted and the opportunity cost was equal to the difference between the herd gross margin if no carbon project was undertaken, and the herd gross margin of undertaking a carbon project, including the change in capital value of the herd from year 1 to year 25. The opportunity cost of undertaking an environmental plantings method project using the Fitzroy farm model from Bowen and Chudleigh's (2019) study is contained in Table 33 below.

Table 33: Opportunity cost of undertaking an environmental plantings method project

Opportunity cost = gross margin of herd without carbon project *less* gross margin of herd with carbon project, including the change in the capital value of the herd from year 1 to year 25	**Scenario 1: 4,350 ha (50% of farm) of the Fitzroy farm model is developed into a vegetation-based carbon sequestration project**	**Scenario 2: 433 ha (5% off farm) of the Fitzroy farm model is developed into a vegetation-based carbon sequestration project**
Opportunity cost of carbon project	$1,858,628	$212,159

Other costs

The exact value of the costs (in addition to opportunity cost) of undertaking a carbon sequestration project using the environmental plantings method are largely unknown, and Table 34 below contains an estimate of the costs. Where possible, costs were based upon peer reviewed data, however, for many costs there was no research available, so estimates from experienced stakeholders were sought. It has been assumed that a carbon service provider is engaged to deliver some services that involve complexities, such as the preparation of the offset reports. A cost estimate for weed control and fire management has not been included due to the lack of information of same, and the likelihood that the primary producer would perform these tasks themselves.

Table 34: Costs of 25-year project using the environmental plantings method

Project Scenario	**Scenario 1: Project area of 4,350ha**	**Scenario 2: Project area of 433 ha**
Project set up costs (Year 1) (feasibility study, project application, project plan, surveying and mapping,	$8,000 - $15,000	$8,000 - $15,000

agronomist advice, application management, financial and legal advice)		
Project establishment (Year 1) (buying seeds/seedlings, planting costs) @ $3,000/ha - $7,500/ha)	$13,050,000 - $32,625,000	$1,299,000 - $3,247,500
Ongoing project administration (monitoring and reporting @ $2,000/year)	$50,000	$50,000
Report (submitted every 5 yrs, $3,000/report)	$15,000	$15,000
Audit (total for 3 audits, $20,000/audit)	$60,000	$60,000
Opportunity cost	$1,858,628	$212,159
Total cost of 25-year project	**$15,041,628 - $34,623,628**	**$1,644,159 - $3,599,659**

Investment analysis results

The investment analysis of implementing an environmental plantings method project on Bowen and Chudleigh's (2018) Fitzroy representative farm model produced the results set out in Table 35 below. The red font denotes negative numbers.

Table 35: Net Present Value of 25-year environmental plantings method project

	Scenario 1: 4,350ha project area	Scenario 1: 4,350ha project area	Scenario 1: 4,350ha project area	Scenario 2: 433ha project area	Scenario 2: 433ha project area	Scenario 2: 433ha project area
ACCU Price / Sequestration rate	$35	$50	$100	$35	$50	$100
1.4 t CO_2e/ha/yr	-$29,854,169 to -$11,204,645	-$28,980,413 to -$10,330,889	-$26,067,891 to -$7,418,367	-$3,051,645 to -$1,189,264	-$2,964,671 to -$1,102,290	-$2,674,758 to -$812,377
1.8 t CO_2e/ha/yr	-$29,271,665 to -$10,622,141	-$28,148,263 to -$9,498,740	-$24,403,592 to -$5,754,068	-$2,993,663 to -$1,131,282	-$2,881,839 to -$1,019,458	-$2,509,093 to -$646,712
2.2 t CO_2e/ha/yr	-$28,689,160 to -$10,039,637	-$27,316,114 to -$8,666,590	-$22,739,294 to -$4,089,770	-$2,935,680 to -$1,073,299	-$2,799,007 to -$936,626	-$2,343,429 to -$481,048

The results demonstrate that in 100% of the 36 scenarios tested, a negative NPV was generated, indicating that primary producers would be worse off by undertaking the project. This is largely due to the high planting costs that ranged from $3,000/ha to $7,500/ha and the loss of agriculture production profits due to the change of land use from beef cattle production to an ACCU Scheme environmental planting project.

These results align with the results found by Waltham et al. (2025) in their analysis of an ACCU scheme planting project in the Mossman district, where they similarly found that the whole of project NPV was negative due to the high planting costs.

4.4 Beef cattle herd management method

This section details the investment analysis of three representative scenarios implementing a beef cattle herd management method[93] project. Scenario 1 involved planting improved pastures of leucaena to optimise steer growth in the Fitzroy region. The second and third scenarios involved supplementing cattle with phosphorus during the wet season in phosphorus deficient country in the Fitzroy region (scenario 2) and acutely phosphorus deficient country in the Burdekin region (scenario 3). Scenarios 1 and 2 were based on the Bowen and Chudleigh's (2018) representative Fitzroy farm model. Scenario 3 was based on the acutely phosphorus deficient farm model set out in DAF's (2024) report titled, "Burdekin Rangelands beef production systems: Profitable management strategies to build resilience".

4.4.1 Scenario 1: Establishing leucaena in the Fitzroy

Bowen and Chudleigh (2018)'s Fitzroy models were utilised to assess whether ACCUs could be earned by implementing pasture improvement by planting leucaena (see details at 3.0.2). In accordance with the ACCU scheme rules, the beef cattle herd management calculator was utilised to estimate the volume of avoided emissions generated by the project.

Several inputs must be entered into the beef cattle herd management calculator including:

1. Location of project. In this case, "Queensland – Moderate/High" region was selected;
2. For the project baseline period (3 years before project), number of cattle and their weight for the beginning and end of the year (or date during the year if a beast is purchased/sold) and the age/class of cattle;
3. For the project reporting years (7-year project), number of cattle and their weight for the beginning and end of the year (or date during the year if a beast is purchased/sold) and the age/class of cattle; and
4. Birth and death rates of the herd for both the baseline years and the project years.

The representative Fitzroy Base Model's herd data was used for the 3 baseline years. The data from the representative Fitzroy model with leucaena planting was used for the 7 project years. The result was that ACCUs were earned from year 4 to year 7, which corresponds with the weight increase of the steers that began in year 4 (once the leucaena had grown enough to be stocked) (see details at 3.0.2).

Benefits

Using the assumptions discussed above, the number of ACCUs generated by the project are identified in Table 36 below. The beef cattle herd management calculator includes the ACCU scheme discount. ACCUs were generated from year 4 to year 7, which corresponds with the increased steer growth rates and faster turnoff times that occurred from year 4. These improvements improved both 'kg beef produced per AE' and 'emissions intensity (t CO_2e per t LWG)' by 14% by year 5. Over the 7 years, the project generated net abatement of 1,032 t CO_2e and 1,032 ACCU's. If sold at the current ACCU price of $35, the project could generate total revenue of $36,127.

[93] The beef cattle herd management method was suspended in December 2024 and will expire on 1 October 2025. See Appendix 9.1.7 for the method rules and current uptake.

Table 36: Results from the beef cattle herd management calculator – Scenario 1

Project Year	Kg beef produced per AE (kg)	Emissions intensity of the herd liveweight gain (t CO_2e per t LWG)	ACCUs/Net Abatement (t CO_2e)	Value of ACCUs using price of $35	Value of ACCUs using price of $50	Value of ACCUs using price of $100
Baseline	204	9.0	-	-	-	-
1	207	8.9	0	$0	$0	$0
2	211	8.7	0	$0	$0	$0
3	211	8.7	0	$0	$0	$0
4	222	8.3	134	$4,673	$6,675	$13,350
5	232	7.9	287	$10,028	$14,325	$28,650
6	233	7.9	303	$10,588	$15,125	$30,250
7	233	7.9	310	$10,840	$15,485	$30,970
Total	**-**	**-**	**1,032**	**$36,127**	**$51,610**	**$103,220**

Costs

The costs of undertaking a beef cattle herd management method project are largely unknown and were estimated as having the values set out in Table 37. The costs excluding the producer's time were included to test the outcome of the investment analysis in a situation where the producer was already recording weights and did not require an extra muster, so the additional costs were not incurred. Furthermore, whilst inaccurate, some producers do not value their time when making cost benefit assessments to aide in decision making.

Table 37: Costs of beef cattle herd management method project – Scenario 1

Description	Costs (including producer's time)	Costs (excluding producer's time)
Legal advice, accounting advice, feasibility advice (optional)	$10,000	$10,000
Project registration fee	Nil	Nil
Reporting (total cost for 7-year project) *(assumed to be 1-2 days' work each year, using hourly rate of $35)*	$1,960 – $3,920	-
Record keeping (total cost for 7-year project)	$78,271 – $108,347	-
Weighing of cattle (3 people, 6 hours (30 cattle/ hour, 6 classes of cattle), $35/hour)	*$630/muster*	
Extra muster ($3.90-$6.23/head)[94]	*$7,191.60 - $11,488.12 /muster*	
Record keeping of weights and cattle movements (1 day each month, $35/hour)	*$3,360/annum*	

[94] Petty et al. (2013) identified the costs of mustering with helicopter plus riders on horses as $4.80/head, and mustering with riders on horses as $3.00/head. Using the Reserve Bank of Australia inflation calculator, the 2013 values have a current value of $6.23 and $3.90 respectively. Average number of cattle aged <3years in year 1 to 7 is 1,844 head (used for calculation).

Weighing scales	$1,500 – $5,000	$1,500 – $5,000
Audit (3 audits during project @ $7,000 - $11,000/audit)[95]	$21,000 – $33,000	$21,000 – $33,000
Total costs for 7-year project	**$112,731 to $160,267**	**$32,500 to $48,000**

Investment analysis results

The investment analysis of implementing a beef cattle herd management method project on Bowen and Chudleigh's (2018) Fitzroy representative farm model involving planting leucaena produced the results set out in Table 38 below. The red font denotes negative numbers.

Table 38: Net Present Value of beef cattle herd management method project – Scenario 1

ACCU Price	NPV of 7-year project using costs including value of primary producer's time	NPV of 7-year project using costs excluding value of primary producer's time
$35	-$107,019 to -$67,300	-$14,216 to -$979
$50	-$95,317 to -$55,598	-$2,514 to $10,723
$100	-$56,310 to -$16,591	$36,493 to $49,730

The results demonstrate that in 75% of the 12 scenarios tested, a negative NPV was generated, indicating that primary producers would be worse off by undertaking the project. This is largely due to the high record keeping costs. The remaining 25% of scenarios tested generated a positive NPV. Positive NPVs only occurred at ACCU prices of $50 and $100, and under the lower cost scenario that excluded the value of the producer's time to conduct record keeping.

Bowen and Chudleigh's 2018 report identified that the annualised profit from planting leucaena was $40,336, and the total profit over the 30-year period was $620,063. The peak deficit was -$145,772, which occurred in year 4. The payback period was 7 years. The NPV of the 7-year project identified in Table 38 above is ***in addition*** to the profits identified in Bowen and Chudleigh (2018).

The results from the beef cattle herd management calculator illustrate that, if the cost of the producer's time is considered, there is no possibility of a positive NPV. These results appear in line with the low market participation of producers in the beef cattle herd management method.

4.4.2 Scenario 2: Feeding phosphorus supplement during wet season in phosphorus deficient country in the Fitzroy

Bowen and Chudleigh (2018) demonstrated that for cattle herds deficient in phosphorus (P) in the Fitzroy region, supplementing cattle with phosphorus during the wet season would result in improved profits of the beef business. Low soil P can result in phosphorus deficient cattle and that can adversely impact the productivity of the cattle herd due to poor appetite and feed intake, poor growth, increased breeder mortality, bone breakage, bone deformities, and decreased fertility and milk production (Bowen and Chudleigh 2018). Supplementing P-deficient cattle with P increases feed consumption, growth rates of young stock, weaning rates, and reduces death rates (Bowen and Chudleigh 2018). The wet season is the most effective time to supplement P because that is when the cattle's P requirements are the highest because they are growing with the high feed quality (and if control breeding, cows are in late pregnancy or lactating) (Dixon et al. 2020).

[95] Waltham et al. (2024) estimated the audit cost as $7,000 - $11,000.

In the Fitzroy region, most grazing lands are categorised as having 'adequate' or 'marginal' P status, but some smaller areas are categorised as having 'deficient' or 'acute' P status (Bowen and Chudleigh 2018). To conduct their 30-year analysis, Bowen and Chudleigh modelled 12 scenarios to encompass a range of categories of P status (marginal, deficient and acute) and the timing of the P supplementation (wet season, dry season, and wet and dry season) (**P supplementation models**). The P supplementation models were different from the representative Fitzroy model with a leucaena planting that assumed there were adequate levels of soil P. Bowen and Chudleigh (2018) found that the projected profit was highest if the P supplementation occurred during the wet season. Furthermore, the profit increased as the severity of the P deficiency increased ($7,918/annum for marginal P herd, $17,967/annum for deficient P herd, and $48,126/annum for acute P herd) (Bowen and Chudleigh 2018). For the P supplementation models, it was assumed that the breeder herd was run on the P-deficient country, whilst the heifer and steer herds continued to run on the more productive country that had adequate levels of soil P; hence the heifers and steers required no P supplementation and had the same growth path as the representative Fitzroy base model (see details at 3.0.2).

Key Assumptions

The focus of this report is one of the 12 models analysed by Bowen and Chudleigh (2018): **deficient P herd, wet season P supplementation**. Bowen and Chudleigh (2018) made several assumptions to conduct their analysis of the impact of P supplementation on a deficient P herd, which they compared to baseline deficient P herd that received no supplementation. The assumptions included:

- The breeder herd received the P supplementation during the wet season from year 1 to year 30. From year 1 to 30, the P supplement costs for the breeder herd was $5.32/breeder;
- The effects of the P supplementation on liveweight, conception rates and death rates were gradually experienced by the herd from year 2 to year 5. From year 5 onwards, the full effects of the P supplementation were experienced;
- The liveweight of the breeder cows gradually increased in year 2, 3, 4 and 5, by which time the complete effect of the P supplementation was experienced. Similarly, by year 5, the liveweight of the weaners increased. From year 5 onwards, the liveweights remained the same. By year 5, the P-supplemented breeder cows were 15 kg heavier than the breeder cows receiving no P supplementation, and the P-supplemented breeder cows' calves were 5kg heavier at 12 months old than the calves of the breeders receiving no supplementation;
- The death rates of the female cattle without supplementation was 6% for heifers and cows aged over 2 years. Once supplemented, the death rate for heifers and cows aged over 2 years gradually reduced from year 1 to year 5, by which time the new death rate of 4% was reached;
- The conception rates of the female cattle without supplementation was 60% for 3 year old cows, 75% for 4-7 year old cows, and 70% for 8-13 year old cows. Once supplemented, the conception rate for cows gradually increased from year 1 to year 5, by which time the new conception rates of 75%, 81% and 75% were reached for cows aged 3 years, 4-7 years and 8-13 years respectively;
- The herd structure of the P-deficient herd receiving P supplementation reached its new constant by year 13, by which time it had changed compared to the baseline herd structure in several ways. The total number of breeder cows retained at the end of the

year reduced from 555 head to 540 head on account of the breeder cows each being 15 kg heavier and having a higher conception rate (weaning rate on cow retained increased from 89.81% in baseline years to 92.72% in year 13). The number of calves produced annually decreased from 529 in the baseline years to 522 in year 13, and there was a slight reduction in the heifer and steer herds compared to the baseline years.

Beef cattle herd management calculator results

Bowen and Chudleigh (2018)'s Fitzroy P-deficient model before and after P supplementation as described above was utilised to assess whether ACCUs could be earned by supplementing the breeder herd with P during the wet season. The region selected in the was "Queensland – Moderate/Low", so corresponds with the P-deficient status of the land. Herd data from the Fitzroy baseline model (P-deficient herd receiving no supplementation) was used for the 3 baseline years and herd data from the Fitzroy P-deficient model incorporating the change after P supplementation of the breeder herd occurred was used for the 7-year project.

Benefits

The number of ACCUs generated by the project, kilograms of beef produced per adult equivalent, and emissions intensity of the herd liveweight gain are detailed in Table 39 below.

Table 39: Results from the beef cattle herd management calculator – Scenario 2

Project year	Kg beef produced per AE (kg)	Emissions intensity of the herd liveweight gain (t CO_2e per t LWG)	ACCUs/Net Abatement (t CO_2e)	Value of ACCUs using price of $35	Value of ACCUs using price of $50	Value of ACCUs using price of $100
Baseline	211	8.7	-	-	-	-
1	210	8.8	0	$0	$0	$0
2	211	8.7	0	$0	$0	$0
3	213	8.7	0	$0	$0	$0
4	217	8.5	0	$0	$0	$0
5	220	8.4	2.1	$74	$105	$210
6	219	8.4	0	$0	$0	$0
7	219	8.4	0	$0	$0	$0
Total	**-**	**-**	**2.1**	**$74**	**$105**	**$210**

The results show 2.1 ACCUs were generated in total by the project in year 5, which corresponds with the full liveweight increase, the full reduction of the female death rates, and the full increase of the conception rates that occurred in year 5. Overall, 'kg beef produced per AE' and 'emissions intensity (t CO_2e per t LWG)' improved by just 4%. In years 2 and 3, the increased liveweight of the breeder cows, and improved conception and death rates were too small a change to improve the emissions intensity of the herd. In years 4, 6 and 7, the emissions intensity of the herd liveweight gain improved by decreasing from the baseline level of 8.7t CO_2e per t live weight gain (LWG) to 8.5 t CO_2e per t LWG in year 4 and 8.4 t CO_2e per t LWG in year 6 and 7. However, no ACCUs were generated because the net abatement amount is calculated by first subtracting 4% from the herd's historical baseline emissions (on account of a variation to emissions from environmental factors outside of the projects control), and then the difference between that amount and the herd's emissions in the project year is calculated.

Costs

The costs of undertaking a beef cattle herd management method project are largely unknown and were estimated as having the values set out in Table 40 below.

Table 40: Costs of beef cattle herd management method project – Scenario 2

Cost	Costs (including producer's time)	Costs (excluding producer's time)
Legal advice, accounting advice, feasibility advice (optional)	$10,000	$10,000
Project registration fee	Nil	Nil
Reporting (total cost for 7-year project) *(assumed to be 1-2 days' work each year, using hourly rate of $35)*	$1,960 – $3,920	-
Record keeping (annual cost) Weighing of cattle (3 people, 6 hours (30 cattle/ hour, 6 classes of cattle), $35/hour) Extra muster ($3.90-$6.23/head)[96] Record keeping of weights and cattle movements (1 day each month, $35/hour)	$80,619 – $112,097 *$630/muster* *$7,527 – $12,023.90/muster* *$3,360/annum*	-
Weighing scales	$1,500 – $5,000	$1,500 – $5,000
Audit (3 audits during project @ $7,000 - $11,000/audit)[97]	$21,000 – $33,000	$21,000 – $33,000
Total costs for 7-year project	**$115,079 to $164,017**	**$32,500 to $48,000**

Investment analysis results

The investment analysis of undertaking a beef cattle herd management method project by supplementing a P-deficient breeder herd with P, using Bowen and Chudleigh's (2018) Fitzroy deficient P model, produced the results set out in Table 41 below. The red font denotes negative numbers.

Table 41: Net Present Value of beef cattle herd management method project – Scenario 2

ACCU Price	NPV of 7-year project using costs including value of primary producer's time	NPV of 7-year project using costs excluding value of primary producer's time
$35	-$137,366 to -$96,488	-$41,464 to -$28,226
$50	-$137,342 to -$96,464	-$41,439 to -$28,202
$100	-$137,259 to -$96,381	-$41,357 to -$28,119

The results demonstrate that in all of the 12 scenarios tested, a negative NPV was generated, indicating that primary producers would be worse off by undertaking the project. This is largely due to the meagre amount of ACCUs generated by the project.

[96] Petty et al. (2013) identified the costs of mustering with helicopter plus riders on horses as $4.80/head, and mustering with riders on horses as $3.00/head. Using the Reserve Bank of Australia inflation calculator, the 2013 values have a current value of $6.23 and $3.90 respectively. Average number of cattle aged <3 years for year 1-7 was 1,930 head (used for calculation)

[97] Waltham et al. (2024) estimated the audit cost as $7,000 - $11,000.

Bowen and Chudleigh's (2018) report identified that the annual profit from supplementing a deficient P herd with P during the wet season was $17,967 with a peak deficient of -$4,251 and a payback period of 1 year. The negative net benefits of the 7-year project identified in Table 41 above are ***in addition*** to the profit identified in Bowen and Chudleigh (2018). These results appear in line with the low participation rate of producers in the beef cattle herd management method.

4.4.3 Scenario 3: Feeding phosphorus supplement during wet season in acutely deficient phosphorus country in the Burdekin

DAF (2024)'s report regarding beef production in the Burdekin rangelands demonstrated that wet season P supplementation of cattle herds acutely deficient in phosphorus (P) in the Burdekin rangelands region would increase profits of the cattle farming business. DAF (2024) identified from a 30-year analysis that P supplementation during the wet season would generate $168,900 additional profit/annum, with a peak deficit of -$158,400 and a payback period of 2 years. For acutely deficient herds, wet season P supplementation offered the highest profit (compared to dry season supplementation or dry and wet season supplementation).

Cattle herds acutely deficient in P in northern Australia can suffer a 20-percentage unit decline in weaning rates, a 32kg decrease in calf liveweight at weaning and cull-cow liveweight at the end of the wet season, and a 13-percentage unit increase in breeder mortality (Dixon et al. 2020). Supplementing an acutely deficient cattle herd can negate these impacts by increasing feed consumption and improving growth rates, reducing the effects of nutritional deficiencies in pasture and increasing breeder productivity (DAF 2024).

The Burdekin Rangelands Region

The Burdekin Rangelands region of Queensland encompasses 5.5 million ha of grazing land (DAF 2024). DAF (2024) constructed a representative Burdekin Rangelands farm model based on data from that region for the purpose of conducting analysis of economic implications of various management decisions relating to drought resilience.

Using Breedcow and Dynama herd budgeting software, DAF (2024) constructed a 30-year analysis of a representative case-study beef cattle enterprise and looked at four types of P deficient land including adequate, marginal, deficient and acutely deficient. The highest additional profit was generated from P supplementation of acutely deficient P herds with supplementation occurring during the wet season, which is the focus of this analysis. DAF's (2024) report looked at a strategy of wet season P supplementation of the breeder herd, heifers aged 1-2 years, steers aged 1-2 years, steers aged 2-3 years, and steers aged 3-4 years. DAF (2024) made several assumptions to conduct its analysis of the impact of supplementing with P during the wet season, which was compared to a baseline acutely deficient P herd of cattle receiving no supplementation. The assumptions and characteristics of the representative property and herd include:

- 25,000ha property with a carrying capacity of 3,000 adult equivalents;
- Soil acutely deficient in phosphorus*;*
- It was assumed that the P supplement was fed to the cattle as a loose lick. The cost (including freight) of the P supplement was $2,097/t. In addition, in year 1 of the project, a capital expense of $20,000 was incurred on account of the cost of infrastructure to feed out loose lick (e.g. construction of feeding sheds and installation of troughs) (DAF 2024). 'Labour costs for feeding out loose lick in the paddock ranged from $1.25-$2.40/head /annum' (DAF 2024);

- The cattle herd received the full amount of P supplementation from year 1 to 7 of the project. However, the effect of the P supplementation (increased cattle weights, decreased death rates, increased weaning rate) were not experienced until year 3 of the project. From year 3 onwards, the cattle weights for all classes of cattle increased by 23kg to 27kg annually compared to the baseline when no P supplement was fed;
- Once receiving the P supplementation, the death rates of the male and female cattle decreased by between 1 to 4 percentage points (depending on cattle class) in year 3 of the project, by which time the full effect of the P supplementation was experienced. The death rates from year 1 to 3 remained the same as the baseline;
- The conception rates of the female cattle mated increased in year 3 by between 11.9 and 36.7 percentage points compared to the baseline conception rates, depending on age of the female cattle;
- The herd structure for the baseline model (acute P herd receiving no supplementation) is the same as the year 1 herd structure. The cattle herd structure remained the same as the baseline herd structure for the first 2 years. From year 3 onwards, once the effects of the P supplementation were experienced, the herd structure began to change. By year 7, compared to the baseline herd structure, the number of calves produced each year increased from 748 calves to 775 calves, the heifer and steer weaner herds increased by 17 and 16 head respectively, the 1-2 year old heifer and steer herds increased by 22 and 21 head respectively, the 2-3 year old steer herd increased by 26 head, and the 3-4 year old bullock herd increased by 27 head. The breeder herd decreased from 1,358 head to 1,078 head on account of the breeder cows each being 20 kg heavier (30kg heavier for sale cows) and having a higher conception rate (weaning rate on cows mated increased from 46.96% in baseline years to 57.01% in year 7). The number of bulls decreased from 61 head to 51 head.

Beef cattle herd management calculator results

DAF's (2024) acute P model before and after P supplementation as described above was utilised to assess whether ACCUs could be earned by supplementing the cattle herd with P during the wet season. The region selected in the beef cattle herd management calculator was "Queensland – Low", to correspond with the acute P status of the land. Herd data from the Burdekin Rangelands acutely P-deficient baseline model (acutely P-deficient herd receiving no supplementation) was used for the 3 baseline years and herd data from the Burdekin Rangelands acutely P-deficient model incorporating the change after P supplementation of the cattle herd occurred was used for the 7-year project.

Benefits

The number of ACCUs generated by the project are detailed in Table 42 below.

Table 42: Results from the beef cattle herd management calculator – Scenario 3

Project Year	Kg beef produced per AE (kg)	Emissions intensity of the herd liveweight gain (t CO_2e per t LWG)	ACCUs (Net Abatement, t CO_2e)	Value of ACCUs using price of $35	Value of ACCUs using price of $50	Value of ACCUs using price of $100
Baseline	115	16.0	-	-	-	-
1	115	16.1	0	$0	$0	$0
2	115	16.1	0	$0	$0	$0

3	151	12.2	1,314	$45,983	$65,690	$131,380
4	157	11.7	1,535	$53,739	$76,770	$153,540
5	157	11.7	1,550	$54,261	$77,515	$155,030
6	158	11.7	1,585	$55,482	$79,260	$158,520
7	158	11.6	1,608	$56,284	$80,405	$160,810
Total	**-**	**-**	**7,593**	**$265,748**	**$379,640**	**$759,280**

ACCUs were generated from year 3 to year 7, which corresponds with the liveweight gain increase, reduction of death rates, and increase of conception rates that occurred in year 3. These improvements combined to improve both 'kg beef produced per AE' and 'emissions intensity (t CO_2e per t LWG)' by 38%. Over the 7 years, the project generated net abatement of 7,593 t CO_2e and 7,593 ACCU's. If sold at the current ACCU price of $35, the project could generate total revenue of $265,748.

Costs

The costs of undertaking a beef cattle herd management method project are largely unknown and were estimated as having the values set out in Table 43 below.

Table 43: Costs of beef cattle herd management method project – Scenario 3

Cost	Costs (including producer's time)	Costs (excluding producer's time)
Legal advice, accounting advice, feasibility advice (optional)	$10,000	$10,000
Project registration fee	Nil	Nil
Reporting (total cost for 7-year project) *(assumed to be 1-2 days' work each year, using hourly rate of $35)*	$1,960 – $3,920	-
Record keeping (annual cost) Weighing of cattle (3 people, 6 hours (30 cattle/ hour, 6 classes of cattle), $35/hour) Extra muster ($3.90-$6.23/head)[98] Record keeping of weights and cattle movements (1 day each month, $35/hour)	$101,339 – $145,197 *$630/muster* *$10,487.10 – $16,752.47/muster* *$3,360/annum*	-
Weighing scales	$1,500 – $5,000	$1,500 – $5,000
Audit (3 audits during project @ $7,000 - $11,000/audit)[99]	$21,000 – $33,000	$21,000 – $33,000
Total costs for 7-year project	**$135,799 to $197,117**	**$32,500 to $48,000**

[98] Petty et al. (2013) identified the costs of mustering with helicopter plus riders on horses as $4.80/head, and m ustering with riders on horses as $3.00/head. Using the Reserve Bank of Australia inflation calculator, the 2013 values have a current value of $6.23 and $3.90 respectively. Average number of cattle aged <3 years for year 1-7 was 2,689 head (used for calculation)

[99] Waltham et al. (2024) estimated the audit cost as $7,000 - $11,000.

Investment analysis results

The investment analysis of undertaking a beef cattle herd management method project by supplementing an acutely deficient P herd with P using DAF's (2024) representative Burdekin Rangelands farm model produced the results set out in Table 44 below.

Table 44: Net Present Value of beef cattle herd management method project – Scenario 3

ACCU Price	NPV of 7-year project using costs including value of primary producer's time	NPV of 7-year project using costs excluding value of primary producer's time
$35	$43,064 to $94,175	$166,328 to $179,565
$50	$132,142 to $183,253	$255,406 to $268,643
$100	$429,068 to $480,179	$552,332 to $565,570

All 12 scenarios tested generated a positive NPV ranging from $43,064 to $565,570 in total for the 7-year project, indicating that the primary producer would be better off by undertaking the project. The highest NPV ($565,570) was generated for an ACCU price of $100 and the lowest end of the cost scenario that excluded the value of the primary producer's time.

DAF (2024) identified from a 30-year analysis that P supplementation during the wet season for an acute P herd would generate $168,900 additional profit/annum, with a peak deficit of -$158,400, and a payback period of 2 years. The NPV of the 7-year project identified in Table 44 above is ***in addition*** to the returns identified in DAF's (2024) report. These results do not align with the low uptake by primary producers of projects using this method, which is discussed below.

4.4.4 Discussion

Under the beef cattle herd management method (which has been suspended and will close in October 2025), ACCUs are awarded for new management activities that result in reduced emissions intensity of the herd liveweight gain, which can be achieved by increasing weaning and branding rates, increasing growth rates, and lowering mortality rates, all of which will lead to improved productivity and profitability of the beef operation (regardless of whether ACCUs are generated) (Wiedemann et al. 2015; Bray et al. 2016). Beef production systems with better efficiency will produce more beef per unit of methane emitted (Rolfe 2001). Therefore, primary producers are likely achieving desirable carbon farming outcomes (in terms of emissions intensity of beef production) by adopting best livestock management practices (Bray et al. 2016). Since the beef cattle herd management method began in 2015, 15 projects have been registered across Australia using the method, 11 of which are based in Queensland. Of these, only 3 projects (or 20%) have been issued a total of 1,044,037 ACCUs (which is ~40% of the total number of ACCUs issued for projects using agriculture methods). The project proponents undertaking projects using this method have large cattle herds with numbers greater than 50,000 head. Three key factors may explain the low participation by primary producers in ACCU scheme projects adopting the beef cattle herd management method and the trend that project proponents are typically large scale cattle producers, including: (1) the business scale required to generate enough ACCUs; (2) the inefficiencies of the baseline beef production business required so that a project will generate improvements to the emissions intensity of the herd; and (3) the length of time required for changes in a herd to materialise (for example, genetic changes) (Bray et al. 2016).

First, it has been suggested that a large scale of operation would be required to cover the costs of implementation of a beef cattle herd management method project (Bray et al. 2015). Dr Stephen Wiedemann stated, '[the] best opportunities are for large herds (>20,000 AE)'

(Wiedemann 2015), and Walsh and Cowley (2016) suggested that if the ACCU price was $25, a herd size of at least 6,800AE was required to cover the project costs. This may be because as the number of cattle that experience improved emissions intensity of liveweight gain increase, the number of ACCUs generated increases.

Furthermore, a project using the beef cattle herd management method may only be feasible for large scale operations due to economies of scale. Economies of scale is the concept that as the output of a farm increases, the average cost per unit of production decreases (de Roest et al. 2017). Productivity in Australia's agriculture sector has risen by 2.5% each year because of technical progress such as significant improvements in land and labour productivity (Chavas 2008). The increase in farm productivity that has occurred over the past few decades is partially due to increased specialisation (Chavas 2008). Specialisation and economies of scale often go hand in hand because scale enlargement is often the only way to profitably employ expensive new technology (de Roust 2007). It is understood that in some areas of a beef cattle production operation, there are economies of scale and larger operations have the economic advantage of lower marginal costs (EY 2018; Langemeier et al. NK; Ikerd 2023; Wu et al. 2019; Pritchard et al. 2010), such as lower marginal costs of record keeping, mustering and reporting. This suggests there is little opportunity for the majority of Queensland farmers to undertake a project using this method, given that the average beef cattle herd per farm in Queensland is 1,151 head (ABARES 2024*b*). However, diseconomies from elsewhere can be hidden by economies from another source (Moran 1961), and the continued survival of the family farm suggests that 'even small farms can be scale efficient' (Chavas 2008). Whilst there are some economies of scale in beef cattle production, the average cost function has a typical L shape, which means that average costs tend to decline as farm size increases but reach a lower plateau for average to large farm sizes (Chavas 2008).

The scenario 1 (leucaena planting in Fitzroy region) and scenario 2 (P supplementation of a P deficient herd in the Fitzroy region) analysis involved a beef cattle herd of 1,500 adult equivalents. The investment analysis for scenario 1 were that in 75% of the 12 scenarios tested, a negative NPV was generated, largely due to the high record keeping costs. The remaining 25% of scenarios tested generated a positive NPV, which only occurred at ACCU prices of $50 and $100, and under the lower cost scenario that excluded the value of the producer's time to conduct record keeping. The investment analysis from scenario 2 revealed that in all 12 scenarios tested, a negative NPV was generated. Given that the ACCU price as of 31 March 2025 was $33.08/ACCU, these results are consistent with the concept that a large scale operation with large herd numbers is required for an ACCU project using this method to be feasible. However, the results from scenario 3 (P supplementation of a P deficient herd in the Burdekin region), involving a beef cattle herd of 3,000 adult equivalents, illustrated that a positive net benefit could be generated from undertaking a project using this method at all ACCU prices and cost levels. Scenario 3 involved a herd twice the size of the herd in scenario 1 and 2, which may have contributed to the difference in results. However, it is likely that the significant improvement of the overall herd efficiency in scenario 3 was the ultimate reason a positive NPV was generated, which is further explained below.

Second, the magnitude of the changes to the beef cattle herd weight gains, weaning and branding rates and/or mortality rates must be significant to achieve the desired productivity, profitability or emissions improvement (Bray et al. 2016). Wiedemann (2015) posited that beef cattle operations that are currently performing poorly have the greatest opportunity to generate ACCUs by implementing management changes to reduce the emissions intensity of the herd liveweight gain. 'Lower quality pastures and lower turnoff management systems will produce higher levels of methane emissions per kilogram of beef produced' (Rolfe 2001). The results from this report support Wiedemann's assessment. For example, in scenario 3 (P supplementation of an acutely P deficient herd in the Burdekin Rangelands region), undertaking a project resulted in a positive NPV. In contrast, in scenario 2 (P supplementation of a P deficient herd in the Fitzroy region), undertaking a project generated a negative NPV. The key difference between the scenarios was the magnitude of the change caused by the P supplementation, which was significantly larger in scenario 3 compared to scenario 2. Scenario 3 involved an acutely P deficient herd, and the P supplement was fed to all classes of cattle who experienced the full benefit of the P supplementation by year 3. In comparison, in scenario 2, only the breeder cows were deficient in P and received the supplementation, and the cows experienced the full benefit of the P supplementation by year 5. Table 45 below details the differences between scenario 2 and 3 and notes the much higher impact of the P supplementation in scenario 3.

Table 45: Comparison of results of wet P supplement for Fitzroy and Burdekin herds

	Fitzroy deficient P herd (Scenario 2)	Burdekin Rangelands acute P herd (Scenario 3)
Property size	8,700 ha	25,000 ha
Carrying capacity	1,500 AE	3,000 AE
Year full effects of P supplementation experienced	Year 5	Year 3
Class of cattle receiving supplementation	Breeder cows	All cattle
Weight gain	In year 5, compared to the baseline herd, the retained cattle in the following classes had an extra liveweight gain/head of: • Cows 3+, 15kg; and • Heifers 0-1 and steers 0-1, 5kg.	In year 3, compared to the baseline herd, the retained cattle in the following classes had an extra liveweight gain/head of: • Heifers 0-1, 24kg; • Heifers 1-2, 20kg; • Heifers 2-3, 23kg; • Cows 3+, 20kg; • Steers 0-1, 27kg; • Steers 1-2, 25kg; • Steers 2-3, 25kg; • Bullocks 3-4, 25kg.
Death rate	The female death rates decreased as follows: • Heifers 2-3, from 6% to 4% in year 5; and • Cows +3 years, from 6% to 4% in year 5.	Both the male and female death rates decreased as follows: • Steers 0-1, from 7.8% to 6.8% in year 3; • Steers 1-2, steers 2-3 and bullocks +3, from 3.8% to 2.3% in year 3; • Heifers 0-1, 7.8% to 6.8% in year 3; • Heifers 1-2, 3.8% to 2.3% in year 3; • Heifers 2-3, 11.6% to 8.6% in year 3; and • Cows +3 years, 8.7% to 4.7% in year 3.

Conception rate	The conception rates increased as follows: • Cows 3 yrs, 60% to 75%; • Cows 4-7 yrs, 75% to 81%; and • Cows 8-13 yrs, 70% to 75%.	The conception rates increased as follows: • Heifers 2-3 yrs, 48.9% to 85.6%; • Cows mated 3 yrs, 19.3% to 33.6%; • Cows mated 4 – 5 yrs, 59.7% to 72.2%; • Cows mated 6 yrs, 57.9% to 69.8%; • Cows mated 7 yrs, 55.2% to 68.3%; • Cows mated 8 yrs, 54.1% to 66.8%; • Cows mated 9 – 10 yrs, 49.7% to 62.9%; and • Cows mated 11 – 12 yrs, 58.9% to 88.3%.
Herd structure	By year 13, compared to the baseline herd structure: • total number of breeder cows decreased from 555 head to 540 head on account of the breeder cows each being 15 kg heavier and having a higher conception rate (weaning rate on cow retained increased from 89.81% to 92.72%); • calves produced annually decreased from 529 in to 522; • slight reduction in the heifer and steer herds.	By year 7, compared to the baseline herd structure: • total number of breeder cows decreased from 1,358 head to 1,078 head on account of the breeder cows each being 20 kg heavier (30kg heavier for sale cows) and having a higher conception rate (weaning rate on cows retained increased from 50.03% to 67.89% in year 7); • calves produced annually increased 748 to 775; • heifer and steer weaner herds increased by 17 and 16 head respectively; • 1-2 year old heifer and steer herds increased by 22 and 21 head respectively; • 2-3 year old steer herd increased by 26 head; • 3-4 year old bullock herd increased by 27 head; and • bulls decreased from 61 head to 51 head.
Total ACCUs generated from 7-year project	2.1 ACCUs	7,592.8 ACCUs
Annual profit identified in Bowen and Chudleigh (2018) and DAF (2024)	$17,967 additional profit/annum, with a peak deficient of -$4,251 and a payback period of 1 year	$168,900 additional profit/annum, with a peak deficit of -$158,400, and a payback period of 2 years

Furthermore, more significant changes in herd efficiency may be possible for large scale operations (compared to smaller scales) because of the potential labour inefficiencies within their business. Large operations may have less efficient labour compared to family farms. ‘It has long been the common belief that family labour is more motivated to work harder and longer [than employed labour], because of the added profit incentive associated with farm ownership’ (Australian Farm Institute 2015). ‘Small farms often involve family labour, [and] measured labour productivity does tend to be higher than on larger farms’ (Westbrooke and Nuthall 2017). Corporate farms often face slower decision-making due to multiple management layers and a greater number of stakeholders, which can result in lower returns compared to the more agile, family-run operations (Wu et al. 2019). Therefore, a project using the beef cattle herd management method will likely be feasible and generate a positive NPV in circumstances where the management change causes significant improvements in the beef cattle herd.

Third, the project period for the beef cattle herd management method is 7 years. This timeframe may not capture the improvement to herd emissions intensity generated by long-term practice changes such as pasture improvement, fertility selection and genetics. Although these strategies ‘do deliver long-term productivity and emissions intensity benefits, these practices are unlikely to make a measurable difference to emissions intensity over the relatively short timeframe of a contracted project’ (Walsh and Cowley, 2016). The results from scenario 1 (planting leucaena) and scenario 2 (P supplementation of a P deficient herd in the Fitzroy region), that a negative NPV was generated in 75% and 100% of tested scenarios respectively, are consistent with Walsh and Cowley’s (2016) analysis, because the benefit of the management change was not experienced by the herd until year 4 in scenario 1 and year 5 in scenario 2. In scenario 1, ACCUs were generated from year 4 onwards, once the cattle were grazed on leucaena.

In summary, the limited participation of primary producers in projects using the ACCU scheme beef cattle herd management method may be driven by the large cattle herd numbers required to achieve financial feasibility due to the economies of scale of costs including record keeping, mustering and reporting. Scenario 3’s investment analysis suggests that the large herd requirement can be offset in cases where significant improvements the beef cattle herd can be achieved by a management change. Additionally, the delayed onset of measurable benefits within the 7-year project timeframe presents a challenge to project proponents. The scenario analyses confirm that only under specific conditions—such as large herd sizes, acute baseline inefficiencies, and rapid realisation of benefits—can such projects yield a positive NPV.

Is this method an effective way to reduce GHG emissions?

The beef cattle herd management method awards ACCUs based on a reduction in emissions intensity of the herd liveweight gain relative to the baseline period. However, it does not require a reduction in the herd’s total emissions. As primary producers improve herd efficiency, overall production may increase, potentially leading to higher total methane emissions. As Rolfe (2001) noted, increasing liveweight gains without reducing herd size will raise total methane emissions. Moreover, lowering stocking rates to reduce emissions may negatively impact the business’ profitability through reduced livestock sales, even if individual animal productivity improves (Bray et al. 2016). Technological developments such as greenhouse gas suppressant technologies for cattle may create opportunities to reduce emissions (Rolfe 2001).

4.5 Blue carbon method

The economic viability of a project utilising the tidal restoration of blue carbon ecosystems method (**blue carbon method**) will vary case by case, and project proponents should seek independent advice (ERF n.d. a). The blue carbon method has had low uptake by landholders across Australia due to several challenges, including high project costs and short project supply, largely due to the limited size of available sites (Nuyts et al. 2024). This section seeks to better understand the nature of blue carbon method projects and the benefits, costs and risks thereof by first, assessing where the best opportunity for blue carbon method projects may exist and second, reviewing the study by Waltham et al. (2025) of the economic viability of blue carbon method projects in the Mossman District.

ACCUs are issued to blue carbon method projects on the basis that coastal wetland ecosystems (including saltmarsh, mangroves, seagrass and supratidal forests) are restored by reintroducing tidal flows (Twomey et al. 2024). Coastal wetland ecosystems have higher carbon stocks and carbon sequestration rates compared to terrestrial forests (Hagger et al. 2022; Duarte de Paula Costa et al. 2021), and saline soils typically emit lower levels of methane and nitrous oxide compared to freshwater ecosystems and agricultural lands (Hagger et al. 2022). Furthermore, coastal wetland ecosystems enhance water quality and biodiversity, provide habitat for fish, native plants, animals and migratory birds, have great cultural value for Aboriginal Australians, as well as commercial and recreational value (Abbott et al. 2020, Hagger et al. 2022, Rowland et al. 2023, Duarte de Paula Costa et al. 2021).

In Queensland, there are large areas of coastal wetlands that, through the conversion to agriculture and urban development, have been cleared and degraded since European settlement (Rowland et al. 2023; Abbott et al. 2020; Hagger et al. 2022; Duarte de Paula Costa et al. 2021). There is an opportunity to restore blue carbon ecosystems along the Queensland coastline (Rowland et al. 2023). For example, 83% of the mapped wetlands in the Fitzroy Basin have been modified to exclude tidal flows and create pastures flooded with freshwater, typically by construction of bund walls (Hagger et al. 2024). Furthermore, there are large areas of land behind tidal barriers in the Fitzroy, Burdekin, and Mackay Whitsunday NRM regions, which presents a large opportunity to reintroduce tidal exchange in those regions (Duarte de Paula Costa et al. 2022).

Degraded coastal agricultural land (such as land suffering from waterlogging, salinisation, soil acidification and erosion) has the lowest opportunity cost and may be suitable for blue carbon method projects, as landholders commonly cease agricultural practices on degraded fields (Rowland et al. 2023). Blue carbon projects on degraded agricultural land can potentially be undertaken without trade-offs to agricultural production (Rowland et al. 2023). Restoration of degraded coastal agricultural land may also enhance the productivity of neighbouring farmland. This was observed in a study based in Myanmar where 'successful colonisation and growth of planted mangroves on abandoned rice paddies benefited adjacent agricultural areas with increased productivity through improved soil conditions and weed suppression' (Rowland et al. 2023). Restoration of tidal flows can also be an effective method of controlling some weed species that landholders are obliged to eradicate, and which typically occupy degraded agricultural land (Abbott et al. 2020; Rowland et al. 2023). Economic feasibility of restoration of productive agricultural land is unlikely because of higher opportunity costs of competing land use; however, in some locations (most likely degraded agricultural land) a blue carbon method project may be viable (Rowland et al. 2023).

A major risk of reintroducing tidal flows is the potential negative impact on freshwater wetlands which also provide an important ecosystem service and may be lost as a result. It has been posited that prior to reintroducing tidal flows, future blue carbon project must assess the conditions and ecosystem services provided by freshwater wetlands, and sensitive freshwater wetlands should be protected (Duarte De Paula Costa et al. 2022). Not every site will be suitable for restoration (Duarte De Paula Costa et al. 2022).

Study by Waltham et al. (2025) of the economic viability of blue carbon method projects in the Mossman District

In 2025, the Department of Primary Industries published a report it had funded prepared by James Cook University and Griffith University titled, 'Feasibility of environmental market-based mechanisms as an income source for farmers in the Mossman district', authored by Nathan Waltham, Katie Motson, James Smart, Syezlin Hasan, Diane Jarvis, Ben Jarihani, Mahmood Sadat-Noori, and Allyson Genson. The report assessed the financial viability of undertaking ACCU scheme and Reef Credit scheme projects for sugarcane farmers in the Mossman District (Waltham et al. 2025). The study was completed in the context of uncertainty about the future financial viability of the Mossman Sugar Mill.

Waltham et al. (2025) used discounted cash flow analysis to investigate the financial viability of converting sugarcane farming land in the Mossman district to an ACCU scheme project using the tidal restoration of blue carbon ecosystems method (blue carbon method). The study also reviewed the financial viability of running a Reef Credit scheme project, using the managed fertiliser application method, in conjunction with the ACCU scheme project and stacking the credits. However, Waltham et al. (2025) noted that:

'Cessation of fertiliser application on land transitioning from sugarcane to production of [...] blue ACCUs may *not* [be] eligible for DIN Reef Credits. However, in this report, the financial viability of [...] blue carbon projects under relevant ACCUs schemes is evaluated with and without additional revenue from DIN Reef Credits. Inclusion of DIN Reef Credits in this way is solely intended to illustrate how credit stacking with an environmental co-benefit can improve the financial viability of a [...] blue carbon project on a land block' (Waltham et al. 2025).

Waltham et al. (2025) found that at ACCU prices between $30 and $100/ACCU, none of the blue carbon project generated a positive whole-of-project NPV under all three landholder cost scenarios (Waltham et al. 2025). However, if the ACCUs were stacked with DIN Reef Credits, then a positive whole-of-project NPV was generated by all three case study sites at approximate levels of current ACCU and reef credit prices using landholder cost Scenario 3 (lower-bound estimates) (Waltham et al. 2025).

Blue carbon tidal reintroduction method

Waltham et al. (2025) chose three study sites in the Mossman area. The sites were on marginal land which generated low sugarcane yields and quality or suffered saline intrusion (Waltham et al. 2025). The study used BlueCAM to estimate the ACCUs generated by the project and made the following assumptions:

- meters was the modelled tidal range at project sites;
- The reporting period was 22/7/2024 to 22/7/2049 (25-year crediting period);
- The permanence period was 25 years;
- 1kL of fuel was used during the reporting period;
- Land type was sugarcane land; and
- The land inundated by water due to sea level rise throughout the 25-year crediting period was included in the carbon estimation area (Waltham et al. 2025).

Table 46 shows the amount of CO_2e sequestered at each of the case study sites (1, 2 & 3), which was estimated using BlueCAM (Waltham et al 2025). Sites 1, 2 and 3 were estimated to sequester 20,096, 19,236 and 3,945 t CO_2e respectively within the 25-year reporting period, indicating a total value of approximately $703,400, $673,300 and $138,100 at the current ACCU price of $35/ACCU.

Table 46: Tonnes CO_2e sequestered at sites 1, 2 & 3 (BlueCAM)

	Tonnes CO2e sequestered (BlueCAM)	Tonnes CO2e sequestered (BlueCAM)	Tonnes CO2e sequestered (BlueCAM)
Year	**Site 1**	**Site 2**	**Site 3**
2024	100	75	12
2029	4,084	3,893	795
2034	8,075	7,177	1,580
2039	12,073	11,550	2,367
2044	16,082	15,391	3,156
2049	20,096	19,236	3,945
2057	26,539	25,417	5,213

Source: Adapted from Waltham et al. (2025)

Managed fertiliser application method (DIN method)

Waltham et al. (2025) estimated, using predictions of DIN losses from the Paddock to Reef framework for sugarcane land in the Mossman and Daintree districts under representative prior fertiliser applications, the potential number of DIN Reef Credits that could be generated via the managed fertiliser application method when all fertiliser applications cease following land use change from sugarcane production at blue carbon sites.

Discounted cash flow analysis of undertaking a ACCU scheme blue carbon method project and a Reef Credit scheme DIN method project

Waltham et al. (2025) conducted a discounted cash flow analysis at the three case study sites for the following projects:

- Blue ACCUs alone (blue carbon project); and
- Blue ACCUs hypothetically stacked with DIN Reef Credits (blue carbon project in conjunction with a Reef Credit scheme project).

To complete the discounted cash flow analysis of the financial viability of undertaking projects, Waltham et al. (2025) made assumptions to calculate the revenue and costs as set out in this section.

The crediting period for a blue ACCU scheme project is 25 years, whereas the crediting period for a DIN Reef Credit project is 10 years. Consequently, in the simulations with stacked credits, the DIN Reef Credits were hypothetically stacked with ACCUs for the first 10 years of the 25-year ACCU project (Waltham et al. 2025). The key assumptions made are summarised in Table 47 below.

Table 47: Parameter settings for discounted cash flow analysis of projects at Sites 1, 2 and 3

Parameter	Setting
Real discount rate	7% per annum
Cost of capital	8% per annum

Loan duration	10 years
ACCU pricing	Between $30/ACCU and $100/ACCU in steps of $5
DIN Reef Credit pricing	$100/credit, $150/credit and $200/credit
Project permanence period	25 years
Project crediting periods	25 years for Blue carbon ACCUs 10 years for DIN Reef Credits
Lead-in Time	3 years for Blue carbon ACCUs 3 years for Blue carbon ACCUs and DIN Reef Credits combined
Total project duration	29 years for Blue carbon ACCUs 29 years for Blue carbon ACCUs and DIN Reef Credits combined

Source: Adapted from Waltham et al. (2025)

In addition to the assumptions described above, Waltham et al. (2025) estimated the costs of undertaking a blue carbon project and a DIN Reef Credit project, including that undertaking the projects would result in a reduction in property value due to 'loss in the flexibility of using the land and the binding contractual obligations, including the required maintenance cost, for the remainder of the crediting period' (Waltham et al. 2025). Furthermore, the discounted cashflow analysis factored in an annual opportunity cost to account for the foregone net revenue due to the landholder ceasing to farm sugarcane on the project area. Waltham et al. (2025) used three cost scenarios in their analysis with a different reduction in land value and opportunity cost value, including:

- **Scenario 1** was the **upper bound estimate** of costs to the landholder and assumed there was a reduction in property value of $5,018/ha and a reduction in gross margin of $430/ha/year;
- **Scenario 2** was the **midpoint estimate** of costs to the landholder and assumed there was a reduction in property value of $2,509/ha and a reduction in gross margin of $215/ha/year (50% of the Scenario 1 values);
- **Scenario 3** was the **lower bound estimate** of costs to the landholder and assumed there was a reduction in property value of $2,509/ha and no reduction in gross margin (Waltham et al. 2025)[100].

In addition to land value decline and opportunity cost, the costs of undertaking a blue carbon project and a DIN reef credit scheme project used by Waltham et al. (2025) are set out respectively in Table 48 and Table 49 below.

Table 48: Costs for tidal restoration of blue carbon ecosystem BlueCAM method

Description of cost	Value of cost	When the cost is incurred
Blue ACCUs: Engagement and conceptualisation phase		
Informal (initial) engagement	$1,000 per landholder	First year of project
Preliminary site survey	$5,000 per site	First year of project
Engagement process	$2,500 per landholder	First year of project
Initial hydrological assessment	$12,000 per site	First year of project
Cultural heritage survey (only likely to be undertaken at	**(Included here for information only)** Range between $3,000 for a small, simple	Second year of project

[100] Lower-bound estimate motivated by a situation where agricultural production has already ceased on project land (Waltham et al. 2025).

sites under relevant property rights and governance contexts). **Not included in the project's DCFA for blue ACCU sites**.	case with no complications over two months to $30,000 for a large, complex case over 7 months. A typical survey would cost around $10,000 and take place over a 4-month period.	
Legal & contracts between landholders, and project developer	$10,000 per actor	Second year of project
Baseline establishment	$5,000 per project site	Third year of project
Reduction in land value	$5,018/ha under landholder cost Scenario 1 $2,509/ha under landholder cost Scenario 2 $2,509/ha under landholder cost Scenario 3	Start of establishment phase (second year of project).
Blue ACCUs: Project establishment phase		
Detailed project design (including detailed hydrological assessment)	$32,000 per site	Third year of project
Development approvals	$50,000	Third year of project
On-site works (barrier removal for tidal restoration)	Costs are site-specific. **Site 1:** Excavation cost is $3,840 for partial removal of a bund [130m (length) x 5m (width) x 1.5m (height)]. Three flood gates to be removed. **Site 2:** Excavation cost is $4,357 to remove a bund [150m (length) x 5m (width) x 1.5m (height)]. One flood gate to remove. **Site 3:** Excavation cost is $1,646 to remove a bund [60m (length) x 6m (width) x 1m (height)]. No flood gate removal required at Site 3. **Sites 1, 2 and 3:** Assume rock reinforcement is required when removing a bund, it will add another $125,000 to the cost for each of the three sites.	Third year of project
Project management through engagement, conceptualisation, and establishment phases	20% of total expenditure on development approvals, detailed project design and on-site works.	Assumed to be split equally between years 1, 2 and 3 of the project.
Blue ACCUs: Production phase		
Annual on-ground maintenance	$925 per ha of inundation per year	Annually starting in project year 4. Continues until tidal wetland is fully established in project year 8.
Monitoring and reporting	$2,500	Occurs in years when ACCUs are claimed: assumed to be in years

		4,9,14,19,24 and 29 of project.
Independent audits	$20,000 per audit	Years 9 and 19 of project.
Opportunity cost to the landholder of foregone net revenue from agricultural production on land committed to ACCU project	$430/ha/year under landholder cost Scenario 1 $215/ha/year under landholder cost Scenario 2 $0/ha/year under landholder cost Scenario 3	Annually from the start of the production phase until the end of the permanence period (Year 3 onwards).

Source: Adapted from Waltham et al. (2025)

Table 49: Costs for Reef Credits via the managed fertiliser application method

Description of cost	Value of cost	When the cost is incurred
DIN Reef Credits stacked with ACCUs: Engagement and conceptualisation phase		
Informal (initial) engagement (*assumed to be included in the blue carbon project cost*)	$0/landholder	First year of project
Engagement process (*assumed to be included in the blue carbon project cost*)	$0/landholder	First year of project
Legal & contracts between landholder and project developer (*assumed to be included in the blue carbon project cost*)	$0/actor	First year of project
Baseline establishment & data collection (7 years of farm data on fertiliser purchase and application)	$5,000/project site	First year of project
DIN Reef Credits stacked with ACCUs: Project establishment phase		
Project management through all phases of the DIN Reef Credit component of the stacked project	$10,000	First year of project
DIN Reef Credits stacked with ACCUs: Production phase		
Annual monitoring and reporting	$2,500	Annually starting in year 1
Independent audits	$7,000	Annually
DIN Reef Credits stacked with ACCUs: Commercialisation		
Open registry account	$1,500	Once per project in year 1
Project registration & lodgement	$750	Once per project in year 1
Application for credit certification & issuance	$750	Once per project in year 1
Reef Credits issued to registry account	$0.50/credit	Annually for 10 years
Transfer of Reef Credits to buyer	$0.25/credit	Annually for 10 years
Methodology compensation payment	$0.25/credit	Annually for 10 years
Truii Natural Capital Suite software	$2/credit claimed	Annually for 10 years

Source: Adapted from Waltham et al. (2025)

Results

The results of the discounted cash flow analysis conducted by Waltham et al. (2025) were:

- All of the blue carbon sites generated a negative NPV under all three cost scenarios at all ACCU prices;
- If blue carbon projects and DIN reef credit projects were run on the project land, and the credits were stacked, then at all three sites, positive NPVs were generated at

approximately current levels of ACCU and reef credit prices using cost scenario 3 (lower-bound estimates). Positive NPVs were possible for higher landholder cost scenarios 1 and 2, provided higher ACCU prices and reef credit prices were used. However, those price levels are significantly higher than current market prices (Waltham et al. 2025).

The results of Waltham et al. (2025) are consistent with the low market participation rate observed, with only 2 project proponents having registered blue carbon method projects.

Similarly, Twomey et al. (2024) looked at the viability of a blue carbon method project at a case study site adjacent to a tidal creek connected to the Johnstone River in Northern Queensland and found that using a carbon price of $33/ACCU, undertaking a blue carbon method project was not profitable compared to grazing cattle. Conversely, Hagger et al. (2024) conducted a cost benefit analysis of blue carbon projects in the Fitzroy basin and found that a proportion of the potential projects would be profitable. In their analysis, Hagger et al. (2024) identified the potential coastal wetland restoration areas in the Fitzroy Basin, which are identified in green in Figure 28 below.

Figure 28: Potential coastal wetland restoration areas in the Fitzroy Basin

Source: Adapted from Hagger et al. (2024)

In their analysis, Hagger et al. (2024) estimated that the carbon abatement from tidal restoration in the Fitzroy Basin was 9.94 ±0.34t CO_2e/ha/yr. Hagger et al. (2024) found that, using a discount rate of 1% and an ACCU price of $57 over 25 years, 60% of potential restoration projects in the Fitzroy Basin would be profitable, which would increase to 75% if the ACCU price was $132 (Hagger et al. 2024). However, when the discount rate was increased to 4%, then 54% of projects in the Fitzroy Basin were profitable (Hagger et al. 2024). Furthermore, if higher restoration costs were used, then no sites were profitable (Hagger et al. 2024). Arguably, the discount rates used by Hagger et al. (2024) were too low compared to most economic analyses which tend to use a discount rate of 5%-7%. Ultimately, the potential profitability of a blue carbon project involving tidal restoration is location and project specific.

Conclusion

In summary, this section assessed where the best opportunity for blue carbon method projects exists and found that coastal degraded agricultural land along the Queensland coastline has the lowest opportunity cost given its non-productive agricultural use. Second, the study by Waltham et al. (2025) analysed the economic viability of blue carbon method projects in the Mossman District and found that the blue carbon method project study sites did not generate a positive NPV using all three landholder cost scenarios and at all ACCU prices ($30 to $100/ACCU). However, if the blue carbon method ACCUs were hypothetically stacked with DIN Reef Credits (which may ***not*** be possible), then a positive whole-of-project NPV could be generated.

5 Opportunities, risks and tax implications

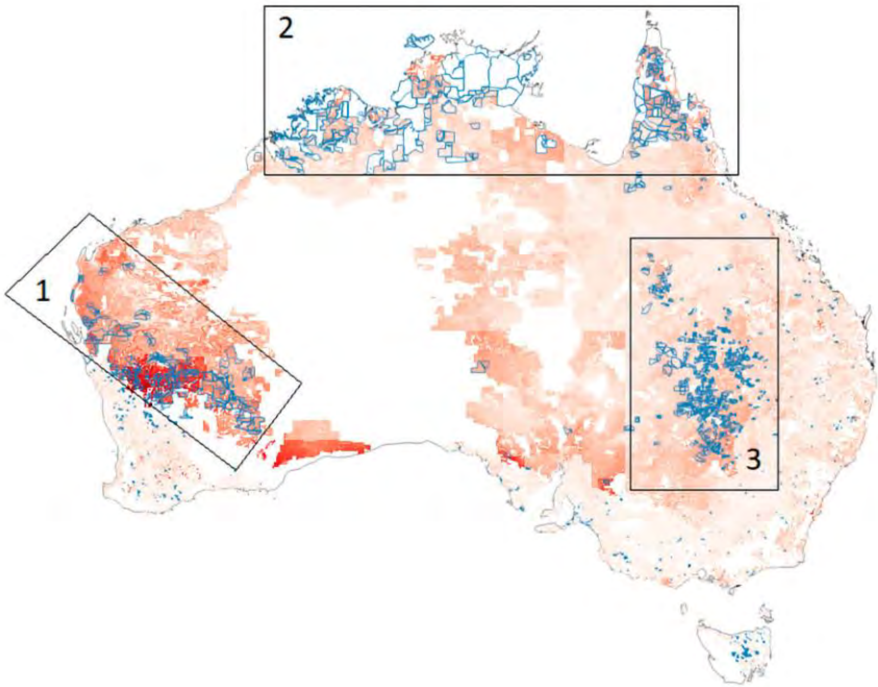
5.1 Opportunities

Queensland primary producers are well positioned to take advantage of the potential opportunities offered by environmental market schemes given that agriculture accounts for 80.03% of Queensland's land use (ABARES 2025). Some key areas of opportunity for primary producers for participating in environmental market schemes include targeting lower opportunity cost marginal agricultural land, opportunities to stack or bundle credits, and new emerging methods.

5.1.1 Marginal land and complementary projects

First, primary producers may find opportunities to benefit from participating in environmental markets by targeting marginal agricultural land that has low productivity because it has a lower opportunity cost. According to the Australian Government's net zero by 2050 plan, up to 65 Mt CO_2-e per year could be abated by planting trees on marginal agricultural land or integrating them into farming systems with minimal impact on agricultural productivity (Barber et al. 2024). However, Barber et al. (2024) noted that 'low profitability land may also have low carbon sequestration potential'. In their study, Barber et al. (2024) used an opportunity cost approach to identify the areas suitable for nature-based climate solutions such as participation in an environmental market scheme by locating the areas across Australia that have the lowest opportunity cost of agricultural land use. This was calculated by a ratio of the FullCAM maximum above-ground biomass layer (M) to Profit at Full Equity (PFE), which was used 'as a proxy for long-term average land use profits' (Barber et al. 2024). Barber et al.'s (2024) study was based on 2010-2011 PFE estimates (it is not known whether the results would differ if more recent PFE estimates were used). Figure 29 below illustrates the results found by Barber et al. (2024). The blue boundaries identify current ACCU scheme projects and red illustrates the opportunity cost of agricultural land use with the brightest colour red representing the lowest opportunity cost (highest ration of M to PFE) (Barber et al. 2024). Areas with no PFE data available are denoted in white (Barber et al. 2024).

Figure 29: Map of current ACCU Scheme projects (blue) and the suitability of areas for future projects identified in varying shades of red

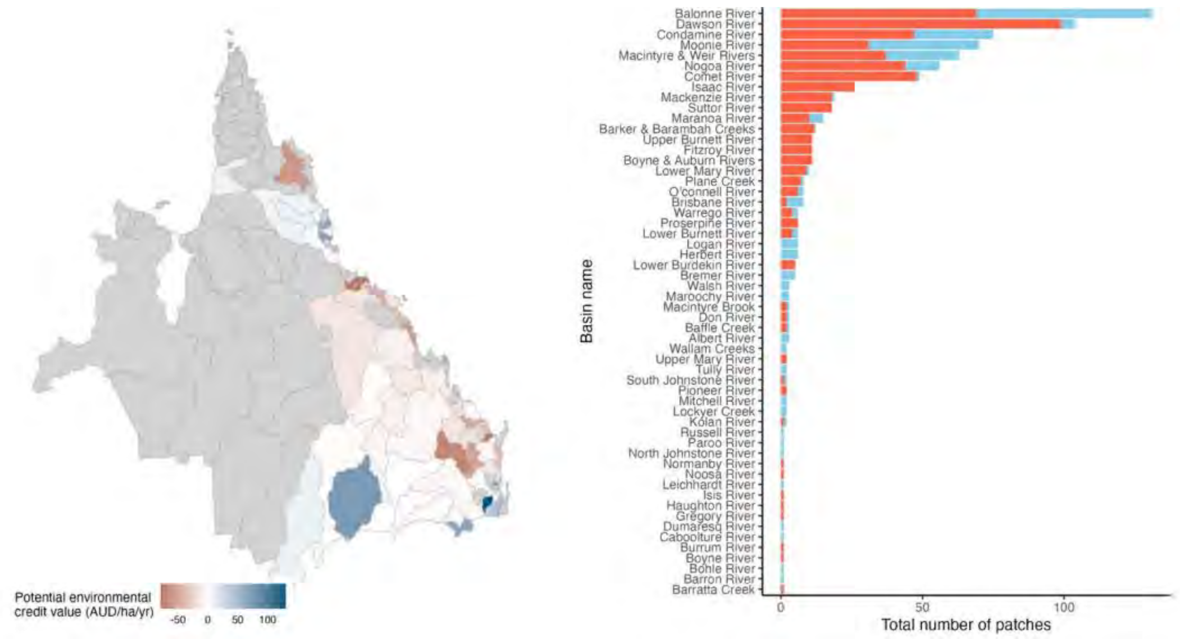


Source: Adapted from Barber et al. (2024)

Barber et al. (2024) observed that agricultural profitability is positively correlated with total carbon abatement potential (which is unsurprising given higher rainfall areas have higher agricultural profits per hectare and also have higher sequestration potential for vegetation and soil). Furthermore, Barber et al. (2024) identified that the current ACCU scheme projects are located in areas with a high ratio of carbon potential to current land use profits (which aligns with expectations given these areas would have lower opportunity costs of agricultural production).

Research by Kath et al. (2025) involved 'cost-benefit analyses on 752 cropping areas in Queensland to assess their potential for generating environmental credits for farmers'. The study focused on farming areas receiving low profits and found that benefits of environmental market schemes varied across regions, and in some areas, it was not financially viable. The results of the study are illustrated in Figure 30 below. The blue colour corresponds to areas with positive potential benefits from environmental market scheme projects and the red colour represents negative values.

Figure 30: 'Potential environmental credit value under a low profit (5th percentile) scenario across each basin and crop class and the relationship between potential environmental credit value and farm profit' (Kath et al. 2025)



Source: Adapted from Kath et al. (2025)

In addition to targeting marginal agriculture production areas for conversion to environmental market scheme projects, primary producers can benefit from clever project design aiming to implement projects that enhance primary production, such as planting trees as shelter belts for farming land, improving soil health and water retention, or reducing fertiliser use to generate reef credits and thereby reducing input costs for the farm. This would enable primary producers to undertake environmental market scheme projects on land with greater potential to generate environmental market scheme benefits, like carbon sequestration, without reducing agricultural production. Bilotto et al. (2025) noted, 'when interventions to reduce GHG emissions instigated a productivity co-benefit – such as improved metabolisible energy per unit area, or shade and shelter via planting of trees, both carbon neutrality as well as improved profit were possible under future climate'.

Table 21 above is a matrix of co-benefits associated with ACCU scheme projects and indicates that soil carbon projects are most likely to deliver improved farm productivity. Soil carbon projects also do not necessarily compete with agricultural production for land use, which was demonstrated in the investment analysis of the Fitzroy case study involving planting leucaena to increase SOC stocks, whilst at the same time improved liveweight gains of the steer herd and thereby increased farm profitability.

In summary, primary producers can benefit from environmental markets by focusing on marginal agricultural land, which typically has low productivity and thereby low opportunity cost, or by adopting a project that complements and enhances agriculture production.

5.1.2 Stacking

Second, stacking enables project proponents to receive increased revenue from their projects by generating multiple environmental market scheme credits from the same project activity (Deane 2024). As was discussed in section 3.2.1 Stacking, ACCUs can be stacked with a Nature

Repair Market biodiversity certificate, reef credits, cassowary credits and LRF co-benefits provided that the project is registered under the ACCU scheme first and where required, the additionality requirements are met under both schemes.

Stacking may have a critical role to play in rendering projects financially viable for primary producers. This was seen in the study by Waltham et al. (2024) (see section 4.5 Blue carbon method for detail), which found that at ACCU prices between $30 and $100/ACCU, none of the case study ACCU scheme blue carbon method projects in the Mossman region generated a positive whole-of-project NPV under all three landholder cost scenarios (Waltham et al. 2025). However, if the ACCUs were stacked with DIN Reef Credits, then a positive whole-of-project NPV was generated by all three case study sites at approximate levels of current ACCU and reef credit prices using landholder cost Scenario 3 (lower-bound estimates) (Waltham et al. 2025). Furthermore, the results from this study suggest that at the current ACCU price of $35.90, most of the case study scenarios tested involving ACCU scheme projects were financially unviable. Stacking offers the opportunity to increase the revenue received and has potential to render projects viable.

5.1.3 New emerging methods

Third, primary producers can benefit from participating in an environmental market scheme in the future under new emerging methods. For example, the constructed wetlands method is under review under the Reef Credit scheme and there is a pipeline of new methods in development under the Nature Repair Market.

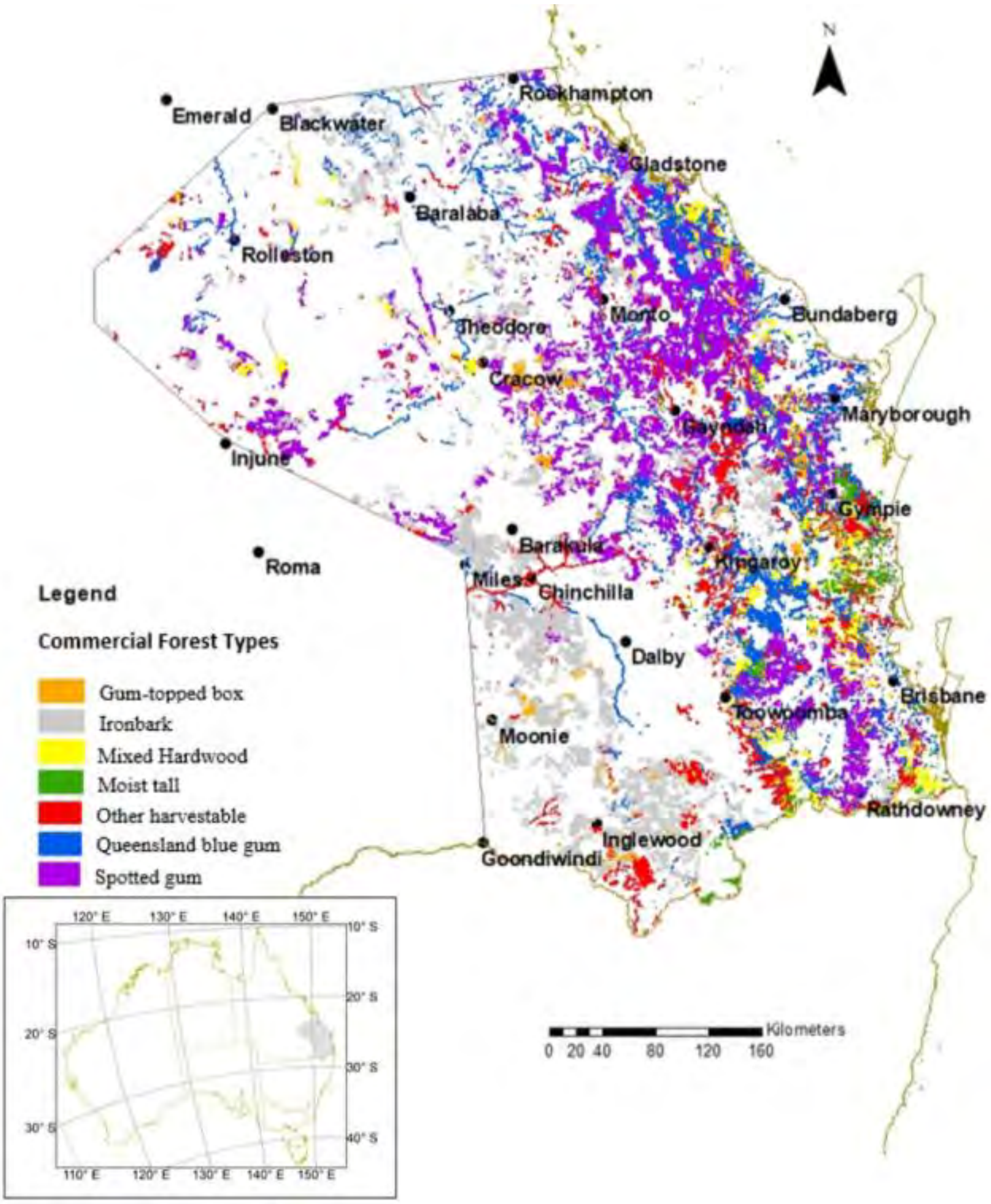
The ACCU scheme utilises a proponent led method development process that enables anyone to propose new ideas for methods. The *Method Development Tracker* page on the DCCEEW website tracks the progress of proposed methods. Currently, there are 30 proposed agriculture and land methods listed, including the ‘Integrated Reforestation and Avoided Re-clearing (IRAR) Method’ (modifies and integrates the HIR method, avoided clearing method and environmental plantings), and the ‘Improved Avoided Clearing of Native Regrowth (IACNR) Method’ (varies the Avoided Clearing of Native Regrowth method that expired on 1 April 2025), which were proposed by the Queensland Department of Environment, Science and Innovation (DCCEEW 2025d). Four proposed methods have been prioritised for development, including ‘Improved Avoided Clearing of Native Regrowth’, ‘Reducing disturbance of coastal and floodplain wetlands by managing ungulates’, ‘Improved Native Forest Management in Multiple-use Public Forests’, and ‘Extending Savanna Fire Management to the Northern Arid Zone’ (DCCEEW 2025d). Two proposed methods are under development including the ‘Savanna Fire Management (SFM) Emissions Avoidance 2024 method and SFM Sequestration and Emissions Avoidance 2024 method’ and the ‘Integrated Farm and Land Management (IFLM) method’ (which would combine several soil and vegetation sequestration activities into a single method) (DCCEEW 2025d).

Silvopastoral systems

Silvopastoral systems refers to the combination of livestock grazing and natural or planted forests on the same site (Francis et al. 2022). Silvopastoral systems can benefit primary producers in several ways including environmentally (aesthetics, improved water quality, carbon sequestration, shelter and shade and conservation of soil and wildlife habitat), and financially (diversified source of income and improved climate change resilience of farms) (Francis et al. 2022).

Queensland primary producers have an opportunity to manage their land as a silvopastoral system. The greatest proportion of Australia’s native forest is located in Queensland, a large portion of which is owned by primary producers (Francis et al. 2023). Supply of timber by state-owned native forests has significantly declined and the hardwood timber industry has increasingly relied on private native forests for log supply (Francis et al. 2022). Southern Queensland's native forests contain hardwood timber species including spotted gum, ironbark and blackbutt that have unique structural and aesthetic qualities making it suitable for products like electricity distribution poles, dry flooring and decking, landscaping products and green-off-saw structural timber (Francis et al. 2023). Figure 31 below identifies the areas of Queensland that contain suitable native forests for timber harvesting.

Figure 31: Timber Production Opportunities from Private Native Forests in Southern Queensland



Source: Adapted from Francis et al. (2023).

The study by Francis et al. (2022) investigated the financial viability of silvopastoral systems in southern Queensland by analysing four case study properties dominated by spotted gum over a 20-year management period. The study found that compared to grazing or timber production alone, ‘the financial performance of managing the forest under a silvopastoral system with joint cattle and timber production provided the highest NPV for all case study properties’ (Francis et al. 2022). Francis et al. (2022) identified the factors constraining widespread adoption of silvopastoral systems as sovereign risk (land clearing rules that cause uncertainty regarding future harvesting rights) and long payback periods (trees can take 20 to 30 years to grow to harvestable size).

Silvopastoral systems also provide an opportunity to increase carbon sequestration by incentivising primary producers to retain regrowth for timber production rather than clearing that regrowth. Venn et al. (2024) found that relative to periodic re-clearing, private native forest regrowth can sequester large volumes of carbon and that ‘spatial analysis identified that tens of thousands of hectares of commercially important regrowth continues to be re-cleared annually, indicating existing ACCU methods have not incentivised retention’. Forests managed for timber are beneficial for carbon sequestration because timber products like electricity poles, engineered wood products and structural timber store carbon off-site for many decades while enabling new trees to grow and sequester carbon, and timber products can continue to store large amounts of carbon if disposed in landfills; sustainably produced timber products have lower carbon footprints compared to substitutes like steel and concrete; and reduced susceptibility of forest carbon sinks to disturbances such as cyclones and wildfires by diversifying sinks via off site wood products can improve climate change resilience (Venn et al. 2024). Furthermore, silvopastoral systems involving the planting, harvesting and replanting of trees, can counter the issue of diminishing longitudinal carbon sequestration associated with trees that approach maturity (Bilotto et al. 2025). Ven et al. (2024) identified that the ‘development of a new native forestry ACCU method, such as the Forestry Australia proposed Enhancing Native Forest Resilience (ENFR), would overcome the opportunity costs of carbon faming in agricultural landscapes by facilitating ongoing income streams form livestock and timber, while also generating carbon credits’. However, Venn et al. (2024) also noted that ‘improvement to forest policy to remove sovereign risk associated with sustainable private native forestry will also be essential to motivate retention of regrowth’ (Venn et al. 2024).

In summary, primary producers may benefit from participating in environmental market schemes through emerging methods. One promising opportunity is the adoption of silvopastoral systems, which combine livestock grazing with forest management and can sequester carbon and deliver positive environmental outcomes whilst also increasing profits. The development of an ACCU scheme method that enables primary producers to earn credits via silvopastoral systems would further incentivise adoption of this management approach. Southern Queensland is well-placed for this due to its extensive native forests, particularly hardwood species like spotted gum and ironbark.

5.1.4 Summary of opportunities

Queensland primary producers are well-positioned to benefit from environmental market schemes due to the state's significant agricultural land use (80.03%). Key opportunities include:

1. **Marginal agricultural land**: Producers can target low-productivity land for environmental projects, as it has a lower opportunity cost. While such land may also have limited carbon sequestration potential, careful cost-benefit analysis can reveal profitable opportunities.
2. **Stacking and bundling credits**: Producers can increase returns by stacking or bundling credits generated from the same project site, provided eligibility criteria are met.
3. **Emerging Methods**: New methods under development offer future participation routes.

- **Silvopastoral Systems**: Combining livestock grazing with forest management has proven both environmentally and financially beneficial in suitable areas such as southern Queensland. This system can increase carbon sequestration, improve biodiversity, and diversify income. Policy support and the development of a dedicated ACCU method would enhance adoption.

Overall, environmental market schemes present multiple pathways for Queensland primary producers to generate new income streams while supporting climate and biodiversity goals.

5.2 Risks

There are a multitude of risks associated with participation in environmental market schemes, including the potential reduction in land value, government policy uncertainty, financial viability of projects, risk of project failure and permanence obligations, and complex and asymmetrical information. These risks are analysed in detail below. Furthermore, the risks specific to soil organic carbon sequestration projects and vegetation-based carbon sequestration projects are identified and discussed.

5.2.1 Land value

First, participating in an environmental market scheme may negatively impact land value. Landholders should be aware of ‘a potential reduction in land value when considering whether to switch a block of land from agricultural to environmental market usage’ (Waltham et al. 2025). Undertaking an environmental market scheme project involves a loss of flexibility, contractual obligations to deliver and maintain the project, contractual liability for project costs, and uncertainty as to project revenue, which span the project’s permanence period of 25 to 100 years for ACCU scheme, Nature Repair Market and LRF scheme projects, 10 to 25 years for Reef Credit scheme projects, and 25 years for Cassowary Credit scheme projects (Waltham et al. 2025). This is likely to have a dampening effect on demand for land and may negatively impact on the price of land that is the subject of an environmental market project compared to land used solely for agriculture (Waltham et al. 2025). Furthermore, some projects that compete for agricultural land use (for example, projects that involve establishing forests by planting trees) could result in reduced farming productivity of the land, which can lead to a reduction in land value (Pachas et al. 2023; Fitch et al. 2022). Conversely, participation in an environmental market scheme can offer an additional and diverse income stream that may be viewed as beneficial by buyers and could lead to an increase in land value. Therefore, the overall impact of environmental market scheme participation on land value will depend on the specific project characteristics, market perceptions, and how potential buyers weigh long-term obligations against the promise of diversified income.

5.2.2 Policy uncertainty

Second, government policy uncertainty is a risk that can limit primary producer participation in environmental market schemes (Baumber et al. 2020; Deane et al. 2024; Battaglia et al. 2022; Pudasaini et al, 2024). There have been delays in the release of environmental markets schemes and methods (such as the ACCU scheme integrated farm management method that was first proposed in 2022 and was planned to be provided to the Minister for approval in May-June 2024 (DCCEEW 2023); however, the method remains under development (DCCEEW 2025d)), as well as premature cancellations of methods, such as the Emissions Reduction Assurance Committee’s December 2024 order to suspend the beef cattle herd management method 2015. Such policy uncertainty can disincentivise participation in environmental market schemes. It was reported by The Australian Financial Review in March 2025 that the Northern Territory cattle station ‘Benmara’ was listed for sale by Hartree Partners (Lenaghan 2025). Hartree Partners had acquired to property in May 2024 for the purpose of carbon farming, but due to the uncertain and delayed commencement of the ACCU scheme integrated farm management method, the investment was abandoned (Lenaghan 2025). The Australian Financial Review quoted Hartree’s head of environmental origination, Cheryl Bower, saying, ‘While we remained dedicated to the Australian market, we are reassessing our investment priorities until there is more clarity on new carbon methods’ (Lenaghan 2025). This highlights how uncertainty around government policy and method development timelines can undermine investor confidence and deter primary producers from committing to long-term environmental market projects.

5.2.3 Financial viability

Third, there is always a risk that an environmental market scheme project is not financially viable, in circumstances where the price of credits is volatile and can decrease in the future, and the costs involved in undertaking projects are high (Whish et al. 2016; Deane et al. 2024; Pudasaini et al, 2024). If the project fails to deliver the intended environmental benefit (such as sequestering carbon), then no credits will be issued, and the proponent will have incurred costs without a financial reward (Deane et al. 2024). To reduce this risk, primary producers should attempt to design a project that does not reduce revenue from their normal farming business (Deane et al. 2024). Furthermore, primary producers should undertake their own investment analysis prior to committing to an environmental market scheme project.

5.2.4 Project failure and permanence obligations

Fourth, there is a risk that a project will fail to generate the intended environmental outcome. This risk is exacerbated by the long timeframes of projects (Deane et al. 2024; Whish et al. 2016). The permanence periods vary depending on the environmental market scheme as follows: the ACCU scheme, Nature Repair Market and LRF scheme permanence period is 25 or 100 years; the Reef Credit scheme permanence period is 10 to 25 years depending on the method; and the Cassowary Credit scheme permanence period is 25 years. Project proponents are committed to delivering the project for the entirety of the permanence period, and failure to do so can result in relinquishment of credits. This requires the project management be sustained for permanence period, which is an extended timeframe and ownership/management of the land could change during that period. Biophysical factors can cause project failure, such as climate change, extreme weather events, wildfire, drought, pests and diseases, and invasive exotic species. Other factors that can cause failure include the limited capacity of a project area to deliver the environmental outcome, such as limited soil organic carbon storage capacity.

5.2.5 Complexity and asymmetrical information

Fifth, complex rules and asymmetrical access to information present significant risks that can limit primary producer participation in environmental market schemes (Baumber et al. 2020). As demonstrated by this report, environmental market schemes involve intricate regulatory frameworks, technical requirements, and varying standards across the different schemes, which can be difficult for producers, particularly those with limited resources or technical expertise, to navigate. As noted by Baumber et al. (2020), such complexity can act as a barrier to entry. Asymmetrical information, where buyers and intermediaries (such as carbon service providers) often have greater access to resources, market intelligence, and legal expertise, can lead to power imbalances, increasing the risk of lower compensation for less-informed sellers (Pearse 2018). In some cases, producers may feel pressured to sign contracts without fully understanding the long-term implications, especially when they lack access to neutral, professional intermediaries (Pearse 2018). Additionally, Battaglia et al. (2022) and Pudasaini et al. (2024) highlight that the perceived complexity, lack of clarity on costs and risks, and limited support for decision-making contribute to low participation rates. Misconceptions, such as questioning the value of being paid to grow “rubbish”, also reflect a broader gap in sector-wide understanding and communication (Battaglia et al. 2022). Furthermore, there is a lack of clarity on the comparative benefits between the different environmental market schemes, which may be a barrier to entry. More research is needed to provide comprehensive farm level case study cost benefit analyses across regions, comparing environmental market scheme methods to assist primary producers to make decisions about which environmental market scheme would be most beneficial for them to participate in. The various schemes, each with multiple methods, makes it a complex area to navigate. Addressing these asymmetries and information complexities through clear, accessible information and support mechanisms is critical to fostering broader and more equitable participation in environmental markets.

5.2.6 Greenwashing and integrity

Consumers are increasingly preferencing environmentally friendly and sustainably produced products, prompting businesses to adopt ‘green’ initiatives to brand themselves as environmentally responsible (Devitt 2024; ACCC 2023; Brooks et al. 2025). ‘Greenwashing’ occurs when the claims made by businesses regarding their environmentally friendly credentials are false, misleading, or have no reasonable basis (ACCC 2023; Brooks et al. 2025). Greenwashing can undermine investor confidence in the market for environmentally friendly/sustainably produced goods and services (Kershaw 2024; Brooks et al. 2025). An antidote to greenwashing can be found in mandatory disclosure regimes, such as the regulated sustainability reporting for climate-related financial disclosure requirements introduced in Australia in late 2024[101] (Kershaw 2024; Brooks et al. 2025).

Integrity of environmental market schemes in essential, given that the value of credits is reliant on credit buyers’ trust that the credits represent real, additional and permanent benefits to the environment (Hemming et al. 2022; Brooks et al. 2025). If buyers lose faith that environmental market scheme credits are delivering the promised outcomes, willingness to purchase those assets will dissipate (Hemming et al. 2022; Brooks et al. 2025).

ACCU scheme

There are concerns regarding integrity of some methods under the ACCU scheme, such as the HIR method (Fowler et al. 2024). Professor Andrew Macintosh (former Chair of the Emissions Reduction Assurance Committee) and his scientific colleagues had published criticisms of the ACCU scheme in 2022 and labelled it ‘a fraud on the environment’ (Fowler et al. 2024). Macintosh et al. (2024a) found limited evidence of regeneration in some HIR projects that had been awarded ACCUs and found that the changes in woody vegetation cover in the HIR project areas mirrored changes in neighbouring land not subject to project activities. Macintosh et al. (2024a) posited that any changes in woody vegetation cover on HIR project areas were attributable to factors other than the project activities like seasonal variation. Furthermore, Macintosh et al. (2024b) analysed a sample of 116 HIR method projects and found that 87 of the sampled projects (75%) had been credited for sequestration equivalent to canopy cover near or above 20%. However, Macintosh et al. (2024b) found that only 31% of these 87 projects had an average canopy cover in 2023 near or above 20%, indicating that 60 projects had been over credited.

[101] *Treasury Laws Amendment (Financial Market Infrastructure and Other Measures) Act 2024*.

In response the initial 2022 criticism by Professor Macintosh and colleagues, an independent panel, led by former Chief Scientist Professor Ian Chubb, was appointed by the Australian government to conduct a review of the ACCU scheme to ensure its integrity. The review found that the ACCU scheme is 'essentially sound' (Chubb et al. 2022). Professor Macintosh and colleagues criticised the review's findings, and accordingly, 'the integrity of a large proportion of ACCUs already issued under the national scheme remains contentious' (Fowler et al. 2024). Integrity issues that result is a loss of credibility of the ACCU scheme are risks to primary producers seeking to generate and either inset or sell credits.

EnergyAustralia case

In May 2025, EnergyAustralia, an electricity retailer, settled a greenwashing case brought by Parents for Climate who alleged that EnergyAustralia had engaged in misleading or deceptive conduct through its marketing of its Go Neutral carbon offset product (EnergyAustralia 2025). In a statement published as part of settlement, EnergyAustralia stated:

> 'Today, EnergyAustralia acknowledges that carbon offsetting is not the most effective way to assist customers to reduce their emissions and apologises to any customer who felt that the way it marketed its Go Neutral products was unclear. [...] While offsets can help people to invest in worthwhile projects that may reduce greenhouse gas emissions elsewhere, **offsets do not prevent or undo the harms caused by burning fossil fuels** for a customer's energy use. Even with carbon offsetting, the emissions released from burning fossil fuels for a customer's energy use still contribute to climate change' (EnergyAustralia 2025).

This case did not proceed to court, so the evidence has not been dissected through the usual legal channels. Nevertheless, it raises concerns regarding consumer preferences for direct emissions reduction over using offsets. However, the ACCU scheme was designed to achieve 'net' protection of environmental and social values by providing a mechanism to exchange compensatory environmental benefits as offsets for certain harmful activities allowed to continue (Fowler et al. 2024). Furthermore, offsets a necessity for some industries given the technology has not yet been developed to transition completely away from fossil fuels (e.g. steel manufacturing, which is required for the development of renewable energy infrastructure) (Fowler et a. 2024). Therefore, the sentiment of the legal settlement by EnergyAustralia is concerning.

It is critical to maintain the integrity of all environmental market schemes, and the credibility of the role of ACCUs as offsets in Australian's transition to net zero, to ensure continued consumer and industry support and trust in the market schemes.

5.2.7 Soil carbon projects

There are several risks associated with SOC sequestration projects under the ACCU scheme that could impact the success of a project. Table 50 below identifies these potential risks.

Table 50: Risk factors of soil organic carbon sequestration project

Risk factor	Explanation	Potential Consequence
Rainfall variability	Lower rainfall can result in no or a reversal of SOC sequestration. Higher rainfall generally results in increased levels of SOC due to increased plant productivity (Mitchell et al. 2024; Meyer et al. 2018).	Relinquishment of ACCUs. Project operates at a loss.

	In the worst case, if there was a significant reversal[102] of SOC sequestration, then under section 90 of the Act, the Regulator may require that ACCUs be returned. The specified number of ACCUs to be relinquished must not exceed the net total number of ACCUs issued in relation to the project.	
Cost of soil sampling and project establishment	The cost of soil sampling and establishing a project is high and needs to be incurred at the start of the project. The soil sampling fee will be incurred again each time the sampling occurs. In the worst-case scenario, if a project did not sequester SOC, then the project proponent will have lost the money they invested in soil sampling and project establishment. In the worst case, if no measurable SOC sequestration occurred, then the project proponent will have invested significant sums of money with zero return. One option for project proponents is to discontinue the project after the second sampling round if there was no increase in SOC, as there is no obligation to continue with a soil carbon project. This would limit the financial loss to the cost of project establishment and two sampling rounds (CFF 2024).	No ACCUs earned. Project operates at a loss.
Extreme weather conditions/events such as drought, flood, fire, and frost	Extreme weather conditions/events such as drought, flood, fire, and frost, could result in a loss of SOC stocks. Project proponents should consider the impact of weather conditions and seasonal variation in carbon stocks when conducting sampling (CFF 2024). If there was a significant reversal[103] of SOC sequestration because of a natural disturbance (flood, drought, bushfire, pest attack or disease), then, pursuant to section 91 of the Act, the Regulator may require the return of ACCUs if it was *not* satisfied that the project proponent had, within a reasonable period, taken reasonable steps to mitigate the effect of the natural disturbance. The specified number of ACCUs to	Relinquishment of ACCUs. Project operates at a loss.

[102] If the reversal relates to an event other than a natural disturbance or conduct, then a reversal of the removal of carbon dioxide from the atmosphere is taken to be a ***significant reversal*** if the size of the project area in which the reversal occurs is at least the smaller of 5% of the total project area or 50 hectares (s88 Carbon Credits (Carbon Farming Initiative) Rule 2015).

[103] In relation to a natural disturbance, a reversal of the removal of carbon dioxide from the atmosphere is taken to be a ***significant reversal*** if the size of the project area in which the reversal occurs is at least the 5% of the total project area (s89 *Carbon Credits (Carbon Farming Initiative) Rule 2015*).

	be relinquished must not exceed the net total number of ACCUs issued in relation to the project.	
Scientific uncertainty about long-term soil dynamics	There is scientific uncertainty about long-term soil dynamics. There have been large and unexpected losses of SOC stocks in Australia over the long-term (Badgery et al. 2020) 'with no obvious moisture or temperature drivers but most likely attributed to a decline in mineral nitrogen availability' (Mitchell et al. 2024).	No or few ACCUs earned. Relinquishment of ACCUs. Project operates at a loss.
Climate change risk	Climate change poses a risk of 'decreased rates of organic matter input to soil, and increased rates of loss through changes to soil respiration and the microbial biota at higher temperatures' (Henry 2023). This may result in no SOC sequestration or a loss of SOC stocks.	No or few ACCUs earned. Relinquishment of ACCUs. Project operates at a loss.
Limited SOC storage capacity	SOC stocks may be saturated, or soil type and circumstance may mean there is limited storage capacity of SOC.	No ACCUs earned.
Rate of SOC sequestration is slower than predicted	The SOC sequestration rate may be slower than what was predicted, as each project is unique and impacted by several biophysical factors and varying management strategies.	No or few ACCUs earned. Project operates at a loss.
25 or 100 year permanence period	Project proponents are committed to maintaining the project and the associated change in management for the permanence period and must maintain the SOC sequestration for the period.	Inflexibility (White 2022).

5.2.8 Vegetation projects

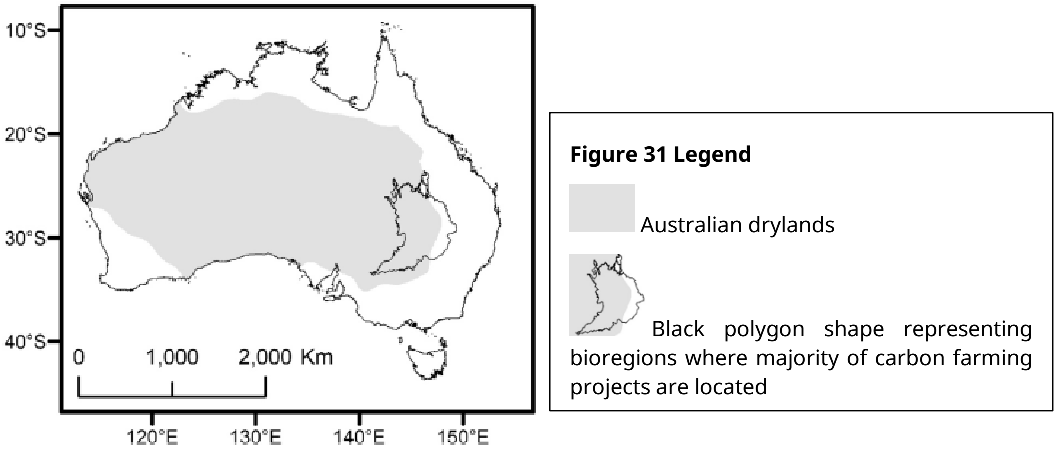
There are several risks associated with the ACCU scheme vegetation-based carbon sequestration methods, including the risk of the project failing due to biophysical factors such as drought and fire, the risk to the farming enterprise business of the loss of productive farming area, and the risk that the land cannot be cleared after the cessation of the project. These risks are discussed in detail below.

Risk of the project failing

When undertaking a project under the ACCU scheme utilising a vegetation method, such as reforestation by environmental plantings, there is a risk that the project may fail due to the plants not growing. Vegetation-based carbon sequestration projects are successful if the carbon storage is maintained throughout the permanence period (25 or 100 years). 'However, there are a number of biophysical risks to maintaining these long-term carbon stores, including fire, drought and heat stress, grazing by livestock and wild herbivores, recruitment failure after active regeneration, and changes in climate' (Nolan et al. 2018). A reduction in the rate of carbon sequestration or the loss of stored carbon back to the atmosphere can be the result of these risks (Nolan et al. 2018). For example, wildfires are estimated to decrease annual terrestrial carbon uptake by 0.32 Pg C per year, which constitutes about 20% of the total annual terrestrial carbon sink in a world without fires (Nolan et al. 2018). 'These risks not only affect the environmental and economic value of existing carbon abatement projects, but may also inhibit their uptake by additional landholders, effectively reducing carbon abatement potential' (Nolan et al. 2018). It is critical to the success of vegetation-based carbon sequestration projects to understand these risks (Nolan et al. 2018).

The study by Nolan et al. (2018) assessed the risks of carbon projects based in drylands of Australia, which is identified in Figure 32 below by the light grey shading. Nolan et al. (2018) looked specifically at a semi-arid region of the drylands in Queensland and New South Wales where most carbon farming projects are located, which is identified in Figure 32 below by the black polygon shape.

Figure 32: Location of drylands in Australia



Source: Adapted from Nolan et al. (2018)

Table 51Table 51 below summarises the likelihood and consequences of the risk factors identified by Nolan et al. (2018) and the management strategies and risk reduction mechanisms to mitigate them.

Table 51: Summary of risk factors associated with vegetation-based carbon farming projects

Risk	Likelihood of risk and potential consequences to carbon sequestration	Management strategies and risk reduction mechanisms
Fire	Fire can destroy vegetation and result in a loss of carbon sequestration that is emitted to the atmosphere by combustion during a fire and by decomposition following a fire. Fire tracks fuel load, which is higher following above-average rainfall when there is an increase in plant growth. Fire is highly variable in dryland Australia, which experiences highly variable rainfall. 'For example, in mulga woodlands, which cover 20-25% of the Australian continent and dominate arid and semi-arid landscapes, fire return intervals range from 3 to 52 years' (Nolan et al. 2018). Fuel loads will	Fuel load reduction (prescribed burning, mowing or livestock grazing to reduce pasture fuel load). Fire suppression – effective at containing low intensity, small fires. 'Suppression resources include personal protective equipment, fire-fighting equipment, and access to water, which require adequate preparation prior to wildfire occurrence. Preparation also includes, but is not limited to, well-maintained fire breaks, preparation of a written fire plan, consideration of the capacity to defend assets from fire (which includes personal capacity as well as equipment availability and condition

	increase over time due to carbon projects that involve regeneration of vegetation or vegetation plantings. This is however, depended on the matrix of fuel loads across a landscape.	of the grounds), and the availability of a safe place to seek shelter' (Nolan et al. 2018).
Drought and heat stress	Heat stress and drought can occur independently and jointly. Arid and semi-arid vegetation has adapted to low rainfall and exhibit a range of survival strategies including deep root systems to access ground water, and 'numerous morphological and physiological adaptations to survive under conditions of low soil water availability' (Nolan et al. 2018). Nevertheless, increased mortality rates and subsequent carbon emissions will result from prolonged drought. For example, the 1991-94 severe drought resulted in large reductions in live tree basal area in some areas in Queensland, such as the 29% reduction in live tree basal area across 195 sites in northeast Queensland recorded by Fensham and Holman (1999) (Burrows et al. 2002). The impact of drought on carbon storage and sequestration depends on how different plant species respond to disturbances. Resprouting species may experience delayed mortality compared to non-resprouting species, and vegetation dominated by resprouting species is likely to experience lower negative impacts from drought.	Drought and heat stress are unpreventable, but there are potential strategies that can be employed to mitigate negative effects on carbon stocks: • Grazing: there is mixed evidence of the impact of grazing on a recovering landscape. Following a disturbance, in some circumstances grazing may cause mortality of regenerating seedlings or shrubs, but in other cases it can enhance recovery. 'For example, grazing exclusion can enhance post-drought recovery of semi-arid shrubs while low intensity grazing can enhance the growth rate of woody seedlings by reducing competition from co-occurring grassy species' (Nolan et al. 2018). • Thinning: typically, thinning reduces stand-level transpiration, which can lead to increased soil moisture content and may therefore reduce the risk of drought-induced tree mortality. 'However, to date there has been no research on whether the carbon lost from thinning is offset by enhanced productivity and reduced mortality in surviving trees' (Nolan et al. 2018).
Recruitment failure after active regeneration	Plants can fail to germinate or establish in a regeneration or planting project. Factors that can influence this include the presence of a seedbank (which is impacted by rainfall, and predation such as ants), germination and establishment (germination may be delayed until the occurrence of an abiotic trigger like fire or rainfall, timing of rainfall is imperative for seed germination,	The planning stage and later stages are important opportunities to mitigate risks specific to regeneration or revegetation projects. During the planning stage, choosing sites near existing vegetation or scattered trees can enhance opportunities for the recruitment of woody species. Additionally, factors like the size and productivity of the site play a crucial role in determining carbon

	emergence and seedling survival), and competition ('woody species may be particularly vulnerable to [...] competition because they are under-represented in soil seed banks compared with herbaceous or grassy species, and the survival rate of woody species often declines with increasing grassy biomass' (Nolan et al. 2018)).	sequestration rates. The germination and establishment phases have high risk due to their reliance on rainfall with is unpredictable across drylands. Potential mitigation strategies include adding mulch to soil and irrigating. 'However, irrigation is unlikely to achieve desired outcomes because of the long duration that is often required and the risk of high mortality when irrigation is removed' (Nolan et al. 2018). The issue of some seeds requiring fire to germinate may be overcome by pre-treating seeds if direct seeding, or planting seedlings. 'Thinning may be beneficial at later growth stages if there is a high density of woody regrowth, though thinning does not always result in greater rates of carbon sequestration' (Nolan et al. 2018).
Climate change	Increased atmospheric concentrations of greenhouse gases, including carbon dioxide, is a key characteristic of climate change. This leads to higher temperatures, more frequent extreme weather events like droughts and heatwaves, and altered rainfall patterns (Nolan et al. 2018; Singh et al. 2010). The impact of climate change is uncertain. There may be an increase in annual rainfall on average, which can increase productivity, and which would also be supported by an increase in atmospheric CO2. However, this potential increase in productivity could be offset by increases in temperature and the frequency of drought events.	Species composition is an important determinant of carbon stocks accumulation. 'Greater plant species diversity and an herbaceous layer dominated by perennial species, rather than annuals, can enhance resistance and resilience to disturbance' (Nolan et al. 2018). Carbon projects involving revegetation can incorporate high diversity in terms of species composition, functional traits, and within-species genetics to assist the projects resilience to climate change.

Risk of loss of productive agricultural land

Vegetation-based carbon farming projects under the ACCU scheme such as environmental planting projects and natural vegetation regeneration projects are in competition with agricultural land use (including grazing native vegetation, grazing modified pastures and cropping) (CSIRO 2022; Harper and Sochacki 2019). This competition for land and the natural resourses thereon, such as water, cannot be ignored despite the potential for improved productivity and sustainability of reforested farmland (Harper and Sochacki 2019). Vegetation-based carbon farming projects have given rise to concerns about 'the displacement of rural communities and competition with farmers for land' (Harper and Sochacki 2019). 'These debates aside, there are very real issues of land degradation and biodiversity decline in Australia, and these can be treated with broadscale reforestation' (Harper and Sochacki 2019), provided the regeneration occurs in degraded ecosystems (e.g. land that has been gheavily cleared), rather than a relatively intact ecosystem.

Due to the competition with agricultural land, reforestation of large areas of Australian agriculture land is unlikely (Harper and Sochacki 2019). 'Areas where reforestation is likely to occur are where present land-uses are unprofitable; this includes salinised land, and soils with other impediments, or there are other imperatives such as biodiversity or watershed management' (Harper and Sochacki 2019).

In many areas, particularly in central and southern Queensland, woody vegetation regrows on properties that were previously mechanically cleared for pastoral production (Bray et al. 2016). Preventing the re-clearing of this regrowth can enhance carbon stocks as woodlands regenerate, while in some cases, also offering additional environmental benefits (Bray et al. 2016). However, this comes with trade-offs, as retaining more woody vegetation reduces pastoral productivity and livestock carrying capacity (Bray et al. 2016). 'Flexibility in the scale, type and configuration of reforestation amongst other land uses is an important consideration, as is the length of time landholders are required to maintain the reforested land' (Evans 2018).

Land clearing

The permanence period for a vegetation project under the ACCU scheme is 25 or 100 years, and a key consideration for landholders is the long-term productivity of their land after the permanence period has expired. For example, a landholder may wish to clear vegetation that they planted or allowed to regrow through the project or harvest timber. Under the legislation of the most relevant vegetation methods for Queensland graziers, namely the avoided clearing of native regrowth method and the reforestation by environmental or mallee plantings FullCAM 2024 method, once the project permanence period has ceased, there is no restriction on clearing activities. However, landholders may face restrictions imposed by other legislation such as the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) and the *Vegetation Management Act 1999* (Qld) (VMA Act). An example of this is with Brigalow.

Brigalow regrowth

There is a risk to landholders who undertake a project under the ACCU scheme involving retaining previously cleared brigalow regrowth for 25 or 100 years, that at the end of the project the Brigalow regrowth will not be able to be cleared. The Brigalow ecological community, Brigalow (A*cacia harpophylla dominant and co-dominant*), has historically been cleared for pastoral purposes and now occupies 10% of its former area (DCCEEW 2003). The ecological community of Brigalow was listed as a threatened community pursuant to the Federal EPBC Act on 4 April 2001 and categorised as endangered (DCCEEW 2024d), and in Queensland, it has been listed as endangered under the VMA Act. 'The purpose of listing the Brigalow ecological community is to help prevent its further decline and, ultimately, to assist efforts toward the recovery of the community' (DCCEEW 2003).

A person must not take an action that has or will have or is likely to have a significant impact on a listed threatened ecological community included in the endangered category pursuant to section 18(6) of the EPBC Act. Remnant and regrowth Brigalow were not distinguished in the Brigalow ecological community listing in the EPBC Act (DCCEEW 2003). Clearing of remnant Brigalow is prohibited in Queensland pursuant to the VMA Act (DCCEEW 2003). Brigalow regrowth is regarded as part of the listed Brigalow ecological community if it 'retains the species composition and structural elements typical of that found in the undisturbed listed regional ecosystems [… and] such regrowth will usually be 15 years or more old' (DCCEEW 2025). DCCEEW (2003) explained:

> 'Brigalow regrowth is not considered part of the Brigalow ecological community that is listed under the EPBC Act if it is of poor quality. An activity that affects Brigalow regrowth of poor quality is, therefore, not subject to the EPBC Act. In general, areas that have been cleared within the past 15 years will not have regained the structure and species composition typical of remnant Brigalow and, therefore, will not qualify as the listed Brigalow ecological community. Accordingly, clearing of Brigalow regrowth that is less than 15 years old **does not** need to be referred for assessment and approval under the EPBC Act' (DCCEEW 2003).

The implication is that Brigalow regrowth after the expiration of the permanence period under an ACCU scheme vegetation method project will be at least 25 years old and may be regarded as part of the Brigalow ecological community that is protected under the EPBC Act. Additionally, category C area under the VMA Act is an area that contains high value regrowth vegetation, which means vegetation located in an area that has not been cleared for at least 15 years if the area is an endangered regional ecosystem.

Risk associated with timing of vegetation regeneration projects

Carbon sequestration typically occurs at the highest rate during the first 4 to 11 years of a plants life. Therefore, to maximise the amount of carbon sequestered by regenerating vegetation, the timing of commencing a project under the ACCU scheme is important. If the age of the regrowth is 10 years at the start of a project, then the project proponent will have missed out on the period during which the carbon sequestration rate is highest. It is therefore important that project proponents time projects so as to benefit from the highest rate of carbon sequestration (rather than commence a project when regrowth is already aged beyond 11 years for example).

5.2.9 Summary of risks

In conclusion, while environmental market schemes offer opportunities for income diversification and environmental stewardship, they also present a range of significant risks that can limit primary producer participation. These include potential reductions in land value, uncertainty surrounding government policy and method development, questions over financial viability, the risk of project failure and long-term permanence obligations, and the complexity and asymmetry of information within the sector. Furthermore, criticisms of the credibility of the ACCU scheme and the role of offsets threaten to undermine the efficacy of the scheme. For soil organic carbon and vegetation-based sequestration projects, these risks span biophysical uncertainties, such as rainfall variability, extreme weather events, and the broader impacts of climate change, as well as economic and regulatory considerations including upfront costs, permanence obligations, and land use restrictions. While strategies exist to mitigate many of these risks, such as adaptive management practices and informed site selection, primary producers must carefully assess the trade-offs and potential consequences before undertaking a project. As such, addressing these risks through targeted policy design, transparent communication, and improved access to independent support services will be crucial in ensuring that environmental markets are both effective and equitable for landholders across Australia.

5.3 Tax implications

Project proponents participating in environmental market schemes face various legal and tax implications[104]. These may include limited access to tax concessions, questions around the deductibility of project-related expenses, and the potential consequences of generating non-primary production income.

5.3.1 Concessional tax treatment of ACCUs

First, in some circumstances, primary producers who participate in an environmental market scheme may have access to tax concessions, however, concessional tax treatment is **limited to ACCUs** and does not apply to other environmental credits.

Tax treatment of ACCUs – no concession

If a project proponent does not qualify for the concessional tax treatment of ACCUs, then the general rules apply to the taxation of ACCUs, which are set out in division 420 of the *Income Tax Assessment Act 1997* (Cth) (**ITAA97**). Division 420 ITAA97 provides that project proponents can deduct certain costs of becoming the holder of an ACCU in the year it is issued. If the value of ACCUs increases over an income year, the increase must be included in assessable income; if the value decreases, a deduction can be claimed for the loss. In the year they first acquire an ACCU, its starting value is treated as nil. Income from selling an ACCU is assessed as non-primary production income, and costs related to disposal can also be deducted (ATO 2023a). There is a specific provision for the cost of preparing and lodging an 'certificate of entitlement' or an 'offsets report', which is deductible. Furthermore, the cost of acquiring an ACCU is also deductible (ATO 2023a).

Concessional tax treatment of ACCUs

The tax concessions available to eligible primary producers include, 'for the purposes of the Farm Management Deposit (FMD) scheme and accessing the income tax averaging rules:

1. the proceeds from the sale of eligible ACCUs will be treated as primary production income; and
2. related deductions for expenses [incurred] in becoming the holder, holding or disposing of eligible ACCUs will be treated as primary production deductions' (ATO 2023).

Project proponents will be eligible for the concessional tax treatment of ACCUs if:

- the project proponent is an individual;
- the ACCU is issued either directly to the project proponent or transferred to them by a carbon service provider and the ACCU is issued on or after 1 July 2022 in relation to an eligible ACCU scheme project;

[104] **Disclaimer:** The taxation laws and regulations referred to in this report are subject to change. Any information or guidance contained in this report does not constitute legal or personal financial advice and is for general information purposes only. In preparing this publication, the author has not taken into account the investment objectives, financial situation and particular needs of any particular investor. All readers should seek advice from a professional adviser regarding the application of any of the content in this publication to a particular factual scenario. All readers must only rely on their own professional advice.

- at all times while the project is carried on, a ***primary production business***[105] is carried on in the same area as the project or in an area connected to where the project occurs;
- at all times while the project is carried on, the project proponent is carrying on a primary production business **or** is a beneficiary of a trust that is carrying on a primary production business **or** is a partner in a partnership that is carrying on a primary production business;
- If eligible, project proponents are assessed on the sale proceeds of ACCUs, rather than the change in value of ACCUs.

Where there is a commercial agreement between a project proponent and a carbon service provider to share the revenue and costs of an ACCU scheme project, the project proponent will be eligible for concessional tax treatment if the requirements above are met, regardless of whether they receive ACCUs, regular payments, or a share of the proceeds from the sale of ACCUs under the commercial agreement (Tellery Group 2023; ATO 2023a). However, project proponents will not be eligible for the concessions if the agreement with the carbon service provider constitutes a lease or rental arrangement (Tellery Group 2023; ATO 2023a).

The concessional tax treatment does not apply to ineligible entities, including companies and trusts. Furthermore, ACCUs acquired prior to 1 July 2022 or purchased from a third party are ineligible, as are ACCUs issued to primary producers for projects that are not connected to their primary production business. In these cases, the general tax rules under division 420 apply (ATO 2023a).

Summary of concessional tax treatment

In summary, primary producers using FMDs and primary production tax averaging, should be aware that income derived from environmental market projects may not qualify as primary production income (BDO 2022). The concessional tax treatment of income from ACCUs as primary production income that is available to eligible primary producers is viewed positively and considered a facilitator of primary producer participation in the ACCU scheme (Slegers et al. 2023). However, the breadth of this relief is limited to specific circumstances (such as a primary production business must be carried on *at all times* while the ACCU scheme project occurs), and primary producers and their professional advisors must carefully consider the tax implications of undertaking a project under the ACCU scheme (Slegers et al. 2023).

Additionally, the legal structure (individual, trust, company, partnership) of the project proponent of the ACCU scheme project or party to a contract if a carbon service provider is involved, will have a critical impact on access to the concessional tax treatment of ACCU income. As identified above, concessional tax treatment is limited to individuals. If a partnership runs

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[105] ***Primary production business*** means a business of:
(a) cultivating or propagating plants, fungi or their products or parts (including seeds, spores, bulbs and similar things), in any physical environment; or
(b) maintaining animals for the purpose of selling them or their bodily produce (including natural increase); or
(c) manufacturing dairy produce from raw material that you produced; or
(d) conducting operations relating directly to taking or catching fish, turtles, dugong, bÃªche - de - mer, crustaceans or aquatic molluscs; or
(e) conducting operations relating directly to taking or culturing pearls or pearl shell; or
(f) planting or tending trees in a plantation or forest that are intended to be felled; or
(g) felling trees in a plantation or forest; or
(h) transporting trees, or parts of trees, that you felled in a plantation or forest to the place:
 (i) where they are first to be milled or processed; or
 (ii) from which they are to be transported to the place where they are first to be milled or processed (s995.1 *ITAA97*).

the primary production business and holds the ACCUs, to qualify for the concessional tax treatment, it must consist only of individual (natural person) partners, and not a company or trust partner (Slegers et al. 2023). If a trust runs the primary production business and holds the ACCUs, to qualify for the concessional tax treatment, trustees must ensure that income distributed from ACCU sales to individual beneficiaries is clearly attributable to those sales. This usually requires properly drafted trust distribution resolutions to "stream" the ACCU income to beneficiaries and a trust deed that allows such streaming (Slegers et al. 2023).

Furthermore, as noted above, the concessional tax treatment of classifying income from ACCUs as primary production income is limited to the ACCU scheme. If primary producers undertake a project under another environmental market scheme such as the Reef Credit scheme, then the income generated from participation in that schemes will be treated as non-primary production income, which can have implications such as limiting access of the primary producer to the FMD scheme (to access the scheme, primary producers cannot earn over $100,000 non-primary production income), or access to other primary producer concessions like land tax and transfer duty in Queensland (these are discussed in further detail below) (BDO 2022; Slegers et al. 2023).

5.3.2 Project expenditure and tax deductions

Project proponents undertaking a project under any environmental market can claim a deduction for the costs incurred of establishing and running an environmental market project under the general income tax deduction provisions (CER 2024q; Tellery Group 2023; Slegers et al. 2023). However, many of the costs associated with establishing and running a project are ‘capital in nature and therefore require consideration of potential deductions available under the capital allowance regime (including primary production write-offs)’ (Sleger et al. 2023). Primary producers can access a range of capital write-offs that allow for accelerated deductions (outlined in Subdivisions 40-F and 40-G of the ITAA97) for capital improvements to land used in carrying on a primary production business, such as water facilities, fodder storage, fencing, horticultural plants, and landcare operations (Slegers et al. 2023). However, as these deductions are only available if the expenditure is in relation to the carrying on of a primary production business, it raises questions as to whether they are available to capital expenditure in relation to an environmental market project (Slegers et al. 2023). For example, the ATO Federal Commissioner previously held that planting mallee trees for carbon credits did not qualify for a deduction as horticultural plants (ATO Interpretative Decision ATO ID 2004/634) (Slegers et al. 2023). Lawyers are therefore urging caution be taken in this area (Slegers et al. 2023).

Commercial lawyers, Slegers et al. (2023), noted that the safer option may be to claim capital allowance deductions under division 40 for depreciating assets—those with a limited effective life that decline in value over time. Land itself isn’t depreciable, but improvements to it may be. Deductions might also be available under division 43 ITAA97 (for capital works like buildings and structures, and environmental protection earthworks) and subdivision 40.1000 ITAA97 (deduction of expenditure incurred in establishing trees in carbon sink forests) (Slegers et al. 2023).

Evidently, the rules governing what qualifies for a tax deduction are complex, and project proponents should seek professional advice.

5.3.3 Impacts of earning non-primary producer income

As previously flagged, income derived from environmental market projects may not qualify as primary production income, which can have several implications for primary producers (BDO 2022). Income from the sale of credits generated under the Reef Credit scheme, LRF scheme, Nature Repair Market or Cassowary Credit scheme is non-primary production income, as is income from the sale of ACCUs if the project proponent fails to qualify for the concessional tax treatment discussed above. Earning non-primary production income may have negative implications for primary producers including:

1. limiting access of the primary producer to the FMD scheme (to access the scheme, primary producers cannot earn over $100,000 non-primary production income);
2. limiting access to primary producer land tax exemption (in Queensland, pursuant to s53 of the *Land Tax Act 2010* (Qld), land – or part of land – used solely for the business of primary production is exempt from land tax. Environmental market projects are not included in the definition of 'primary production'[106]);
3. limiting access to the transfer duty concession available to primary producers (in Queensland, pursuant to s105 of the *Duties Act 2001* (Qld), transfer duty is taken to be nil for transfers of land between family members provided the land is used (and will be continued to be used) for the business of primary production. Environmental market projects are not included in the definition of 'primary production'[107]); and
4. limiting access to tax loss concessions if project proponents' annual income exceeds $250,000 (BDO 2022; Slegers et al. 2023).

Accordingly, primary producers engaging in environmental market projects must carefully consider the tax and legal implications of earning non-primary production income, as it may significantly impact their eligibility for key concessions and benefits.

5.3.4 Summary

Evidently, while environmental market schemes offer opportunities for primary producers to diversify income and participate in sustainability initiatives, the associated legal and tax frameworks are complex and nuanced. Access to concessional tax treatment is restricted to specific circumstances, and eligibility depends heavily on the nature of the entity, the structure of commercial agreements, the relationship between the project and the primary production business, and the timing and source of ACCU acquisition. Beyond the ACCU scheme, income from other environmental markets will generally be treated as non-primary production income, which can limit access to a range of important concessions and deductions available to primary producers. Given the intricate interplay between tax laws, environmental markets, and agricultural operations, it is essential that primary producers seek professional advice before undertaking environmental market projects.

[106] ***Primary production*** activities mean
(a) maintaining animals for the purpose of selling the animals or their bodily produce, including their natural increase;
(b) cultivating land for the purpose of selling produce;
(c) propagating or cultivating plants or mushrooms, for the purpose of selling the plants or mushrooms or produce from the plants, whether the plants or mushrooms are grown— (i) in sand, gravel or liquid, without soil and with added nutrients; or (ii) in the ground or in pots, bags or containers;
(d) planting or tending trees in a plantation or forest for the purpose of selling the trees or produce from the trees;
(e) an activity, other than an activity mentioned in paragraph (a), (b), (c) or (d), that is agriculture, dairy farming or pasturage;
(f) an activity that is— (i) directly related to, and carried out to support, an activity mentioned in any of paragraphs (a) to (e); and (ii) carried on for the same business of primary production mentioned in section 53(1) of the Act (s2 *Land Tax Regulation 2021* (Qld)).

[107] *Business of primary production* means a business of agriculture, pasturage or dairy farming (schedule 6, *Duties Act 2001* (Qld)).

6 Discussion

Environmental markets are market-based instruments that facilitate the exchange of environmental goods and services (such as biodiversity, habitat, and clean air and water) for monetary or other forms of value. They are designed to incentivise protection, restoration and the sustainable use of environmental assets and can improve resource allocation, attract private investment and offer cost-effective alternatives to government regulation.

Agriculture is the largest land management sector in Queensland occupying 80% of the land area. The Australian agricultural sector accounted for 18.4% of Australia's total greenhouse gas emissions in 2023 and key Australian agricultural industry bodies have committed to achieving carbon neutrality, including Meat & Livestock Australia whose target is net zero by 2030. Reaching this target will involve adopting grazing management practices that lower emissions or enhance carbon sequestration in soils and vegetation, which creates opportunities for primary producers to participate in environmental market schemes. Primary producers can potentially benefit by earning a diversified source of income from the sale of credits. Co-benefits could also be produced such as improved soil health and structure, water retention and better management of erosion and salinity, however, these co-benefits can also be generated without participating in an ACCU project. There are costs involved with participation that can be significant, and potentially render a project financially unviable, mostly emanating from the cost of undertaking a project and the opportunity cost of reduced primary production activities. Furthermore, there are risks including project failure or not achieving carbon sequestration or emissions abatement targets, long-term farm production impacts, reduced land value and government policy uncertainty. Participation in environmental market schemes can also have significant taxation implications.

The opportunity to gain from participating in environmental market schemes varies from primary producer to primary producer, and a case-by-case assessment is required to determine the suitability of participation for individual business enterprises. Unfortunately, there is limited independent objective information currently available to help primary producers to make well informed decisions. Consequently, the role of this scoping report was to investigate the environmental market schemes currently available and emerging, analyse the key drivers of demand and supply, benefits and costs, and identify the potential opportunities, risks and taxation implications for Queensland primary producers.

6.1 Overview

There are five key environmental markets in Queensland and Australia, including the national ACCU scheme that commenced in 2011, the Queensland Reef Credit scheme that commenced in 2017, the Queensland Land Restoration Fund that commenced in 2020, the national Nature Repair Market that commenced in 2025 and the Queensland Cassowary Credit scheme that was launched in May 2025. Table 52 below summarises the key characteristics of the environmental markets in Queensland and Australia.

The greatest number of projects have been commenced, and credits issued, under the ACCU scheme, totalling 2,503 registered projects and 161,203,002 ACCUs issued (CER 2025d). While participation in the ACCU scheme and other environmental markets has risen over time, it remains low and there is an undersupply of environmental goods and services. For example, only 37% of Australia's *annual* emissions have been abated in the ACCU scheme since 2014, while Australia's legislated targets are to reduce annual emissions to 43% below 2005 levels by

2030, and to net zero by 2050. Australia's net greenhouse gas emissions were 433 Mt CO_2e, in 2023. In 2021-22, 44 Mt CO_2e was sequestered, whereas past research has estimated that there is the economic potential to sequester around 2.7 times that amount each year (106–130 Mt CO_2e/yr) and the technical potential to sequester around 30 times that amount (1,336 Mt CO_2e/yr).

Potential reasons deterring agricultural producers from participating in environmental markets include high transaction costs, monitoring and compliance costs and challenges, uncertainties about payment streams, loss of flexibility over operations and long-term contractual commitments. Another related issue may be that the benefits of participating do not outweigh the costs and risks. A key benefit of participating is income from the sale of credits, which is dependent on the price of credits and the number of credits generated by the project. However, private industry and businesses are increasingly demanding environmental goods and services to meet regulatory requirements as well as for voluntary investment initiatives primarily driven by a combination of social licence strategy and environmental, social and governance reporting.

Table 52: Environmental Markets in Queensland and Australia

Environmental Market	ACCU Scheme	Reef Credit Scheme	Land Restoration Fund (LRF) (grant scheme)	Nature Repair Market	Cassowary Credits
Year scheme commenced	2011	2017	2020	2025	2025
Commodity	Carbon	Great Barrier Reef catchment water quality	Carbon + co-benefits	Biodiversity	Biodiversity
Jurisdiction	National	Queensland	Queensland	National	Queensland
Legislated	Yes	No	No	Yes	No
Credit issued	1 ACCU = 1 t CO_2e abated	1 reef credit = 1kg Dissolved Inorganic Nitrogen or 538kg Fine Sediment	ACCU + premium for co-benefits	1 biodiversity certificate = biodiversity outcome delivered by a project (1 certificate issued per project)	1 cassowary credit = improvement in rainforest condition
Buyers	Voluntary (some demand is driven by regulatory restrictions on emissions via the Safeguard Mechanism)	Voluntary	Voluntary	Voluntary	Voluntary

Scheme Administrator	Clean Energy Regulator	Eco-Markets Australia	Clean Energy Regulator and Land Restoration Fund	Clean Energy Regulator	Eco-Markets Australia
No. of methodologies	9 vegetation, agriculture and savannah burning methods	5 methods	3 categories of co-benefits	1 method	1 method
Price of credits	$35.90/ACCU[108]	$170/reef credit[109]	$52.50 (2020), $71.16 (2021), $120 (2023) /ACCU + co-benefit[110]	Not known	Not known
No. of credits issued	161,203,002 ACCUs[111]	60,868 reef credits	171 co-benefits and 1,320,030 ACCUs were contracted by the LRF in 2020, 2021, and 2023[112]	0	0
No. of projects	2,503 projects[113]	14 projects	26 projects	0	1 project

Source: Partially adapted from Deane et al. (2024)

ACCU method categories relevant for Queensland primary producers include the agricultural, vegetation and savanna burning methods. Within these categories, the suitable individual methods for graziers include soil carbon (ag), beef cattle herd management (ag-suspended), plantation forestry (veg), environmental plantings (veg), avoided deforestation (veg-closed), human-induced regeneration (veg-closed), blue carbon (veg) and savannah burning. ACCU scheme methods automatically end or 'sunset' 10 years after they are made (e.g. those specified as 'closed'). Once expired, no new projects can be registered under the method. Across Australia, the greatest number of projects have been registered using vegetation methods (1,200 or 48%), followed by agriculture methods (801 or 32%), waste methods (239 or 10%) and then savannah burning methods (106 or 4%), whereas the most ACCUs have been issued to projects using vegetation methods (88.1M ACCUs), followed by waste methods (49M or 30%), savannah burning methods (14.7M ACCUs) and agricultural methods (2.6M ACCUs). The beef cattle herd management method only account for 15 projects. In terms of the location of

[108] The ACCU spot price was $35.90 on 23 May 2025 (Core Markets 2025b).
[109] Eco-Markets Australia (2025c).
[110] Queensland Government (2025a).
[111] ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d).
[112] Queensland Government (2025c).
[113] ACCU Scheme Project Register, data as at 28/02/2025 (CER 2025d).

projects for each method, the savannah burning method projects are located in northern Australia (as is required by the method rules), while the plantation forestry, environmental plantings, and soil carbon method projects are mostly located in areas with higher rainfall including the east and west agricultural zones.

Since the commencement of the Reef Credit scheme in 2017, 14 projects have been registered and almost 61,000 reef credits generated. Twelve projects utilised the dissolved inorganic nitrogen (DIN) method, one project the wastewater method and one project the gully remediation method. During that time, over 41,000 reef credits were purchased and retired by nine different organisations including Qantas Airways Limited, Tourism Australia, Terrain NRM, HSBC, Australian Museum Trust, Groundswell Giving Ltd, Great Barrier Reef Foundation, Sydney Opera House Trust, and Queensland Alumina Limited. Landholders may also have the potential to stack these credits with ACCUs but cannot claim credit for the same pollutant reduction.

The Land Restoration Fund, which is a grant scheme (rather than a separate environmental market scheme) was also analysed. It differs from the ACCU scheme as it supports projects that deliver co-benefits, in addition to sequestering or avoiding carbon emissions, by bundling them with the ACCUs and purchasing them. The LRF enables project proponents to bundle ACCUs with LRF co-benefits and collect a higher price (e.g. $100 per unit). By placing value on co-benefits, the LRF can support projects that might otherwise be unviable due to factors such as small scale or high implementation costs. Three investment rounds were held in 2020, 2021 and 2023. The first round contracted 11 projects to purchase 975,000 ACCU's plus co-benefits for a median price of $52.50/ACCU. The second round contracted 7 projects to purchase 164,000 ACCU's plus co-benefits for a median price of $71.16/ACCU. The third round contracted 8 projects to purchase 181,000 ACCU's plus co-benefits for a median price of $120/ACCU. Environmental co-benefits were the most contracted (including threatened wildlife, threatened ecosystems, native vegetation, and GBR) followed by employment and skills, then community resilience. Reforestation by environmental plantings was the most common ACCU scheme method contracted (12 projects) followed by avoided clearing of native regrowth (7 projects).

The Nature Repair Market is the world's first national, legislated, voluntary biodiversity market. It was designed to incentivise the enhancement and protection of biodiversity in native species in Australia through changes in land management practices and has a goal of no new extinctions. Only one method is currently available - replanting native forest and woodland ecosystems - and no projects are registered. Activities include tree planting on agricultural land, restoring vegetation along waterways, and protecting and managing existing habitats or native vegetation. Project proponents have an opportunity to increase the value of their credits by stacking ACCUs with a biodiversity certificate generated from the same project and project area.

The Cassowary Credit Scheme also only has one method currently available, which is the Rainforest Replanting Method. The scheme targets land unsuitable for agriculture and project proponents can earn cassowary credits through rainforest repair, reinstatement, enhanced protection or threat mitigation. Project activities can range from planting rainforests on cleared land to weed control and improving the condition of existing vegetation.

6.2 Drivers of demand and supply

Demand for environmental credits is key to securing changes in agricultural practices and has been steadily increasing in the ACCU scheme. The Safeguard Mechanism has increased demand for ACCUs due to legislated emissions reduction targets for 219 industrial facilities, which rely on the ACCU scheme to offset some of their emissions. Demand by safeguard facilities noticeably increased in 2024 to 60% of ACCU holdings with demand expected to increase each year to 2030. Furthermore, the Australian Government established its Nature Positive Plan, whereby it has committed to work towards zero extinctions and protect 30% of Australia's land and seas by 2030, and the Environmentally Sustainable Procurement Policy and Reporting Framework that requires products purchased by the government 'minimise GHG emissions. Other significant Australian and Queensland Government investments include the Reef 2050 Plan and the Landscape Repair Program. These actions will each contribute to stimulating demand for environmental services.

Voluntary demand of ACCUs has also gradually increased since 2019 with purchases increasing to 1.1 million in 2024 due to factors such as ethical or moral considerations, alignment with environmental and social responsibility goals, responsiveness to customer expectations and marketing advantages. Demand for reef credits has fluctuated due to supply volatility. The Australian Government recently introduced regulations for sustainability reporting by large businesses to begin between 2025 and 2027. Reporting requirements include disclosures on scenario analyses and greenhouse gas emissions (Scope 1, 2 and 3), which may increase demand for environmental credits given increasing pressures on businesses to maintain their social licence to operate and ESG factors.

Consumer demand for food produced according to higher environmental standards may also help to increase the adoption of sustainable agriculture management practices through ecolabelling and environmental standards, where consumers can opt for differentiated products or higher standards typically at a higher price. While consumer preferences for sustainably produced goods are evident (e.g. organic foods or free-range eggs), past Australian research has identified that price was the dominant influence in purchasing decisions, followed by health considerations. One study revealed limited interest by consumers in considering carbon footprint when purchasing meat whereas other credence factors including animal welfare and health are important. The extent of willingness to pay varies between products and consumers.

Participation rates by primary producers in environmental markets remains low but the supply of ACCUs by project participants is trending upwards. However, that is not yet the case for other environmental markets. Limited participation can be addressed by understanding and targeting the underlying decision-making drivers of primary producers. While financial gain is a primary motivator, primary producers also consider several other factors including (but not limited to) the costs and financial viability of participating, the management demands of a project, timeframe, risk and uncertainty associated with a project, access to information and knowledge, long-term business sustainability, keeping the farm property in the family, ecosystem co-benefits and personal beliefs and values. Targeting the facilitators and barriers to entry into environmental markets can support participation and increase the supply of credits. For example, facilitators included linking programs to economic benefits was essential for farmers as it helped set an expectation of financial return, thus leading to intrinsic rewards. Other examples included providing information and technical assistance to primary producers' to facilitates participation, increased financial security from diversified income, early adopters' motivations can be largely environmental, and best outcomes in interventions may be facilitated in existing farmer groups, not alone. There are many barriers to entry including high project costs and lack of financial viability of projects as well as uncertainty, scheme complexity, cumbersome management requirements and long project time frames.

Stacking can occur when a management change/s generates multiple environmental benefits and earns credits across different environmental markets (e.g. carbon and biodiversity). Where participation rates are low, allowing stacking presents an opportunity to increase participation and can potentially provide improve the financial viability of environmental market projects and drive supply. However, strict provisions of most environmental markets require credits to be "additional", meaning they must result from the new incentive created by the environmental market. Stacking is possible within each scheme but it depends on the particular methods and project circumstances whether it can occur.

The combination of the above-mentioned demand factors indicate growing, albeit nuanced, demand for environmental market credits, with government regulation and policy currently providing the strongest market signals. Despite this, whilst supply of environmental market credits (mostly ACCUs) has increased over time, current participation levels by primary producers in all environmental market scheme remains low.

6.3 Benefits and costs

Participating in environmental market schemes can offer primary producers a range of potential benefits. These include increased and diversified income from the sale of environmental credits, which can enhance farm investment capacity, succession planning, and community wellbeing. Projects may also deliver valuable ecosystem co-benefits like improved biodiversity, soil health, water quality, and overall farm resilience. In addition, landholders undertaking environmental improvements may access preferential financing through 'green loans' offered by institutions such as NAB and CBA. Participation in these schemes can also open marketing opportunities, allowing producers to brand their products as carbon neutral or environmentally sustainable, although price premiums for such products is not guaranteed. Ultimately, the potential benefits of participating in environmental market schemes are not guaranteed, and it has been suggested that the low participation rates in the ACCU scheme may be because 'economic benefits are too limited to drive major practice change' (Pudasaini et al. 2024).

Participating in environmental market schemes also involves a range of costs that landholders must consider. These include direct project costs, such as feasibility assessments, legal and accounting advice, ongoing monitoring and audits (with audit costs alone ranging from $7,000 to $30,000 per audit for the ACCU scheme), and costs tied to the specific methodology used. Some methods, like projects involving tree plantings, are particularly expensive, with tree planting costs varying from $3,000/ha to $55,000/ha. In contrast, methods such as savannah burning or avoided clearing tend to be lower cost. In addition to upfront and ongoing costs, opportunity costs must be considered, especially for methods that compete with primary production for land and resources, such as environmental plantings or blue carbon projects. Methods that integrate with existing farming operations, like soil carbon projects, generally pose lower opportunity costs. Ultimately, the costs associated with a project.

Participating in environmental markets generates both benefits and costs for primary producers, and the ultimate outcome of that equation as either a net gain or loss will vary case by case and depend on the circumstances of the primary producer's project. Given the uncertainty and variability associated with participation in environmental market schemes, primary producers need to conduct their own cost benefit analyses and obtain professional advice before signing up to a project. Furthermore, McLean et al. (2023) advised that primary producers should not undertake projects at the detriment of their primary production business.

6.4 Investment analysis

The investment analysis section quantified the benefits and costs from implementing projects for four different ACCU scheme methods. The ACCU scheme methods were chosen given their relevance for graziers and/or higher participation rates. Investment analyses were undertaken by completing discounted cashflow analyses to determine the net present value of projects and assess their economic viability for primary producers (using a 5% discount rate). The discounted cashflow analyses aggregated the marginal changes in cashflow that occurred over the life of each project in comparison to not undertaking the ACCU scheme project (e.g. business as usual). The analyses were conducted from the perspective of primary producers, so any wider social benefits and costs have been excluded. Projects were evaluated at the current average ACCU price ($35/ACCU) as well as two higher prices ($50 and $100/ACCU) given demand is forecast to increase. Marginal changes in annual cashflow were calculated by subtracting the costs of implementing each project, including opportunity costs (e.g. forgone income from cattle sales from land use changes), from the income produced by selling awarded ACCU's. Permanence period and risk of reversal discounts, along with temporary withheld credits, were applied when calculating the number of awarded ACCUs, respective of the scheme method. Given variability amongst farms, regions, climatic conditions and projects, the results do not reflect the potential outcomes for all projects but instead provide a general indication of their economic viability. It is important that prospective project proponents conduct their own investment analysis on an individual basis to account for their unique circumstances.

6.4.1 Soil organic carbon measurement

Globally, the largest reserve of terrestrial organic carbon is held in the top metre of soil. It holds approximately twice the amount of carbon as that in the atmosphere and three times more than is stored in vegetation. Over the past two centuries, agricultural land in Australia has been cleared of native vegetation, which typically resulted in 20% to 60% of soil organic carbon (SOC) stocks being lost. Research indicates that an average of 29.7 t/ha of SOC is stored in the top 30cm layer of soil in Australia, which is relatively low when compared to some other countries. However, different soil types have different carbon storage potential. The most suitable soils for carbon sequestration projects are those that have the capacity to sequester large amounts of carbon and are currently depleted of soil organic matter. Research highlights that most Queensland agricultural regions with SOC deficits are in the southeast quadrant of the state (south and east of the Isaac region) (see Figure 23). The soil's capacity to store carbon is finite with the most rapid accumulation of SOC occurring in the first 5–10 years after a positive change is implemented before stabilising over 20–40 years.

There are two key mechanisms to increase SOC levels, including increasing the inputs of carbon-containing biomass into the soil, and reducing the decomposition of soil organic matter and the rate of loss of SOC back to the atmosphere. The maximum amount of carbon that can enter the soil is dependent on the net primary productivity of plants, which is limited by factors such as solar radiation, climate conditions, and the availability of soil water and nutrients. Research indicates that up to 10% of the atmospheric carbon dioxide absorbed by plant leaves during photosynthesis can be sequestered in the soil for over a century. The rate of loss of carbon from the soil can be minimised by avoiding repeated soil disturbances, such as frequent tillage and erosion which promotes microbial breakdown and organic matter oxidation.

Quantifying SOC stocks is complex as many factors influence sequestration such as soil type, terrain (gradient, shape, etc.), climate (precipitation, temperature, evapotranspiration, aridity, etc.) and management (land use, farming system, tillage, etc.). The primary determinants of SOC stocks are moisture availability and soil properties, whereas the impacts of land management are smaller. Rainfall and other climatic factors influence plant productivity and the amount of carbon-containing biomass entering the soil. Soils with high clay content have greater capacity to store SOC because they are protected from microbial decomposition, while soil compaction is negatively correlated with SOC levels.

Moreover, soil type, terrain and climate are unfeasible (e.g. expensive) for landholders to alter to increase their SOC levels. Feasible management options may include increasing carbon inputs such as crop/animal residues (e.g. legumes), compost and amendments, decreasing carbon losses by reducing mineralisation, erosion or leaching or farming system changes such as improved water or soil management (reduced tillage, etc.).

Under the ACCU scheme rules, the 'estimating soil organic carbon sequestration using measurement and models method' can be undertaken by establishing legumes, converting to reduced or no tillage or promoting vegetation growth by reducing the stocking rate, duration or intensity of grazing. A literature review of Australian rangeland studies identified that the rate of SOC sequestration varied substantially between different strategies and studies. Under the right conditions (suitable combination of climate, soil and land management practices), SOC sequestration was found to be achievable. Grazing management strategies included reducing grazing intensity and rotational grazing (versus continuous). Reducing grazing intensity was found to consistently increase sequestration across all the studies and ranged between 0.004 to 0.9 t C/ha/yr. Rotational grazing indicated sequestration of between -1.36 to 0.01 t C/ha/yr, however, most studies were not statistically significant indicating other factors may be at play. Nevertheless, implementing rotational grazing has been found to increase sequestration in international meta analyses but caution is needed when extrapolating overseas findings to an Australian context.

Pasture management strategies included sowing more productive grasses, establishing legumes (into existing grass pastures) and waterponding in scald areas. Sowing more productive grasses indicated sequestration of between 0 to 0.4 t C/ha/yr but most studies were not statistically significant. It was posited that SOC may accumulate more rapidly in initial years if nutrients were applied at sowing to promote growth. Establishing legumes was found to consistently increase sequestration across all the studies and ranged between 0.08 to 0.76 t C/ha/yr. One study examined waterponding in scald areas, which increased sequestration by 0.28 t C/ha/yr (but only). Lastly, one study each examined the impact of reduced tillage or no tillage and found that sequestration increased by 0.28 and between 0.1 to 1.3 t C/ha/yr, respectively.

Of the 575 projects using the SOC measurement method, 26 projects have reported improved SOC stocks once and been awarded ACCUs with 11 of these projects located in Queensland. Many of the 11 Queensland projects include a combination of activities with ten projects 'altering the stocking rate, duration or intensity of grazing', nine projects 're-establishing or rejuvenating a pasture by seeding or pasture cropping', and three projects 'applying nutrients to the land in the form of a synthetic or non-synthetic fertiliser to address a material deficiency'. The 11 Queensland projects had an average SOC sequestration of 1.66 t C/ha/yr and ranged between 0.31 to 3.5 t C/ha/yr. However, a review of five of the Queensland projects concluded that sequestration was climate driven (increased rainfall was identified as the primary driver), and the crediting of ACCUs was for a transient gain, which poses risks to farmers in relation to the permanence requirements of sequestration.

Soil carbon sequestration practices have co-benefits including increased water-holding capacity and fertility, improved soil structure and nutrient retention and reduced soil erosion, which may boost agricultural yields. Research has demonstrated that co-benefits (e.g. promoting long-term soil health) are an important motivating factor for farmers to engage in SOC sequestration projects. However, SOC sequestration projects are subject to the risk of sequestration reversal, which can prevent a project from meeting its 'permanency' requirement and require the relinquishment of ACCUs. For example, climate change threats include less soil organic matter inputs and higher soil respiration losses, while drought and fire can also reverse sequestration.

There is also uncertainty around SOC dynamics due to a scarcity of long-term, repeated SOC sampling and unexplained changes in SOC stocks in some trials.

The investment analysis examined an ACCU project establishing leucaena in strips into a 433ha paddock of grass pasture to increase SOC stocks, which was modelled based on an average hypothetical farm in the Fitzroy region. Past research modelled the same management change on the same farm without undertaking an ACCU project and found that it improved farm profitability by $40,336 per year (annualised NPV) and had a 7 year payback period. Therefore, the objective of this analysis was to identify whether undertaking an ACCU project at the same time would further increase farm profitability. Consequently, this analysis was limited to quantifying the cost and benefits from undertaking the ACCU project only (e.g. ACCU project establishment and reporting costs and income from selling the ACCUs generated).

The total cost of undertaking the project over 25 years was estimated to range between $190,055 and $440,915 depending on soil sampling and auditing costs. Costs included legal/accounting advice ($10,000), project establishment (*$21,650 – mapping, baseline, registration*), soil sampling x6 ($77,940–$259,800 based on $30–$100/ha), offset reporting x5 ($45,465), monitoring requirements ($14,000) and auditing x3 ($21,000–$90,000 based on $7,000-$30,000/audit).

Four SOC sequestration rates were examined including a low, medium and high rate based on sequestration rates measured in Australian trials. A very high rate was also included based on the average sequestration rate reported so far by the 11 Queensland ACCU projects. However, this rate is 2.2 times higher than the rates observed in scientific studies involving legume plantings and is therefore unlikely to be realistic. Many of the ACCU projects include multiple management changes (e.g. altering stocking rates, re-establishing pasture, applying nutrients) and rapid SOC accumulation generally occurs quickly after changes are implemented before tapering off, which may help to explain the very high reported rates. The four rates were 0.08 (low), 0.39 (medium), 0.76 (high) and 1.66 t C/ha/yr (very high), which would sequester approximately 0.29, 1.43, 2.79 and 6.09 t CO_2e/ha/yr, respectively. These SOC sequestration rates were assumed to remain constant from year two (when the leucaena is planted) until year 25 (permanence period). Soil tests are undertaken every five years to measure SOC levels and report them to the CER. Using these assumptions, the project would sequester approximately 3,014 (low), 14,861 (medium), 28,994 (high) and 63,287 t CO_2e (very high) by year 25 and after applying permanence period (20%) and risk of reversal (5%) discounts generate a total of 2,260, 11,145, 21,745 and 47,465 ACCUs respectively. The beef cattle herd management method calculator was used to measure cattle emissions before and after legume establishment, which identified that emissions would decrease due to improved steer liveweight gains and faster turnoff times.

The results of the investment analysis are presented in Table 53. To pay back the costs of undertaking the project at current ACCU prices, graziers would need to achieve SOC sequestration rates that were high to very high or at least medium but with low soil sampling ($30-$60/ha) and auditing ($7,000-$18,500) costs. Attaining high sequestration rates could improve farm profitability by $114,100–$256,400 over the 25-year project but low rates could decrease it by $78,900-$221,300. There is also a risk of sequestration reversal (drought, fire, climate change, long-term dynamics), which could reverse high initial rates of sequestration. At higher ACCU prices ($50-$100/ACCU), graziers would need at least medium SOC sequestration rates. These results align with past research that found returns from soil carbon projects on grazing lands are not necessarily positive due to the high costs of monitoring, management and verification. The benefit of SOC sequestration projects is that they can complement agriculture production businesses with co-benefits (improved farm productivity) and do not necessarily compete with agricultural production for land use, which was demonstrated in this investment analysis (planting leucaena to increase SOC stocks).

Table 53: Net Present Value of soil organic carbon sequestration to establish leucaena in the Fitzroy region on 433ha project area, with varying carbon prices and sequestration rates for 25-year project

Sequestration rate	Net Present Value (millions) at ACCU price of $35	Net Present Value (millions) at ACCU price of $50	Net Present Value (millions) at ACCU price of $100
Low	-$0.22 to -$0.08	-$0.2 to -$0.06	-$0.15 to -$0.01
Medium	-$0.07 to $0.07	$0.01 to $0.16	$0.29 to $0.43
High	$0.11 to $0.26	$0.27 to $0.42	$0.81 to $0.95
Very high	$0.56 to $0.7	$0.91 to $1.05	$2.07 to $2.22

6.4.2 Environmental plantings

Since colonisation, over 40% of Australia's woodlands and forests have been cleared resulting in a loss of biodiversity and stored carbon. Forests sequester more carbon than grasses and crops because of greater biomass and woody long lasting structure. Trees absorb atmospheric carbon dioxide through photosynthesis and store carbon in vegetation and roots. The amount of carbon sequestered varies widely depending on tree species and age, planting design, soil type, climate (rainfall and temperature), slope, nutrient and water availability, management and decomposition rates. Vegetation growth is key to estimating amounts of sequestered carbon, which is highest in a tree's early growth (ages 4–11) and levels off as the tree matures. If rapid carbon sequestration is the goal, timber plantings (typically single species with silviculture management) or plantings of fast growing trees may be preferable; however, native mixed-species plantings (typically environmental plantings) offer greater biodiversity benefits.

A review of 13 Australian studies measured carbon sequestration rates in vegetation, using either field measurements or FullCAM, of 0.035–18 t CO_2e/ha/yr across Australia. Six of these studies measured rates across Queensland alone identifying ranges from 0.035 t CO_2e/ha/yr for managed regrowth in the arid west of the state (such as the Diamantina Shire) to 12.49 t CO_2e/ha/yr for hardwood monoculture in high-rainfall areas of the coastal southeast (such as the Gold Coast). Four of these Queensland studies examined central Queensland sites with Brigalow or Eucalypt vegetation and measured long-term average carbon sequestration rates across at least a 16 year period of 1.4 to 2.2 t CO_2e/ha/yr.

Vegetation-based carbon sequestration initiatives can deliver co-benefits including reduced risk of erosion, waterlogging and flooding, mitigation of dryland salinity, enhanced biodiversity, improved water quality, provision of shade and shelter for livestock and increased resilience to climate extremes. However, these benefits must be carefully balanced against potential trade-offs, such as the loss of productive agricultural land and potential reduction in land value. Discontinuing clearing or planting trees increases tree coverage and can reduce the amount of sunlight and soil moisture available for forage production, which may decrease carrying capacity. Therefore, more productive grazing businesses have relatively higher opportunity costs than less productive businesses given they lose higher productivity grazing land. Consequently, farms located in lower productivity regions, such as the Mulga Lands, can have greater incentives to undertake vegetation-based carbon farming projects. While project participants perceive that additional income and income diversification were a key driver of adoption, they also note general disapproval from local communities due to the impact of 'locking up' land on the local economy.

The ACCU scheme provides methods for landholders to undertake land restoration projects by discontinuing clearing or planting trees to sequester carbon in vegetation. FullCAM estimates the amount of carbon stored in live and dead biomass, and accounts for disturbances such as burning, thinning or harvesting. Project proponents are required to use FullCAM to estimate sequestration, which helps to lower project costs by not requiring expensive in-field measurements and therefore promotes participation. The ‘reforestation by environmental or mallee plantings’ method (environmental plantings) is the most utilised of the currently available vegetation methods. Consequently, the investment analysis examined an ACCU project using this method. Two planting areas were examined across 5% (433 ha) and 50% (4,350 ha) of the total farm area, which were modelled based on an average hypothetical farm in the Fitzroy region. The analysis quantifies the cost and benefits from planting seedlings, lowering carrying capacity and undertaking the ACCU project (project costs and ACCU income).

The total cost of undertaking the 433 ha project (5% of farm) over 25 years was estimated to range between $1,644,159 and $3,599,659. The total costs depended heavily on seedlings and planting costs of between $1,299,000 and $3,247,500 (79-90% of the total cost), which can range between $3000 and $7,500 per hectare. An opportunity cost for foregone cattle income of $212,159 (6-13% of the total cost) was also factored in by calculating the marginal reduction in farm gross margin (average cattle revenue minus variable operating costs) over 25 years. Other costs included project set up costs ($8,000–$15,000 including agronomy/legal advice, surveying/mapping, project plan and registration), monitoring and administration ($50,000 based on $2,000/year), reporting x5 ($15,000) and auditing x3 ($60,000).

Three carbon sequestration rates in vegetation were examined including low, medium and high rates, which were based on sequestration rates measured by central Queensland studies with Brigalow or Eucalypt vegetation. The three sequestration rates were 1.4, 1.8, and 2.2 t CO_2e/ha/yr. These rates were assumed to remain constant from year two (when the seedlings are planted) until year 25 (permanence period). Reports were completed and submitted to the CER (and credits issued) every 5 years. Using these assumptions across 433 ha, the project would sequester approximately 15,155 (low), 19,485 (medium) and 23,815 t CO_2e (high) in vegetation by year 25 and after applying permanence period (20%) and risk of reversal (5%) discounts would generate a total of 11,366, 14,614 and 17,861 ACCUs respectively.

The results of the investment analysis across 433 ha (5% of farm) are presented in Table 54. The results indicate that the project does not generate enough carbon sequestration in vegetation, and ACCUs, at the low, medium or high rates to pay back the costs of undertaking the project at current or higher ACCU prices. Even at the high sequestration rate of 2.2 t CO_2e/ha/yr and highest ACCU price of $100/ACCU, the results indicate that farm profitability would decrease by $481,048–$2,343,429 over the 25 year project. This is largely due to the high costs associated with buying and planting seedlings ($3000-$7,500 per ha) that accounted for 79-90% of total project costs. The results when 50% of the farm area is planted are consistent with these results for 5% of the farm being planted but on a larger scale (x10). These findings correspond to research that found it was not feasible for landholders to undertake a vegetation project involving tree planting.

Table 54: Net Present Value of carbon sequestration by reforestation in the Fitzroy for a 433 ha project (5% of farm), with varying carbon prices and sequestration rates

Sequestration rate	Net Present Value (millions) at ACCU price of $35	Net Present Value (millions) at ACCU price of $50	Net Present Value (millions) at ACCU price of $100
	-$3.05 to -$1.19	-$2.96 to -$1.1	-$2.67 to -$0.81

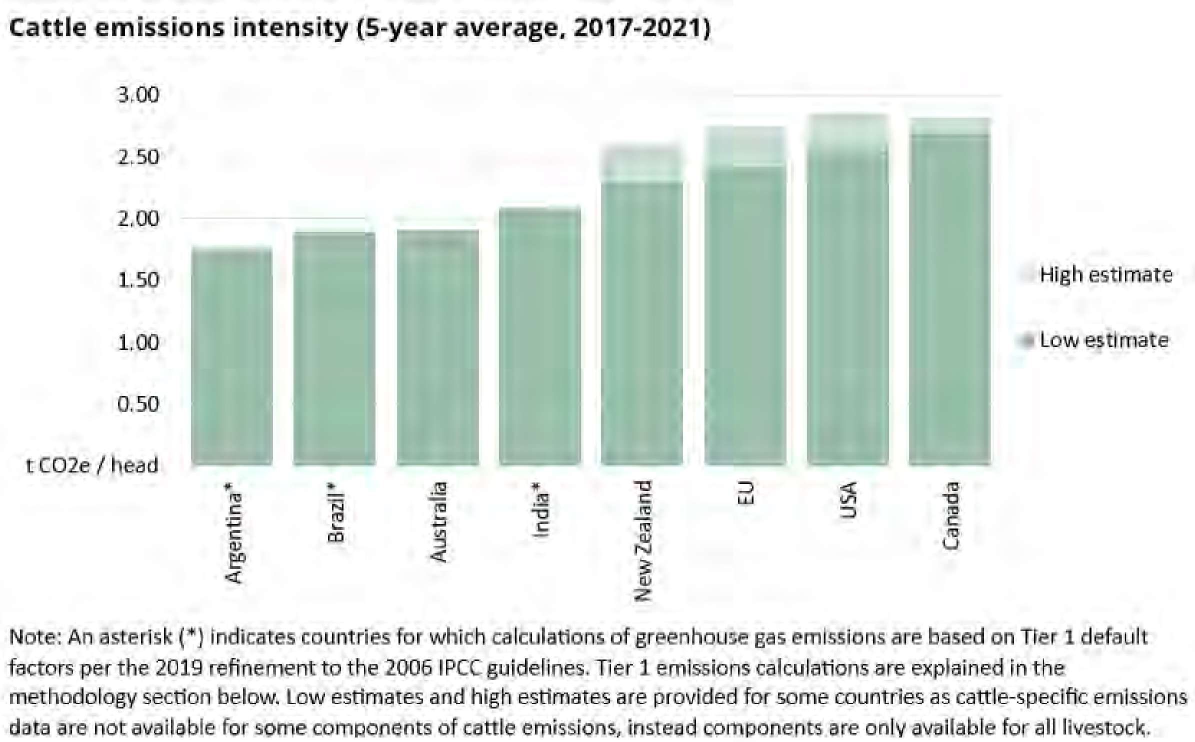
Medium	-\$2.99 to -\$1.13	-\$2.88 to -\$1.02	-\$2.51 to -\$0.65
High	-\$2.94 to -\$1.07	-\$2.8 to -\$0.94	-\$2.34 to -\$0.48

6.4.3 Beef cattle herd management

Enteric methane emissions from ruminant livestock contribute 11 per cent of Australia's total greenhouse emissions (CSIRO 2025). Microbes in the stomachs of cattle produce methane during feed digestion, which cattle mostly emit through burping. Methane is a greenhouse gas that contributes 27-30 times more to global warming than CO_2 (CSIRO 2025). However, methane only has a relatively short life of about 12 years compared to potentially thousands of years with CO_2 (UC DAVIS 2021). Also, it's created from atmospheric carbon, unlike fossil fuels, and is eventually recycled back into the atmosphere as CO_2.

Australia produced 2.6 million tonnes of beef in 2024-25 or 4.2% of global production and was the seventh largest beef producing country behind the United States, Brazil, China, European Union, India and Argentina (USDA 2025). In 2023, Australia was one of the top three beef exporters globally with Brazil the largest exporter (MLA 2024b). Figure 33 shows Australia's cattle emissions intensity per head of cattle relative to the largest beef producing and exporting countries globally. Australia has a relatively low cattle emissions intensity (1.9) like Brazil (1.9) but much lower than the United States (2.6-2.9) and European Union (2.4-2.7).

Figure 33: International cattle emissions intensity statistics



Source: ABARES (2024c).

The ACCU scheme's beef cattle herd management method aims to reduce the emissions intensity of beef production by improving herd efficiency. Beef production systems with better efficiency will produce more beef per unit of methane emitted with desirable outcomes able to be achieved by producers adopting best livestock management practices. This method complements grazing businesses with co-benefits by improving herd productivity and not competing with cattle production for land use. This method was suspended in December 2024 and expires in September 2025. The potential for continuation of this method is not currently known.

Carbon emissions can be avoided in beef cattle herds by improving cattle productivity, reducing the average age of a herd and/or reducing the proportion of unproductive animals (CER 2024a). Reducing emissions intensity is positively correlated with improved weaning, conception, growth (liveweight gains) and mortality rates, all of which lead to improved productivity of the beef operation (regardless of whether ACCUs are generated). Examples of project activities include supplement feeding (e.g. phosphorus), installing new fences and increasing the density of watering points, planting improved pastures (e.g. leucaena, stylos and desmanthus), reducing stocking rates to carrying capacity (if initially overstocked), improving feed quality, vaccinating a herd against Pestivirus and/or improving herd genetics by selecting for reproduction efficiency in breeder cows or by introducing improved genetics via bulls (CER 2024a, Bowen et al. 2019; Bowen and Chudleigh 2018; Murphy et al. 2024; DAF 2024).

As of February 2025, 15 projects were registered using this method with 11 in Queensland. All are large beef producers that own significant numbers of cattle (over 50,000 head). Only three of the 11 projects (20%) have been issued credits totalling 1,044,037 ACCUs, which is ~40% of the total number of ACCUs issued for agriculture method projects. Emissions abatement must be calculated using the Beef Cattle Herd Management Calculator. Baseline emissions need to be recorded over three years before starting the project. Data needs to be recorded over the course of the project, reported every 6 months to 2 years and retained for 7 years. This includes cattle numbers, liveweights, births, mortality, movement reasons and dates upon entry and exit (plus every year where applicable) along with details of project activities and monitoring of land grazed by the herd. Also, at least 3 audits must be conducted.

Three different project scenarios were examined for the investment analysis. The first examined planting leucaena to optimise steer growth in the Fitzroy (same change as the soil carbon analysis). The second and third examined supplementing cattle with phosphorus during the wet season with one examining the Fitzroy on phosphorus deficient country, and the other in the Burdekin on acutely phosphorus deficient country. Given establishing leucaena and phosphorus supplementation during the wet season were found to be profitable in past research without an ACCU project, these analyses were limited to quantifying the cost and benefits from undertaking the ACCU project only to identify whether it would further increase profitability.

Establishing leucaena in the Fitzroy

Like the soil carbon analysis, this investment analysis examined establishing leucaena in strips into a 433ha paddock of grass pasture and was based on an hypothetical Fitzroy farm. The total cost of undertaking the ACCU project over 7 years (permanence period) was estimated to range between \$112,731 and \$160,267 depending mostly on additional record-keeping (including mustering) and auditing costs. Costs included legal/accounting advice (\$10,000), reporting (\$1,960–\$3,920), record keeping (\$78,271–\$108,347 based on cattle weighing \$630/muster, recording weights and movements \$3,360/year and additional muster \$7,192-\$11,488/muster assuming \$3.90-\$6.23/head), weighing scales (\$1,500–\$5,000) and auditing x3 (\$21,000–\$33,000 based on \$7,000-\$11,000/audit). Another analysis was also completed excluding farm labour costs (excluding reporting and record keeping costs), which reduced the cost to between \$32,500 and \$48,000.

In accordance with the ACCU scheme rules, the beef cattle herd management calculator was used to estimate the volume of avoided emissions generated by the project. The emissions intensity of steers decreased from year 4 to year 7, which corresponded with the leucaena paddock being stocked from year 4 and generating increased steer growth rates and faster turnoff times. These improvements improved both kg beef/AE and 'emissions intensity (t CO_2e per t LWG)' by 14% from year 5. When including the ACCU scheme discount, the volume of avoided emissions totalled 1,032 t CO_2e net abatement and 1,032 ACCUs worth $36,127 at the current ACCU price of $35. The results of the investment analysis across 433 ha are presented in Table 55. When factoring in farm labour costs, the project does not generate enough emissions avoidance, and ACCUs, to pay back the costs of undertaking the project at current or higher ACCU prices. When excluding farm labour costs, the project could pay back the costs of undertaking the project at an ACCU price of $50/ACCU if there were low auditing costs ($7,000-$10,000/audit).

Table 55: Net Present Value of emissions avoidance by establishing leucaena in the Fitzroy region using beef cattle herd management method

Farm labour costs	Net Present Value (millions) at ACCU price of $35	Net Present Value (millions) at ACCU price of $50	Net Present Value (millions) at ACCU price of $100
Labour costs included	-$0.11 to -$0.07	-$0.1 to -$0.06	-$0.06 to -$0.02
Labour costs excluded	-$0.01 to -$0	-$0 to $0.01	$0.04 to $0.05

Wet season phosphorus supplementation on phosphorus deficient country in the Fitzroy

Low soil phosphorus can result in phosphorus deficient cattle and adversely impact herd productivity due to poor appetite and feed intake, poor growth, increased breeder mortality and decreased fertility and milk production. Supplementing cattle with phosphorus in the wet season on deficient or acutely deficient country increases pasture and energy intakes, growth, fertility (including milk production) and weaning rates, and reduces mortality rates. Across Queensland, 16% of the area was estimated to be low in soil phosphorus, 17% marginal, 12% deficient and 18% acutely deficient (Leo et al 2024). While most Fitzroy grazing land has adequate or marginal phosphorus levels, some smaller areas are deficient or acutely deficient. This investment analysis examined an ACCU project supplementing a breeding herd on phosphorus deficient country, which was based on the same hypothetical Fitzroy farm used for the leucaena analysis. The total cost of undertaking the ACCU project over seven years (permanence period) was estimated to be similar to the leucaena analysis. The total cost ranged from $115,079 to $164,017 depending mostly on additional record-keeping ($80,619 – $112,097, including mustering costs of $7,527–$12,024/muster assuming $3.90-$6.23/head) and auditing costs ($21,000–$33,000). Another analysis was also completed excluding farm labour costs (excluding reporting and record keeping costs), which reduced the cost to between $32,500 and $48,000.

The effects of phosphorus supplementation on the breeder herd included heavier cows (+15kg), lower mortality rates (from 6% to 4%) and higher conception rates (approx. 6% higher). However, these improvements only increased kg beef/AE and 'emissions intensity (t CO_2e per t LWG)' by 4% with gradual effects that were not fully experienced until the fifth year of the project. Consequently, the volume of avoided emissions only totalled 2.1 t CO_2e net abatement by year 7 (generating only 2 ACCUs) when including the ACCU scheme discount (net abatement is calculated by first subtracting 4% from baseline emissions). The results of the investment analysis are presented in Table 56. Even when excluding farm labour costs, the project does not generate enough emissions avoidance, and ACCUs, to pay back the costs of undertaking the project at current or higher ACCU prices. This is largely due to the meagre amount of ACCUs generated by the project.

Table 56: Net Present Value of emissions avoidance by phosphorus supplementation in the Fitzroy region using beef cattle herd management method – deficient

Farm labour costs	Net Present Value (millions) at ACCU price of $35	Net Present Value (millions) at ACCU price of $50	Net Present Value (millions) at ACCU price of $100
Labour costs included	-$0.14 to -$0.1	-$0.14 to -$0.1	-$0.14 to -$0.1
Labour costs excluded	-$0.04 to -$0.03	-$0.04 to -$0.03	-$0.04 to -$0.03

Wet season phosphorus supplementation on acutely phosphorus deficient country in the Burdekin

Soil phosphorus levels were estimated to be acutely deficient across 18% of Queensland with Cape York, Northern Gulf and Desert Uplands (just west of the Burdekin) the most severely affected regions (Leo et al 2024). Soil phosphorus maps of the Burdekin indicate that levels vary from high to acutely deficient (Leo et al 2024). This investment analysis examined an ACCU project supplementing all cattle on country that is acutely deficient in phosphorus. The analysis was based on a hypothetical 25,000 ha property in the Burdekin region carrying 3,000 adult equivalents. Northern Australian cattle herds acutely deficient in phosphorus can suffer large reductions in weaning rates, calf weights and cull-cow weights along with large increases in breeder mortality. The total cost of undertaking the ACCU project over seven years (permanence period) was estimated to be higher than the previous phosphorus supplementation analysis. The total cost ranged from $135,799 to $197,117 depending mostly on additional record-keeping ($101,339–$145,197, including mustering costs of $10,487–$16,752/muster assuming $3.90-$6.23/head) and auditing costs ($21,000–$33,000). Another analysis was also completed excluding farm labour costs (excluding reporting and record keeping costs), which reduced the cost to $32,500–$48,000.

The effects of phosphorus supplementation included increased cattle weights (+23kg to 27kg), lower mortality rates (by 1% to 4%), higher weaning rates (by 10%) and a smaller breeding herd (from 1,358 to 1,078 head). The effects were gradual but were fully experienced by the third year of the project. These improvements combined to improve kg beef/AE and 'emissions intensity (t CO_2e per t LWG)' by 38% from year 4. The volume of avoided emissions was much larger than the other two beef herd management projects and totalled 7,593 t CO_2e net abatement by year 7 generating 7,593 ACCUs (when including the ACCU scheme discount) worth $265,748 at the current ACCU price of $35.

The results of the investment analysis are presented in Table 57. The results indicate that the project could improve farm profitability over the 7 year project at all the ACCU prices examined and when both including or excluding farm labour costs. At the current ACCU price and including farm labour costs, the project was found to improve farm profitability by between $43,064 and $94,175. Attaining higher ACCU prices would improve the profitability of the ACCU project further as does the exclusion of farm labour costs. These results are largely due to the reduction in emissions intensity caused by large herd productivity gains from supplementing cattle with acute phosphorus deficiencies.

Table 57: Net Present Value of emissions avoidance for phosphorus supplementation in the Burdekin region using beef cattle herd management method – acutely deficient

Farm labour costs	Net Present Value (millions) at ACCU price of $35	Net Present Value (millions) at ACCU price of $50	Net Present Value (millions) at ACCU price of $100
Labour costs included	$0.04 to $0.09	$0.13 to $0.18	$0.43 to $0.48

Labour costs excluded	\$0.17 to \$0.18	\$0.26 to \$0.27	\$0.55 to \$0.57

Key insights

Several insights can be drawn from the analyses and other information (current projects, etc). The volume of avoided emissions generated by the project must be large to generate enough ACCU's to cover the costs of the project totalling \$112,731-\$197,117. At the current price of \$35/ACCU, at least 3,221–5,632 t CO_2e net abatement (or ACCUs) was needed by year 7 for the project to breakeven. The grazing operations examined in the investment analyses were average sized carrying between 1,500 and 2,900 head but all current ACCU projects are much larger carrying over 50,000 head. Beef production efficiency and emissions intensity are closely linked (higher kg beef/AE reduces emissions). For instance, both measures improved by the same percentages in all three projects (e.g. 14% after establishing leucaena). Therefore, the magnitude of the improvements to beef production efficiency must be large enough to achieve the volume of avoided emissions needed to at least repay the project costs. The 38% improvement in kg beef/AE from phosphorus supplementation in the Burdekin was sufficient but the 14% improvement from establishing leucaena was not large enough. Another insight is that management activities that take long periods to implement or establish may not generate sufficient improvements to herd emissions intensity within the short 7-year project timeframe (e.g. fertility selection and genetics).

The number of ACCUs generated by a project is a function of the (1) percentage improvement in beef production efficiency (kg beef/AE) minus the 4% discount, (2) annual herd liveweight gain (t), and (3) baseline emissions intensity (t CO_2e per t LWG). Therefore, implementing project activities that deliver large improvements in beef production efficiency will generate relatively more ACCUs. For example, the Burdekin phosphorus supplementation scenario increased kg beef/AE by 38% in year 7 and paid back the project's costs, while leucaena increased kg beef/AE by 14% and fell short of repaying costs. If leucaena would have increased kg beef/AE by 38% (instead of 14%), then it would have increased the number of ACCUs generated in year 7 from 310 to 861 (2.8 times more).

Larger properties also have more incentives to participate as they have relatively more tonnes of annual liveweight gain across the herd. As an example, if the same parameters were applied across a property twice the size, then each project would generate twice the ACCUs. While project costs would also likely increase, marginal costs would likely be lower for additional record keeping, mustering and reporting due to greater scale. Moreover, scale enlargement is often the only way to profitably employ expensive new technologies. Lastly, lower productivity properties may also have more incentives to participate as they have relatively higher baseline emissions intensity and can generate more ACCUs for any given increase in production efficiency. For example, if the leucaena property had a baseline emissions intensity of 18 instead of 9 t CO_2e/t LWG, but had the same herd liveweight gain (406 t/yr) and improvement in kg beef/AE (14%), then the number of ACCUs generated in year 7 would be 618 instead of 310 (almost double).

6.4.4 Blue carbon

Since European settlement, areas of coastal wetlands in Queensland have been cleared and degraded through conversion to agriculture and urban development. For example, 83% of the mapped wetlands in the Fitzroy Basin have been modified to exclude tidal flows and create pastures typically by constructing bund walls. Furthermore, there are large areas of land behind tidal barriers in the Burdekin and the Mackay-Whitsundays. Coastal wetland ecosystems enhance water quality and biodiversity, and provide habitat for fish, native plants, animals and migratory birds. These areas have higher carbon stocks and sequestration compared to terrestrial forests and agricultural lands with mangroves and saltmarsh potentially sequestrating up to 11 Mt CO_2e/ha/yr and seagrass 4.9 to 5.6 Mt CO_2e/ha/yr. Consequently, there is an opportunity to restore blue carbon ecosystems and research has identified that Australia has the largest area of blue carbon ecosystems and storage capacity of any country.

Degraded coastal agricultural land suffering from waterlogging, salinisation, soil acidification and erosion generally has relatively lower profitability so blue carbon projects can potentially be undertaken with the least impact on agricultural production and business profitability. Restoration of tidal flows can also be effective to control some weed species that landholders are obliged to eradicate and can improve soil conditions on neighbouring farmland. However, not every site will be suitable for restoration and these benefits need to be weighed up with any potential negative impacts on freshwater wetlands that could be lost.

The blue carbon ACCU method applies to projects that reintroduce tidal flow to coastal wetlands by removing or modifying barriers like sea walls or drains. ACCUs are issued by (1) sequestrating carbon in wetland vegetation (mangroves, saltmarshes, seagrasses) and increasing organic carbon-rich (2) sequestrating carbon in soil as organic matter accumulates in coastal wetland ecosystems over time, and (3) reducing methane emissions from converting freshwater wetlands back to coastal wetland ecosystems that were previously drained or converted. Participants must prepare hydrological assessments, operations and maintenance plan, tidal inundation maps and any required management plans (acid sulfate soil, mosquitoes, etc).

Participants are required to use BlueCAM to calculate the soil and vegetation sequestration and emissions avoidance components of a project, which helps to lower project costs by not requiring in-field samples and therefore simplify requirements. A sequestration buffer discount of 25% is applied to projects with 25-year permanence periods. For a 25-year permanence period project, the sequestration buffer discount is 25%. Participants must monitor using on-ground observations, geolocated imagery, or derived vegetation cover data and report these details and project activities every 6 months to 5 years, along with conducting three audits. Participation in this method is low with only two registered projects registered in mid-2024 and accordingly neither has been issued any ACCUs as of February 2025. One of these projects is in Queensland being conducted by the Sunshine Coast Regional Council.

Several past studies have examined the profitability of landholders undertaking blue carbon projects. Waltham et al (2025) investigated conducting earthworks to remove bund walls and tidal gates and reprofile landscapes to maximise tidal inundation at three Mossman sugarcane farms to reestablish the coastal wetland ecosystem and ecological services (e.g. mangroves and saltmarsh vegetation, breeding habitats and carbon sink). A total of 1,244 ha was identified as potentially suitable with further investigation identifying three sites (246, 345 and 158 ha) located on marginal land with low sugarcane yields, extensive weed populations and/or suffering from saline intrusion. The three sites were estimated to sequester between 5,213 and 26,539 t CO2e over 25 years, indicating a total value of between $182,500 and $928,900 at the current ACCU price of $35/ACCU.

Project costs were apportioned separately to the ACCU project developer and the landholder (opportunity costs). For sites 1, 2 and 3, project developer costs ranged between $413,000-$998,000 with $46,000-$73,000 spent during the engagement and conceptualisation phase (e.g. initial hydrological assessment, legals and baseline), $250,000-$514,000 during the project establishment phase (design, approvals, barrier and flood gate removals and rock reinforcements) and $117,000-$411,000 during the production phase (wetland maintenance costs, reporting and auditing). The discounted cash flow analyses also factored in annual opportunity costs to account for the foregone revenue net of operating costs due to the landholder ceasing to farm sugarcane on the project area. Reduction in property values were also factored in as opportunity costs for the loss in flexibility of using the land, binding contractual obligations and required ongoing maintenance costs. Three scenarios were examined including a property value reduction of $5,018, $2,509 and $2,509 per hectare on impacted sugarcane area (35, 58 and 3 hectares) along with a forgone annual gross margin of $430, $215 and $0 per hectare, respectively. The largest reductions reflect the impact on a sugarcane business with full production capacity, while the lowest reflects a business that has ceased production (as evidenced at site 3) and the middle reflects a midpoint. These landholder opportunity costs at sites 1, 2 and 3 ranged between $2.9-$4.9 million for a sugarcane business with full production capacity, $0.8-$1.6 million for a business that has ceased production and $1.6-$2.9 million for a midpoint scenario.

The range in net present value results across the three sites are presented in Table 58 for ACCU only projects and if ACCUs and reef credits could hypothetically be stacked. ACCU scheme only projects cannot sequester enough blue carbon to pay back the costs of undertaking the projects even for businesses that had ceased production (with lower opportunity costs) and received the highest ACCU price of $100/ACCU. However, if ACCUs could hypothetically be stacked with reef credits, projects could be viable for businesses that had ceased sugarcane production. While this may not be possible, it highlights that there may be stacking opportunities with other types of environmental markets such as biodiversity credits through the Land Restoration Fund, or the emerging Nature Repair Market and Coastal Resilience Credit schemes. Other research has identified similar findings in the Johnstone River and Fitzroy, with a proportion of projects identified as profitable in the Fitzroy Basin but at very low discount rates (1%). In summary, degraded and low lying coastal agricultural land with low production and profitability was identified as most suitable for blue carbon projects with economic viability varying case by case. Key project challenges include high project costs (particularly opportunity costs) and limited supply of potential sites in each region.

Table 58: Net Present Value of removing bund walls and tidal gates to maximise tidal inundation in the Mossman region using the Blue Carbon method

Sugarcane production	*Net Present Value (millions) at ACCU prices of* $40	*Net Present Value (millions) at ACCU prices of* $70	*Net Present Value (millions) at ACCU prices of* $100	*Net Present Value (millions) at ACCU and Reef Credit prices of* $40 / $100	*Net Present Value (millions) at ACCU and Reef Credit prices of* $70 / $150	*Net Present Value (millions) at ACCU and Reef Credit prices of* $100 / $200
Full prod.	-$3.7 to -$1.9	-$3.6 to -$1.8	-$3.4 to -$1.8	-$1.9 to -$1.1	-$0.8 to -$0.6	-$0.1 to $0.3
Midpoint	-$2.1 to -$1.1	-$1.9 to -$1.1	-$1.8 to -$1	-$0.4 to -$0.3	$0.1 to $0.9	$0.6 to $2
Ceased prod.	-$1.2 to -$0.7	-$1.1 to -$0.7	-$1 to -$0.7	$0.2 to $0.6	$0.9 to $1.7	$1.4 to $2.8

Source: Adapted from Waltham et al. (2025)

6.5 Opportunities and risks

There are both opportunities and risks associated with participation in environmental market schemes. Key opportunities lie in developing marginal agricultural land that has a low opportunity cost of agricultural production into an environment market scheme project, which has potential to benefit both the environment and the primary production business' profitability. Additionally, primary producers can benefit from clever project design by aiming to implement a project that enhances primary production, such as improving soil health and water retention, planting trees as shelter belts for farming land or reducing fertiliser use to generate reef credits and thereby reducing input costs for the farm. Battaglia et al. (2022) identified soil carbon projects as being most likely to deliver improved farm productivity compared to other ACCU scheme method projects. Furthermore, stacking credits generated by multiple environmental market schemes increases the revenue produced and can render projects economically viable, provided eligibility criteria are met, as was demonstrated in the study by Waltham et al. (2024). Other opportunities may arise as new methods under the schemes that are developed. One opportunity would be the drafting of an ACCU scheme method supporting silvopastoral systems, which can potentially generate both environmental and financial benefits in suitable areas in southern Queensland. These systems can increase carbon sequestration, improve biodiversity and diversify income. Overall, environmental market schemes present multiple pathways for Queensland primary producers to generate new income streams while supporting climate and biodiversity goals.

While environmental market schemes offer opportunities for income diversification and environmental stewardship, they also present a range of significant risks that can limit primary producer participation. Environmental market projects can negatively impact land values due to the associated loss of flexibility, contractual obligations to deliver and maintain the project, contractual liability for project costs, and uncertainty as to project revenue, which span the project's permanence period. Government policy uncertainty permeates another risk for primary producers, such as the premature cancellation of methods. Lack of financial viability is a fundamental risk of environmental market scheme projects, exacerbated by volatile credit prices and high project costs often incurred upfront. Environmental market projects involve natural biophysical processes and are impacted by seasonal variations that can cause reversal of progress or project failure through events like floods, droughts, fires, heatwaves, and cyclones. The likelihood a project will be adversely affected by a natural disturbance is confounded by the long permanence period of projects, typically about 25 years. The complexity of the scheme rules and requirements make it difficult for primary producers to run projects themselves, which increases the cost of labour due to outsourcing. Furthermore, this creates a situation of asymmetrical information where intermediaries like carbon service providers have an advantage of technical skills and understanding, which can adversely affect negotiation of contracts with primary producers.

Additionally, credibility issues with some methods under the ACCU scheme and criticisms of the role of offsets can undermine trust in the ACCU scheme and threaten its viability, posing a risk to primary producers who participate in the scheme. There are additional risks unique to the different types of projects, like the scientific uncertainty regarding the long-term dynamics of soil organic carbon and the limited capacity for soil organic carbon storage for soil carbon projects, or the risk that plants fail to germinate or seedlings die for planting projects. For soil organic carbon and vegetation-based sequestration projects, these risks span biophysical uncertainties, such as rainfall variability, extreme weather events, and the broader impacts of climate change, as well as economic and regulatory considerations including upfront costs, permanence obligations, and land use restrictions. While strategies exist to mitigate many of these risks, such as adaptive management practices and informed site selection, primary producers must carefully assess the trade-offs and potential consequences before undertaking a project. As such, addressing these risks through targeted policy design, transparent communication, and improved access to independent support services will be crucial in ensuring that environmental markets are both effective and equitable for landholders across Australia.

6.6 Tax implications

Primary producers using Farm Management Deposits and primary production tax averaging should be aware that income derived from environmental market projects may not qualify as primary production income. The concessional tax treatment of income from ACCUs as primary production income that is available to eligible primary producers is viewed positively and considered a facilitator of primary producer participation in the ACCU scheme. However, the breadth of this relief is limited to specific circumstances (such as a primary production business must be carried on at all times while the ACCU scheme project occurs), and primary producers and their professional advisors must carefully consider the tax implications of undertaking a project under the ACCU scheme. Additionally, the legal structure (individual, trust, company, partnership) of the project proponent of the ACCU scheme project or party to a contract if a carbon service provider is involved, will have a critical impact on access to the concessional tax treatment of ACCU income. As identified above, concessional tax treatment is limited to individuals. If a partnership runs the primary production business and holds the ACCUs, to qualify for the concessional tax treatment, it must consist only of individual partners, and not a company or trust partner. If a trust runs the primary production business and holds the ACCUs, to qualify for the concessional tax treatment, trustees must ensure that income distributed from ACCU sales to individual beneficiaries is clearly attributable to those sales. This usually requires properly drafted trust distribution resolutions to "stream" the ACCU income to beneficiaries and a trust deed that allows such streaming.

Furthermore, the concessional tax treatment of classifying income from ACCUs as primary production income is limited to the ACCU scheme. If primary producers undertake a project under another environmental market scheme such as the Reef Credit scheme, then the income generated from participation in those schemes will be treated as non-primary production income, which can have implications such as limiting access of the primary producer to the Farm Management Deposit scheme (to access the scheme, primary producers cannot earn over $100,000 non-primary production income), or access to other primary producer concessions like land tax and transfer duty in Queensland. Given the intricate interplay between tax laws, environmental markets, and agricultural operations, it is essential that primary producers seek professional advice before undertaking environmental market projects.

6.7 Contribution to environmental goals

Environmental market scheme projects will contribute to the various goals set by both Federal and State levels of government, such as the net zero by 2050 goal and the GBR water quality targets. However, the size of that contribution depends on the number and scale of projects undertaken under the various schemes. Participation rates by primary producers, who are the largest land managers in Queensland remains low. Across Australia, there are 2,503 projects registered under the ACCU scheme, 14 projects registered under the Reef Credit scheme, 18 projects under the LRF, zero projects under the Nature Repair Market (launched 2025), and 1 project under the Cassowary Credit scheme (launched May 2025). The impact of those projects on greenhouse gas emissions abatement, improvements to GRB water quality, generation of environmental, socio-economic and First Nations benefits, delivery of improved biodiversity outcomes and improvements to rainforest condition is limited to the number and scale of the projects registered under the schemes respectively. There is a significant difference between the number of ACCU scheme projects compared to the remaining schemes that are yet to operate at a similar scale. Stacking between the ACCU scheme and other environmental market schemes may be the key to scalability.

In terms of greenhouse gas emissions reduction, ACCU scheme vegetation and agriculture method projects can play a large role in reaching the legislated targets. However, as acknowledged by Fitch et al. (2022), a portfolio approach combining a range of technologies is required to reach Australia's emissions reduction target as no single technology is sufficient on its own. Fitch et al. (2022) estimated that vegetation and agriculture ACCU scheme methods have economic potential to sequester between 106.3Mt CO_2e and 130.3Mt CO_2e annually (see Table 2, Introduction). These volumes are significant and amount to about a quarter of Australia’s annual net greenhouse gas emissions (in 2023, Australia’s net greenhouse gas emissions were 432.9 Mt CO_2e (DCCEEW 2024)).

7 Limitations

Limitations of the analysis are primarily due to simplified assumptions made to undertake the investment analysis in section 4, including using constant ACCU prices, constant costs, and constant carbon sequestration rates. Furthermore, the impact of seasonal and climate variation on carbon abatement projects was excluded from the analysis. Whilst the assumptions made may detract from the exact accuracy of the investment analysis results, the outcomes found are based on the long-term averages and are still conceptually useful and indicative of the financial viability of projects. Additional analysis accounting for price, cost, carbon sequestration rate and seasonal variation would be beneficial.

Additionally, there is limited information regarding costs of projects, so the assumptions made in the investment analyses of this report at section 4 are estimates. Further research into the costs involved in ACCU Scheme projects would strengthen future analyses. It is important that prospective project proponents conduct their own cost forecasts, sequestration or emissions avoidance forecasts and investment analysis on an individual basis to account for their unique circumstances.

Furthermore, the investment analysis undertaken at section 4.3.2 of an ACCU scheme project using the environmental plantings method tested the effects of different carbon sequestration rates over a 25-year period, using sequestration rates of 1.4 t CO_2e/ha/yr, 1.8 t CO_2e/ha/yr, and 2.2 t CO_2e/ha/yr, rather than using FullCAM to model the sequestration results. This is a limitation of the results, because ACCU payments are based on the amount of sequestration a project can deliver, which is calculated using FullCAM modelling.

Additional limitations of using investment analysis are discussed at section 4.1.

8 Conclusion

Environmental market schemes represent opportunities for Queensland graziers to diversify their income, enhance farm productivity, and contribute to sustainability goals. Schemes accessible to Queensland primary producers include the ACCU scheme, Reef Credit scheme, Land Restoration Fund, Nature Repair Market and Cassowary Credit scheme. For Queensland's agricultural sector, which occupies 80% of the state's land area and plays a crucial role in managing natural resources, these markets provide a pathway to address challenges such as climate change, biodiversity loss and threats to the resilience of the Great Barrier Reef ecosystem, while providing financial incentives.

Queensland primary producers are well positioned to access opportunities through innovative approaches, improved resource management, and participation in emerging markets. Environmental markets offer Queensland's primary producers a chance to diversify their income streams by generating credits for activities that sequester carbon, improve water quality, and enhance biodiversity. For example, the ACCU scheme, which focuses on carbon abatement, already has meaningful participation, with 516 agriculture, vegetation and savannah burning projects in Queensland. This demonstrates the growing awareness and potential for scaling these initiatives across the state.

Despite the promising opportunities, participation in schemes remains insufficient to address the full extent of environmental harm that is being targeted for remediation. For example, there is still a long way to go to reach emissions reduction and improved reef water quality and biodiversity targets. Increasing scheme participation requires addressing barriers such as financial viability due to high upfront costs, scheme complexity and participation risks. By identifying opportunities and mitigating challenges, the agricultural sector can play an important role in shaping Queensland's transition to a more sustainable future.

Demand for environmental goods and services

The demand for environmental services in Queensland is driven by government legislation and policies, businesses and consumers. Australia has legislated targets to reduce emissions by 43% below 2005 levels by 2030 and achieve net zero by 2050. Industrial facilities regulated by Australia's Safeguard Mechanism currently purchase 60% of ACCU holdings to offset emissions, while the Nature Positive Plan, Reef 2050 Plan and Landscape Repair Program create demand for other environmental services including improved biodiversity and water quality in the reef catchments. Voluntary demand is driven by businesses ESG goals and customer expectations. Demand is expected to strengthen further due to increasing environmental policy targets and new business regulations for sustainability reporting. Consumer demand for sustainably produced food is another demand mechanism through ecolabelling or carbon-neutral certifications. However, price often dominates consumer purchasing decisions so businesses generally target smaller segments of their markets.

Challenges to Participation

Despite the promising opportunities, participation in schemes remains insufficient to address the full extent of the environmental harm due several barriers. The report identifies financial viability as a critical challenge, with many projects facing high upfront costs, uncertain credit revenues, and potential trade-offs with agricultural production. Establishing projects often requires significant upfront investment including feasibility assessments, legal and accounting advice, planning, mapping and approvals. On top of that, there are generally complex regulatory requirements with cumbersome long-term monitoring, reporting and auditing, which can be resource-intensive and expensive. Outlays for project activities were very high for some projects. For instance, the environmental plantings project had tree planting costs of $3,000–$7,500 per hectare, which made it financially unviable for a producer receiving ACCUs alone.

Other challenges lie with projects that involve significant trade-offs. For example, the analysis of projects requiring agricultural production to cease revealed that these projects often fail to generate sufficient credits to cover costs, particularly opportunity costs for foregone agricultural revenue and reduced property value and land-use flexibility. Other barriers include the complexity of the schemes themselves, long project timeframes and a lack of technical knowledge, which deters participation. Scheme complexity makes it difficult for producers to run projects themselves, which increases labour costs due to outsourcing. Furthermore, this creates asymmetrical information where intermediaries have a technical skill advantage, which can adversely affect contract negotiations. Additionally, the uncertainty surrounding credit prices and the number of credits generated further complicates decision-making.

Risk is another barrier to entry as projects are affected by a variety of risks including difficulties achieving project objectives such as target sequestration rates or water quality improvements. For example, the variability of biophysical processes and climate can cause sequestration reversal or project failure through floods, droughts, bushfires or the poor establishment of planted trees or legumes. The likelihood of a natural disturbance is confounded by long permanence periods (e.g. 25 years). Policy uncertainty permeates other risks such as the premature cancellation of methods. Credibility issues are another risk and can undermine trust in the schemes and threaten long-term demand for credits (and prices). Tax implications can be another barrier given income from scheme credits may not qualify as primary production income, which could limit access to concessions like the Farm Management Deposit scheme and income averaging.

Overcoming Barriers to Participation

To address these barriers, targeted support is essential. Simplifying regulatory requirements by streamlining reporting and auditing requirements can reduce the complexity of schemes, making them more accessible to producers. Raising awareness of the benefits of environmental markets and building capacity by providing technical assistance can help producers navigate these schemes effectively. Additionally, stabilising credit prices through mechanisms such as forward contracts or price floors can mitigate revenue uncertainty and encourage broader participation. While the demand and price of credits is forecast to increase thus improving viability, providing subsidies, grants or concessional financing can help offset initial cost outlays and foster participation in the shorter term. By undertaking an environmental project, producers may also have access to preferential financing through 'green loans'.

The report also highlights the need for tailored approaches to different types of producers. Larger properties, which benefit from economies of scale, may be better-positioned in certain circumstances to participate in environmental market, such as using the beef cattle herd management method. Conversely, less productive or underutilised land offers opportunities for smaller producers to engage in projects. Given lower opportunity costs, it may be cost-effective to target marginal land types for land restoration projects (blue carbon and vegetation). It is also essential that producers seek professional advice before undertaking projects (e.g. legal and accounting).

While strategies exist to mitigate certain project risks (e.g. adaptive management), primary producers must assess the potential trade-offs and consequences before undertaking a project. As such, addressing project risks through targeted design and access to independent support services will be crucial to success. By aligning strategies with the unique circumstances of each producer, participation can be scaled up effectively. While four scheme methods were examined in the report, it is recommended that further investment analyses are conducted for other methods.

The role of scale and efficiency

The analysis of the beef cattle herd management method revealed that project scale and efficiency can significantly influence the viability of projects. In that scenario, larger properties, benefited from economies of scale, generating more credits while reducing marginal costs. Similarly, less productive graziers may have greater incentives to participate, as they can achieve more significant gains in beef production efficiency and credit generation. These findings underscore the importance of tailoring strategies to different property sizes and productivity levels to maximise participation.

The report also highlights the role of efficiency improvements in enhancing project outcomes. For example, phosphorus supplementation in cattle demonstrated substantial productivity gains in the Burdekin region, generating 7,593 ACCUs through a 38% improvement in beef production efficiency. In contrast, the establishment of leucaena failed to achieve similar outcomes due to a lower improvement rate. These examples demonstrate the importance of prioritising activities that deliver the most significant efficiency gains to maximise the economic and environmental benefits of projects. These examples illustrate the importance of designing methods that align with local conditions and sector-specific needs to maximise their effectiveness.

Opportunities were identified for soil carbon projects if graziers had a sizable paddock (433 ha) with the capacity to achieve at least moderate SOC sequestration. Establishing legumes and reducing grazing intensity can sequester SOC and scaling projects up to undertake multiple beneficial changes may generate more sequestration and credits. Producers may particularly benefit from stacking credits across multiple schemes, such as combining ACCUs with biodiversity or reef credits. For instance, producers that are sequestering carbon in vegetation with an environmental plantings or blue carbon method and are also improving biodiversity may be able to improve the scalability and financial viability of their projects by stacking ACCUs with biodiversity credits (or grants) through the LRF, Nature Repair Market or Cassowary Credit scheme. However, stacking credits across schemes but must be "additional".

Improving farm productivity through co-benefits

Participation in environmental markets also delivers co-benefits that align with the long-term productivity and profitability aspirations of Queensland primary producers. For example, methods that improve SOC levels not only generate ACCUs but can also improve soil health, water retention, nutrient availability, and pasture yields. Establishing legumes or reducing grazing intensity can sequester SOC while simultaneously improving pasture resilience and productivity.

Similarly, productivity improvements closely align to environmental goals, as they reduce emissions intensity by emitting less methane per unit of beef produced. Improved weaning, conception, growth and mortality rates all improve efficiency without competing with agricultural production. For example, phosphorus supplementation for cattle on phosphorus-deficient land, which affects ~30% of Queensland's land area, can improve herd productivity by increasing appetite, feed intake, fertility, and milk production, resulting in faster growing cattle, higher weaning rates, less mortality and smaller breeding herds. Other examples of project activities that can improve productivity include planting improved pastures, installing fences, increasing watering point density and reducing stocking rates to carrying capacity. Given variability amongst projects, primary producers must obtain professional advice and conduct an investment analysis considering their own unique circumstances before signing up to a project.

Opportunities for innovation and collaboration

Innovation is central to unlocking the full potential of environmental markets for primary producers. Investing in research and development of innovative new methods tailored to Queensland's unique conditions and industries can expand the scope and impact of participation in the schemes. For example, emerging technologies, such as methane-reducing feed additives for livestock, also hold promise for generating credits while improving productivity. Also, silvopastoral systems for suitable areas in southern Queensland can increase carbon sequestration, improve biodiversity and diversify income. Methods designed to deliver and stack multiple benefits, such as carbon sequestration, ecosystem enhancement (e.g. biodiversity) and productivity gains, can create more compelling value propositions for producers.

Collaboration between government, industry, and community stakeholders is crucial for the success of these initiatives. Governments can play a key role by providing financial and technical support, while industry bodies can facilitate knowledge sharing and capacity building. Community engagement is also essential to ensure that projects align with local needs and priorities, particularly in areas with high biodiversity or cultural significance.

The path forward

Environmental market schemes represent an opportunity for Queensland to achieve its emissions reduction targets, enhance biodiversity, and support sustainable agricultural practices. While challenges remain, targeted strategies to address barriers and unlock opportunities can enhance the participation and success of these initiatives. By investing in innovative methods, simplifying scheme requirements, balancing economic, environmental, and social objectives, environmental markets can become a cornerstone of Queensland's sustainability strategy delivering long-term benefits for all stakeholders involved. However, realising this potential requires a concerted effort to address existing challenges and scale up participation. With the right strategies and investments, these schemes can drive transformative change. As the state strives to meet its legislated emissions reduction targets and net-zero ambitions, these initiatives will help deliver benefits for the environment, economy, and communities and enable a more seamless transition to a resilient, sustainable and prosperous future for Queensland.

9 Future recommendations

This report makes the following future recommendations:

1. More research is required to identify the benefits and costs of undertaking a project under the Reef Credit scheme, Land Restoration Fund, Nature Repair Market and Cassowary Credit scheme.
2. More information is required to gain a better understanding of the financial viability of environmental market projects for primary producers in Queensland under all environmental market schemes, across different regions. Cost benefit analyses, including the identification and quantification of the benefits and costs involved, should be conducted for case study farms located across Queensland to build on the results of this report. Additionally, projects using the remaining ACCU scheme methods should be tested, as should the impact of stacking with other environmental market scheme projects like the Reef Credit scheme and Cassowary Credit scheme or bundling under the LRF. Such research could investigate the most beneficial opportunities for primary producers by region across Queensland, which could support participation in environmental market schemes.
3. Information dissemination regarding the benefits, costs, opportunities and risks of participation in environmental market schemes is required to support and inform primary producers. Extension through workshops and events both in person and online are key to dispersing information.
4. Further research is needed to understand the variations in SOC stocks, including the impact of different management strategies on SOC stocks in different locations across Queensland and over long time periods.
5. Further research is needed to understand the potential impact on primary producers of the regulated sustainability reporting for climate-related financial disclosure requirements[114]. Primary producers may meet the threshold requiring reporting or must supply their business' sustainability reporting to entities purchasing their livestock (e.g. feedlots may require sustainability reporting information from their suppliers to meet their own reporting requirements). Research is needed to understand the impact of ESG reporting on market access and whether insetting will be required to demonstrate particular credentials (instead of selling credits).
6. Further research into identifying and developing new methodologies that can deliver high quality environmental market scheme credits and are conducive with agriculture productivity, or alternatively, are suitable for marginal agricultural land. For example, development of an ACCU scheme method suitable for silvopastoral systems would enhance adoption of a land management practice that has proven both environmentally and financially beneficial in suitable areas such as southern Queensland.
7. This report involved investment analysis case studies of ACCU scheme projects that implemented land management practice changes that have been shown previously to be profitable for farming businesses (e.g. analysis by Bowen and Chudleigh (2018)

[114] Requirements set out in the *Treasury Laws Amendment (Financial Market Infrastructure and Other Measures) Act 2024.*

demonstrated that planting leucaena and feeding wet season phosphorus in the Fitzroy region improved farming profitability). Further research is needed to understand if undertaking new management activities that improve farming productivity and profitability meet the additionality requirements of environmental market schemes such as the ACCU scheme.

8. The concessional tax treatment of ACCUs discussed at section 5.3.1 Concessional tax treatment of ACCUs should be extended to credits generated under other environmental market schemes.
9. The definition of "primary production" in both national and Queensland taxation legislation should be expanded to include project activities undertaken pursuant to an environmental market scheme to address the issues raised at section 5.3 Tax implications.

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11 Appendices

11.1 ACCU Scheme methods

This report is focussed on the currently available methods most suited to Queensland primary producers, namely the agricultural, vegetation and savanna burning methods. The currently available methods include:

Agriculture methods

1. '**Estimating soil organic carbon sequestration using measurement and models method** (demonstrate an increase in soil carbon above the baseline level by testing and sampling soil)' (CER 2025e).
2. **Estimating sequestration of carbon in soil using default values method** (measure increases in carbon stored in soil with Full Carbon Accounting Model (FullCAM) data) (*there has been zero uptake of this method to date*);
3. **Fertiliser in irrigated cotton method** (regional farms can switch their fertilisers for irrigating cotton to reduce emissions) (*there has been zero uptake of this method to date*);
4. **Animal effluent management method** (recycle and reuse animal waste through an eligible animal waste treatment facility)' (CER 2025e).

Vegetation methods

5. '**Reforestation by environmental or mallee plantings FullCAM method 2024** (plant trees to store carbon);
6. **Reforestation and afforestation method** (plant trees in belt or block configurations, or a combination of both, to establish a permanent forest formation);
7. **Plantation forestry method** (establish, convert or transition to forestry plantations);
8. **Tidal restoration of blue carbon ecosystems method** (reintroduce tidal flow to coastal wetland ecosystems for blue carbon storage)' (CER 2025e).

Savanna burning method

9. **'Savanna fire management methods** (manage and plan savanna fire activities that burn in north Australia to reduce emissions)' (CER 2025e).

In addition to the currently available methods, descriptions and summaries of the avoided clearing of native regrowth method (expired on 31 March 2025) and the beef cattle herd management method (suspended 17 December 2024) have been included due to the relevance on these methods to Queensland primary producers. Furthermore, the Queensland Government is leading the development of a new method to replace the avoided clearing of native regrowth method.

This section contains a review of the above-mentioned methods, including a description of the method and an analysis of the current uptake of the method.

11.1.1 Soil organic carbon measurement (agriculture)

11.1.1.1 Description

The estimation of soil organic carbon sequestration using measurement and models method[115] (soil organic carbon measurement method) enables projects to remove carbon from the atmosphere and store it in soil, primarily by enhancing decomposing plant matter and microbial activity (ERF 2015). Projects earn ACCUs by increasing soil carbon through eligible land management activities.

Eligible Activities

Projects must:

- occur in Australia.
- include at least one new or materially different **land management activity[116]** (e.g. fertilising, liming, irrigation, grazing changes, no-till farming, pasture establishment).
- Avoid **excluded or restricted activities[117]** (e.g. restrictions on clearing and thinning, deep soil disturbance, adding bio-char, soil amendments containing coal, and non-synthetic fertiliser to soil, and irrigation use).

Land Eligibility

Land must:

- Be used for **pasture, cropping, or bare fallow** during the baseline period.
- Allow for 30 cm soil sampling.

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[115] This method is set out in the *Carbon Credits (Carbon Farming Initiative – Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021.*

[116] ***Land management activities*** include:

- using legume species in cropping or pasture systems;
- altering the stocking rate, duration or intensity of grazing (or any combination of such activities) to promote soil vegetation cover or improve soil health, or both;
- re-establishing or rejuvenating a pasture by seeding or pasture cropping;
- establishing, and permanently maintaining, a pasture where there was previously no or limited pasture, such as on cropland or bare fallow;
- retaining stubble after a crop is harvested;
- converting from intensive tillage practices to reduced or no tillage practices;
- modifying landscape or landform features to remediate land (e.g. practices implemented for erosion control, surface water management, drainage/flood control, or alleviating soil compaction. Practices may include controlled traffic farming, deep ripping, water ponding or other means);
- using mechanical means to add or redistribute soil through the soil profile (e.g. clay delving, clay spreading or inversion tillage);
- using a cover crop to promote soil vegetation cover or improve soil health, or both;
- applying nutrients to the land in the form of a synthetic or non-synthetic fertiliser to address a material deficiency (e.g. compost or manure);
- applying lime or other ameliorants to remediate acid soils;
- applying gypsum to manage sodic or magnesic soils;
- undertaking new irrigation (s7, *Methodology Determination 2021).*

[117] See sections 11 and 12 of the *Methodology Determination 2021.*

- Not include forest cover[118] or forest potential[119], organosols, land subjected to illegal clearing of native forest or illegal draining of a wetland, or land involved in another sequestration project.

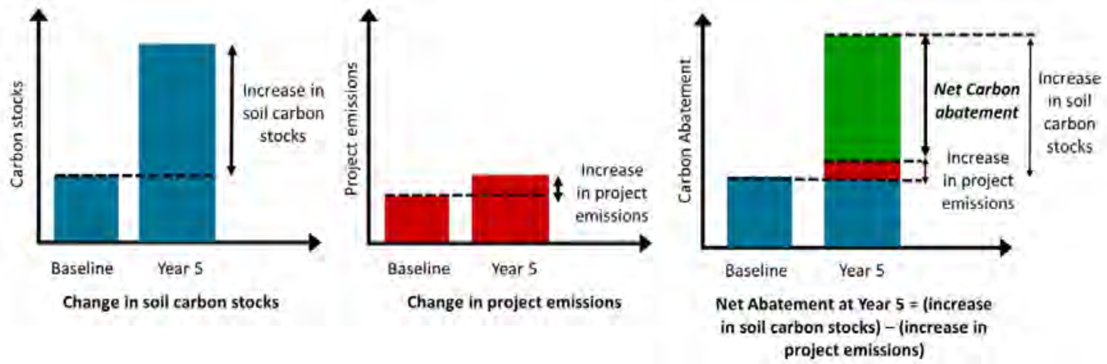
Permanence and Crediting

- Permanence period: 25 or 100 years. ACCUs must be relinquished if the project ends early or reverses (even if the land is sold, the activities to maintain soil carbon stocks must be continued, unless the project is revoked and ACCUs relinquished (CER n.d.)).
- Crediting period: 25 years.

Calculating Net Carbon Abatement

Soil carbon changes are calculated by measuring or estimating the difference between the amount of carbon in the soil after the project has been implemented and the baseline amount of carbon in the soil, less any net increase in emissions in the crediting period compared to emissions in the baseline period. Soil carbon is measured/estimated at least once every 5 years during the project. ACCUs are issued when participants increase or maintain soil carbon above baseline levels, while deducting increases in project emissions[120] (CER n.d.). Figure 34 below illustrates how net carbon abatement is calculated.

Figure 34: Calculating net carbon abatement



Source: Adapted from CER (n.d.).

Two measurement approaches can be used:

1. Measurement-only (soil cores); or
2. Hybrid (soil cores + modelling).

Discounts Applied

- 20% permanence period discount for 25-year permanence period.

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[118] An area of land has ***forest cover*** if the land has an area of at least 0.2 ha and the land has trees that are 2 metres or more in height and provide crown cover of at least 20% of the land (s5 *Carbon Credits (Carbon Farming Initiative—Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021*).
[119] An area of land has ***forest potential*** if the land has an area of at least 0.2 ha and the land has trees that, having regard to the location and characteristics of the land, are reasonably likely to reach 2 metres or more in height and provide crown cover of at least 20% of the land (s5 *Carbon Credits (Carbon Farming Initiative—Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021*).
[120] The sources of emissions that must be accounted for the abatement calculation includes emissions from livestock, synthetic fertiliser, lime, tillage events, soil landscape modification activities, residues, irrigation energy and biochar (s18, *Carbon Credits (Carbon Farming Initiative—Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021*).

- 5% buffer for risk of reversal for both 100-year and 25-year permanence period projects.
- Statistical discount for high variability in soil carbon[121].
- 25% withholding of credits if only two sampling rounds are completed[122].

Specialist Skills

- Independent technicians must conduct soil sampling.
- Specific lab methods or calibrated sensors must be used for carbon testing (CER n.d.).

Monitoring, Reporting & Audits

- Project emissions must be monitored throughout the project and records must be kept (e.g. emissions from livestock, synthetic fertilisers, lime, residue, tillage and soil landscape modification, irrigation energy, and biochar). Table 59 below details the emission sources that must be monitored and the source of records to be kept.
- Reports due every 6 months to 5 years, including technician statements, carbon abatement calculations, project progress, any reversal events and the specific requirements described in section 32 of the method (CER 2024b). Whilst a project proponent can complete the reports themselves, the reporting requirements are technical, so some participants may prefer to engage a carbon project service provider to prepare the reports.
- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.
- Records must be retained for 7 years.

Table 59: Emission sources to be monitored and recorded

Emission source	Description	Unit	Sources of records/evidence
Livestock	Number of livestock by class within project area	Head, livestock class, and grazing days	Logbooks or farm gate records for example.
Urea	Quantity of urea applied to project area	Tonnes	Purchase records, invoices or contractual arrangements
Synthetic fertilisers	Quantity of synthetic fertiliser applied to project area	Tonnes	Purchase records, invoices or contractual arrangements

[121] Discount for reporting highly variable differences in soil carbon stocks within strata is designed to account for the likely variability of carbon stocks, regardless of project activities, across agricultural land and over time. The method applies a statistical approach for adjusting estimates of soil carbon change for the possibility that observed changes are the result of sampling variance (statistical noise) rather than management actions (CER n.d.). The discount is lower in cases where there is a consistent increase in soil carbon across samples. If changes in soil carbon vary widely across samples, small changes in soil carbon may generate no ACCUs.

[122] Temporarily withheld credits applies to participants claiming ACCUs after undertaking two sampling rounds (including the baseline sampling) and withholds 25% of ACCUs until three sampling rounds are reported. This is because with only two sampling rounds, it is not possible to determine whether a change in soil organic carbon stocks is due to management or some other factor, such as climatic variability (CER n.d.).

Lime	Quantity of lime applied to project area	Tonnes	Purchase records, invoices or contractual arrangements
Crop harvest	Quantity of crop harvested by crop type	Tonnes	Invoices, sale records, contracts or other industry practices
Crop harvest	Fraction of residue removed by crop type	Decimal	Industry standard practice such as cover rating assessment
Crop cover	Area sown for cover crop	Ha	Mapped area
Crop cover	Fraction of above-ground crop residue removed	Decimal	Industry standard practice such as cover rating assessment
Tillage	Tilled area for pasture renewal or renovation in the project area	Ha	Mapped area
Soil landscape modification	Quantity of fuel used to carry out soil landscape modification activities	kL	Invoices, contractual arrangements or sales records
Irrigation energy	Electricity and fuel usage	kWh and kL	Purchase records, invoices or contractual arrangements.
Biochar	Quantity of carbon in biochar (if known), or the quantity of biochar, applied to the project area	Tonnes	Invoices, contractual arrangements or sales records

11.1.1.2 Current uptake

Despite this method having had the largest number of projects registered out of all ACCU scheme methods (see Table 6 above for comparison to other methods), participation in this method is still relatively low; this is illustrated by the map at Figure 3 above. As of 28 February 2025, there are 575 projects registered across Australia, and 135 projects are based in Queensland. There are 18,842 farms in Queensland (ABARES 2025), rendering the proportion of soil organic carbon projects to farms as 0.71% (however, not all farms will be suitable for soil carbon projects, such as those located in areas not conducive with soil carbon sequestration or land that already has high soil organic carbon stocks – see section 4.2.1 for more information). Furthermore, in some cases, project proponents have undertaken multiple projects on the same property, but have registered the projects separately, likely as a strategy to minimise risk (the reversal of carbon stocks in one project are not deducted from the gains in carbon stocks of another project). Therefore, the rate of uptake of this method by primary producers is low.

As illustrated by 'Figure 3: Map of all agricultural, vegetation and savannah burning ACCU scheme methods ' featured earlier in this report, the soil organic carbon projects are primarily located in southern Queensland along the coastline in agricultural zones that have higher rainfall and land types more conducive with growing vegetation, thereby having greater capacity for soil organic carbon sequestration (Fitch et al. 2022). The agricultural zones in Queensland have also been historically cleared of native vegetation and developed for agricultural purposes, which typically resulted in a loss of soil organic carbon stocks in the order of 20% to 60% from pre-clearing levels (Fitch et al. 2022). Therefore, it is unsurprising that soil organic carbon method projects are being undertaken in southern Queensland agricultural zones.

Karunaratne et al. (2024) identified the distribution of attainable SOC stocks across major agricultural production regions of Australia and there are land areas across Queensland that are deficient (see Figure 23). Fitch et al. (2022) estimated that the carbon sequestration potential across Australia (amount that is biophysically possible) via soil carbon sequestration is 115 Mt CO_2e per year, but estimate a much lower economic sequestration potential at 5 to 29 Mt CO_2e per year (this is the economically feasible sequestration amount). However, this potential is much larger in Queensland than has occurred to date.

In brief, there are several possibilities to explain why there has been a low uptake, despite the potential financial benefits and other co-benefits. First, it may be that the 'economic benefits are too limited to drive major practice change' (Pudasaini et al. 2024). Farmers are not confident that investing in a SOC sequestration project under the ACCU scheme will generate ACCUs or deliver co-benefits, particularly in circumstances where there is climate and market uncertainty (Pudasaini et al. 2024). Nationwide, only 26 projects (or 4.52%) out of 575 registered projects have been awarded ACCUs. Second, farmers may be reluctant to participate due to 'the lack of information to support decision making, limited capacity of landholders to undertake new farming practices or complex program rules' (Pudasaini et al. 2024). Third, high participation costs, and uncertainty of policy and price are other potential reasons for low participation (Pudasaini et al. 2024). White et al. (2021) posited 'disincentives to participants in soil carbon farming under the [ACCU scheme] are its complexity, permanence obligations, compliance costs and uncertainty of outcomes'. Research suggests that the key factors considered by farmers when they assess whether to undertake a practice change include 'how much benefit they will achieve compared to their existing management practices and how easily they can adopt such practices in their current farming system' (Pudasaini et al. 2024). The drivers of supply are comprehensively discussed at section 3.2 Drivers of Supply of this report.

In summary, the current uptake of soil organic carbon projects is minimal, and the schematic above illustrates the potential for expansion of projects across Australia and Queensland. The full details of how soil organic carbon sequestration occurs and the investment analysis of a case study farm business enterprise adopting this method are provided at section 4.2 Soil organic carbon measurement method of this report above.

11.1.2 Environmental plantings (vegetation)

11.1.2.1 Description

The reforestation by environmental or mallee plantings FullCAM method 2024[123] (environmental plantings method) applies to reforestation projects that establish permanent plantings. ACCUs are awarded based on the net increase in carbon sequestration, less project emissions.

[123] This method is set out in the *Carbon Credits (Carbon Farming Initiative) (Reforestation by Environmental or Mallee Plantings—FullCAM) Methodology Determination 2024.*

Project Requirements

1. **Planting –** a project must establish a permanent planting by planting and maintaining mixed-species environmental plantings[124] **or** mallee plantings[125] **or** a mix. Trees must be planted from seeds or tubestock in linear belts or blocks and must have capacity to reach 2m high.
2. **Forest cover –** project trees must have the potential to achieve forest cover, namely at least 20% cover of the land, and at a density of at least 800 stems per ha (belt planting) or 200 stems per ha (block planting).
3. **Land eligibility –** for at least 5 years before the project commences, land must have been free of forest cover or free of forest cover apart from known weed species that were legally cleared. Furthermore, the land must not contain woody biomass or an invasive native scrub species that need to be cleared for planting to occur, other than known weed species required or authorised by law to be cleared.

Restricted Activities

- **Harvesting**: limited removal of biomass allowed for thinning, fire management, in accordance with traditional Indigenous practices or native title rights, small-scale seed harvesting, or small-scale harvesting for fencing or craft materials for personal use.
- **Grazing**: permitted only if it does not affect the achievement or maintenance of forest cover. Evidence may be required.
- **Infill planting**: refers to subsequent plantings to fill in gaps. Infill planting is allowed if the plantings are in accordance with the project's reforestation management plan for infill planting.

Reforestation Management Plan

For each reforestation project, the project proponent must create and maintain a reforestation management plan, which must include the tree planting species lists, details of species suitability to area and species characteristics (growth, height, crown cover), establishment methods, forest potential, infill planting details, planting geometry (spacing and density), and monitoring strategies.

Permanence and crediting

- Permanence period: 25 or 100 years.
- Crediting period: 25 years.

Carbon Abatement Calculation

The net abatement amount is the change in total carbon stock of the project area compared to the baseline, less the project emissions (fuel use and fire). The baseline is the carbon stock that the project area would have had in the absence of the project if the historical land use and management had continued. The FullCAM model is used to calculate abatement, and relies on

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[124] ***Mixed species environmental planting*** means a planting that consists of a mixture of trees and shrubs that are:
(a) native to the local area of the plant; and
(b) sourced from seeds from within the natural distribution of the species and that are appropriate to the biophysical characteristics of the area of the planting; and
(c) are established through planting.

[125] ***Mallee planting*** means a planting that consists of only mallee species, which are small, multi-stemmed Eucalyptus trees.

inputs including the management activities, project location, planting dates, planting type and species, geometry of planting (belt or block), and spacing and density of planting (CER 2025h).

Discounts Applied

- 20% permanence period discount for 25-year permanence period.
- 5% buffer for risk of reversal for both 100-year and 25-year permanence period projects (CER 2025h).

Specialist skills

Specialist skills may be required for the use of FullCAM and for selecting the appropriate tree species for planting (CER 2025h).

Monitoring, reporting and audits

- Project proponents must monitor and record management actions and disturbance events by on-ground observation and/or remotely-sensed imagery.
- Project proponents must keep records of forest cover and plantings, project area, fires, fuel use, FullCAM modelling, and forest management.
- Reports due every 6 months to 5 years. Key information to be contained in reports include the net abatement amount and calculations, emissions from the project (e.g. fuel use, fires), FullCAM files, project area, forest management and forest cover information, reforestation management plan, information and evidence to demonstrate ongoing implementation of project activities, details of disturbance events, details of any removal of biomass, and the timing and intensity of any grazing.
- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.

Low-risk projects

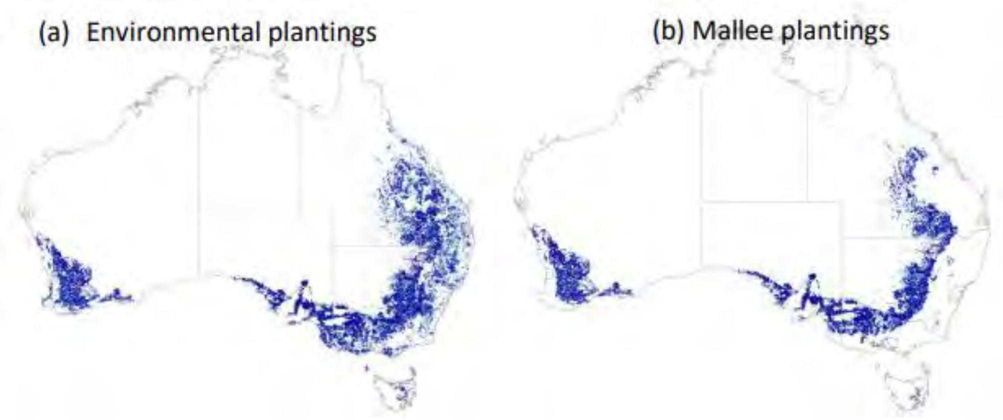
Low-risk environmental plantings projects are exempt from audits. Project proponents must apply to be classified as low-risk. To qualify, projects must be smaller than 200ha, the project proponent must own, lease or hold native title to the land, and the project must be modelled as a mixed species block planting in FullCAM. Low-risk projects are subject to geospatial monitoring by the CER (CER 2025h).

11.1.2.2 Current uptake

Participation in this method is low. As of 28 February 2025, 288 projects were registered using this method nationwide. Of these, 30 projects (10.42%) have been awarded a total of 2,887,130 ACCUs. In Queensland, 23 projects using this method have been registered, which equates to 0.12% of Queensland farms, and only 2 of these have received ACCUs. As already canvassed in this report, the rate of participation and uptake of ACCU scheme projects by primary producers is low. The 23 Queensland projects are all undertaking environmental plantings (rather than mallee plantings) and are located across the state, including in the northern Cook, Douglas, Mareeba, and Cairns regions, the central Mackay, Rockhampton, Gladstone and North Burnett regions, and the southern Fraser Coast, Gympie, South Burnett, Somerset, Toowoomba, Ipswich, Western and Southern Downs, Scenic Rim and Goondiwindi regions. As illustrated by 'Figure 3: Map of all agricultural, vegetation and savannah burning ACCU scheme methods ' featured earlier in this report, the reforestation by environmental planting projects are located along the coastline in agricultural zones that have higher rainfall and land types more conducive with growing vegetation (Fitch et al. 2022).

Fitch et al. (2022) used FullCAM modelling to identify the potential areas across Australia that can be reforested by environmental or mallee plantings, which are depicted in Figure 35 below. The areas suitable for mallee plantings have long-term average rainfalls below 600mm (Fitch et al. 2022).

Figure 35: (a) Potential for future environmental plantings; (b) potential for future mallee plantings



Source: Adapted from Fitch et al. (2022)

Furthermore, Fitch et al. (2022) estimated that the carbon sequestration potential across Australia (amount that is biophysically possible) via environmental plantings is 516 Mt CO_2e per year covering 66.4 Mha (block and belt plantings). Fitch et al. (2022) caveat this by positing that the economic sequestration potential is much lower at 16.4 Mt CO_2e per year (this is the economically feasible sequestration amount). Evidently, there remains much larger project development potential in Queensland than that which has occurred to date.

In summary, current uptake of projects using the reforestation by environmental or mallee plantings method is low and there is substantial room for expansion. The full details of how vegetation-based carbon sequestration occurs and the investment analysis of a case study farm business enterprise adopting this method are provided at section 4.3 Vegetation-based carbon farming methods of this report above.

11.1.3 Reforestation and afforestation (vegetation)

11.1.3.1 Description

This method[126] applies to projects that establish permanent forests on land previously used for grazing, cropping, or fallow. It covers:

- **reforestation**: restoring previously forested land; and
- **afforestation**: creating new forests on previously non-forested land (CER 2024l).

ACCUs are awarded based on increased carbon stored in project areas.

Eligibility and project requirements

- Land must have been used for grazing, cropping or fallow for at least the past 5 years;
- Land must be located in Australia and capable of supporting forest growth;

[126] This method is set out in the *Carbon Credits (Carbon Farming Initiative—Reforestation and Afforestation 2.0) Methodology Determination 2015*.

- Trees must be planted densely enough to achieve forest cover (≥20% crown cover, trees ≥2 m tall, and over ≥0.2 ha);
- Project must involve permanent plantings;
- Removal of trees is restricted (limited to weed removal, biomass sampling, or natural disturbance management such as fire or disease); and
- One preparation burn and one fertiliser application per 25 years allowed per stratum (CER 2024l).

Permanence and crediting

- Permanence period: 25 or 100 years.
- Crediting period: 25 years.

Carbon Abatement Calculation

Net carbon abatement is calculated by in field measurements of the change in the amount of carbon stored in the project area less the project emissions (e.g. fuel and fire). Measurements are taken of tree growth, natural decay and disturbance events. Carbon stock is estimated by converting the biomass estimates into estimates of carbon stock. Biomass is estimated using stratum specific functions, regional functions or CPI functions (allometric functions) (CER 2024l).

Discounts applied

- 20% permanence period discount for 25-year permanence period.
- 5% buffer for risk of reversal for both 100-year and 25-year permanence period projects.

Specialist skills

Project proponents will require forestry expertise to run measurements and calculations, which may be their own expertise or that of a specialist.

Monitoring, reporting and audits

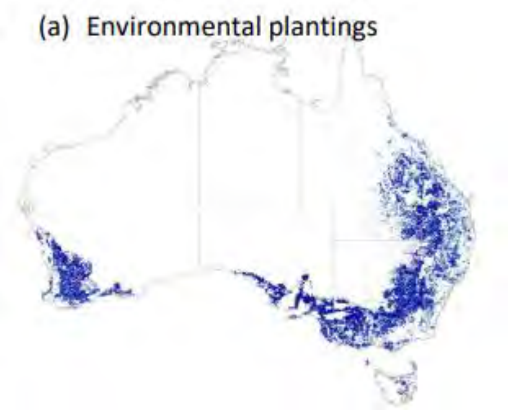
- Project proponents must monitor and record growth disturbance events.
- Project proponents must keep records for 7 years of project proponent's approach to calculating abatement (e.g. details of allometric function based on biomass weight measurements).
- Reports due every 6 months to 5 years.
- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.

11.1.3.2 Current uptake

Participation in this method is low. As of 28 February 2025, there were 17 projects registered using this method across Australia, 8 (or 47%) of which have been issued with ACCUs. Only 1 project is located in Queensland (near Banana) and this project has been awarded 30,191 ACCUs.

Fitch et al. (2022) used FullCAM modelling to identify the potential areas across Australia that can be reforested by environmental plantings, which is depicted in Figure 36 below (same schematic as for the reforestation by environmental plantings method, Figure 35(a)).

Figure 36: Potential extent of possible future environmental planting activity



Source: Adapted from Fitch et al. (2022)

Furthermore, Fitch et al. (2022) estimated that the carbon sequestration potential across Australia (amount that is biophysically possible) via environmental plantings is 516 Mt CO_2e per year covering 66.4 Mha (block and belt plantings). Fitch et al. (2022) caveat this by positing that the economic sequestration potential is much lower at 16.4 Mt CO_2e per year (this is the economically feasible sequestration amount). Evidently, there remains much larger project development potential in Queensland than that which has occurred to date.

11.1.4 Blue carbon (vegetation)

11.1.4.1 Description

The tidal restoration of blue carbon ecosystems method[127] (blue carbon method) applies to projects that reintroduce tidal flow to coastal wetlands by removing or modifying barriers like sea walls or drains. ACCUs are issued for increased carbon sequestration[128] through the establishment of coastal wetland ecosystems or emissions avoidance,[129] particularly methane, due to restored tidal flow (ERF n.d. a).

Carbon abatement sources

There are three carbon abatement sources

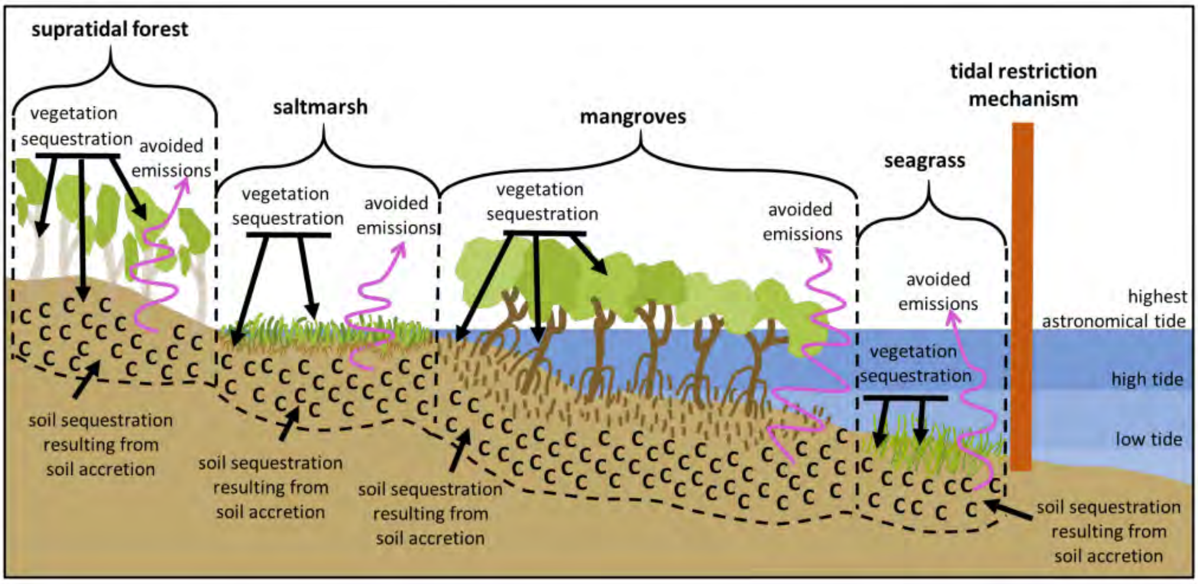
1. **Soil carbon:** sequestration through vertical accretion (‘increase of organic carbon-rich soil that occurs as organic matter accumulates in coastal wetland ecosystems over time’ (ERF n.d. a)).
2. **Above and below-ground vegetation carbon:** sequestration by above and below-ground biomass in wetland vegetation (e.g. mangroves, saltmarshes, seagrasses).

[127] This method is set out in the *Carbon Credits (Carbon Farming Initiative— Tidal Restoration of Blue Carbon Ecosystems) Methodology Determination 2022*.
[128] ‘The restoration of tidal flows to coastal land can increase carbon sequestration through creating conditions that favour the growth and development of blue carbon ecosystems such as mangroves, saltmarshes, seagrasses, and supratidal forests’ (Lovelock et al. 2023).
[129] Tidal restoration can reduce ‘methane emissions from land through changes in soil water content, increases in soil and water salinity, and changes in biogeochemistry that influence microbial processes (e.g. changes in iron availability), which can decrease rates of methanogenesis and increase rates of sulfate reduction’ (Lovelock et al. 2023).

3. **Emission avoidance from introducing tidal flow:** reduced methane emissions from converting freshwater wetlands back to coastal wetland ecosystems that were previously drained or converted[130].

These sources of carbon abatement are illustrated in Figure 37 below.

Figure 37: Carbon sequestration and emissions avoidance covered by the blue carbon method



Source: Adapted from ERF (n.d. a)

Requirements

- Projects must occur in Australia, involve reintroduction of tidal flow, and show a reasonable expectation of achieving eligible carbon abatement.
- Eligible project activities are removing/modifying tidal restriction mechanisms and associated infrastructure modifications (optional).
- Project land must have had tidal flow restricted for at least 7 years prior to the project commencing, or not experienced tidal flow for other reasons, with tidal restriction mechanisms still in place.

Prohibited and restricted activities

Activities not permitted during the project permanence period in the project area include:

- Cropping, livestock grazing, aquaculture, or fertiliser application (these activities can take place outside of the project area).

Restricted Activities (with limits):

- Thinning vegetation and removing biomass (limited to 5% of biomass annually if thinning done to promote growth or biodiversity; limited removal permitted for field sampling, and personal use);

[130] High amounts of greenhouse gases, particularly methane, are emitted by freshwater wetlands because of 'the anaerobic decomposition of organic material stored in the soils of the blue carbon wetlands' (ERF n.d. a). By reintroducing tidal flow into converted freshwater wetlands, the methane emissions are significantly reduced because the saltwater conditions limit the microbial methane production compared to the freshwater conditions (ERF n.d. a).

- Thinning for the purpose of weed control is permitted;
- Indigenous/traditional harvesting permitted;
- Planting or seeding of plants or propagules may be conducted on the land only if the planting or seeding is an environmental coastal wetland planting;
- Boardwalks permitted if no more than 5% biomass is removed annually; and
- Excavation only for eligible project activities or acid sulfate soil management.

Documentation and specialist skills

Project proponents must prepare the following documentation:

- hydrological assessment (prepared/reviewed by qualified specialists);
- operations and maintenance plan;
- tidal inundation maps; and
- acid sulfate soil management plan and mosquito management plans (if required) (CER 2024n).

Permanence and crediting

- Permanence period: 25 or 100 years.
- Crediting period: 25 years.

Carbon Abatement Calculation

Under this method, carbon abatement from a tidal restoration project includes crediting abatement from the avoidance of emissions of greenhouse gases into the atmosphere, as well as abatement from carbon dioxide that is removed from the atmosphere and sequestered in coastal wetland ecosystems (in vegetation and soil). The net carbon abatement from each of the soil and vegetation sequestration and emissions avoidance components of a project are calculated using the Blue Carbon Accounting Model (**BlueCAM**)[131], which was developed alongside the blue carbon method. 'Project proponents are not required to conduct sampling. The model-only approach is intended to simplify the requirements of the method and reduce costs associated with sampling' (ERF n.d. a). The baseline level is 'the amount of carbon that would have been emitted from the soil if tidal flows had not been introduced' (ERF n.d. a). The land type that was present prior to the project commencing (e.g. pasture or sugar cane) is used to determine the baseline level of emissions. Emissions generated by the project activities, such as fuel usage and soil disturbance due to excavation activities, are accounted for in the net abatement calculations (ERF n.d. a).

Discounts applied

Discounts apply only to carbon sequestration, not emissions avoidance.

- For a 25-year permanence period project, the sequestration buffer discount is 25%.

[131] BlueCAM is a cost-effective method of estimating carbon abatement designed to increase participation in blue carbon projects and is advantageous for project proponents who avoid incurring the significantly higher cost of in field measurements (Lovelock et al. 2023). Furthermore, the financial viability of a proposed project can be estimated by modelling the anticipated carbon abatement with BlueCAM prior to commencing a project (Lovelock et al. 2023). However, BlueCAM does have some limitations and may produce conservative estimates of carbon abatement in some cases (Lovelock et al. 2023). In time, as projects are undertaken and data becomes available, the accuracy of the BlueCAM model predictions can be improved, as has occurred with the FullCAM model (Lovelock et al. 2023).

- For a 100-year permanence period project, the sequestration buffer discount depends on the proportion of land that is projected to be impacted by sea level rise over the 100-year period:
    - o If 80-100% of land is predicted to be impacted, then sequestration buffer discount is 5%;
    - o If less than 80% of land is predicted to be impacted, then sequestration buffer discount is 25% (ERF n.d. a).

Monitoring, reporting and audits

- Project proponents must monitor the following and keep records of any restricted activities undertaken, all inputs and calculations of net abatement amounts, fuel usage, material and evidence supporting the project activities, details of excavation activities, monitoring results of coastal wetland ecosystems and monitoring results of natural disturbance events.
- Monitoring must be done by on-ground observation, geolocated imagery, or derived vegetation cover data.
- Reports due every 6 months to 5 years – must detail project activities and BlueCAM input variables.
- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.

11.1.4.2 Current uptake

Participation in this method is low. As of 28 February 2025, there were 2 projects registered using this method that are based in South Australia and Queensland. The projects were registered in mid-2024 and accordingly, no ACCUs have been issued yet. The Queensland project is being conducted by the Sunshine Coast Regional Council.

Fitch et al. (2022) estimated that the national sequestration potential of mangroves and saltmarsh is collectively 11 Mt CO_2e/ha/yr, and 4.9 to 5.6 Mt CO_2e/ha/yr for seagrass. 'There are no estimates for freshwater wetlands at present' (Fitch et al. 2022). Furthermore, Rowland et al. (2023) posited, 'Australia has the largest area of blue carbon ecosystems of any country and thus one of the largest blue carbon storage capacities'. Clearly, there is greater carbon abatement potential than is currently being supplied by projects using this method. The investment analysis of a case study farm business enterprise adopting this method is provided at section 4.5 Blue carbon method of this report above.

11.1.5 Savanna fire management

11.1.5.1 Description

There are two savanna fire management methods that are applicable to Northern Australia and aim to reduce greenhouse gas emissions, namely:

- the sequestration and emissions avoidance method[132], which involves removing carbon dioxide from the atmosphere by sequestering more carbon in dead organic matter compared to the baseline period, and avoiding the emission of methane and nitrous

[132] This method is set out in the *Carbon Credits (Carbon Farming Initiative—Savanna Fire Management—Sequestration and Emissions Avoidance) Methodology Determination 2018*.

oxide from the burning of savannas, compared to the emissions during the baseline period.

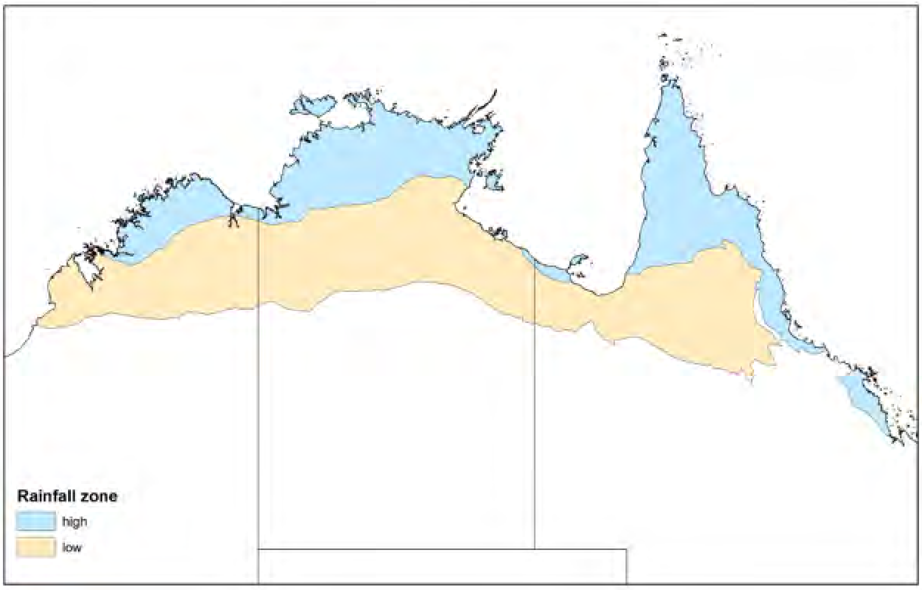
- the emissions avoidance only method[133], which involves avoiding the emission of methane and nitrous oxide from the burning of savannas, compared to the emissions during the baseline period.

These methods involve controlled burning during the early dry season, which produces fewer emissions by reducing the frequency and severity of late dry season fires.[134] ACCUs are issued based on a reduction in emissions for each year of the project compared to the baseline emissions.

Location requirement

To be eligible to use the savanna fire management methods, the project land must be located in either or both of the high or low rainfall zones in Northern Australia, which are identified in Figure 38 below.

Figure 38: High and low rainfall zone in northern Australia



Source: DCCEEW (2024)

Eligibility requirements

- Project land must contain a vegetation fuel type[135];
- Project land must **not** contain the weed species, Gamba Grass (Andropogon gayanus);

[133] This method is set out in the *Carbon Credits (Carbon Farming Initiative—Savanna Fire Management—Emissions Avoidance) Methodology Determination 2018*.

[134] In Australia's savanna landscape, low-intensity fires in the early dry season generate fewer greenhouse gas emissions compared to high-intensity fires in the late dry season, which consume greater amounts of dead organic matter (DCCEEW 2024). 'Small, cooler fires during the early dry season, if done strategically reduce the number and size of large, high-intensity late dry season fires, reduce greenhouse gas emissions, and increase the amount of carbon stored in the dead organic matter in the landscape' (DCCEEW 2024).

[135] ***Vegetation fuel type*** means a type of vegetation that is characterised in terms of the structural formation (canopy height and foliage projected cover) of its dominant stratum and its grass type. The vegetation fuel types are identified for both high and low rainfall zones in the savanna technical guidance document available on the Clean Energy Regulator's website.

- Project activities must involve a planned burn completed annually in accordance with a project management plan.
- The baseline period for high rainfall zone is 10 years prior to commencement of the project, and for low rainfall zone is 15 years prior to commencement of the project.

Permanence and crediting

- Permanence period:
    - savanna sequestration project: 25 or 100 years; and
    - savanna emissions avoidance project: no permanence period [136]
- Crediting period (for both methods): 25 years.

Carbon abatement calculation

- Abatement calculations are based on the baseline period, vegetation fuel type map (defines the vegetation type within the project area), and annual fire scar maps (identify burnt and unburnt areas) (CER 2024m).
- Calculations can be completed manually using the equations set out in the methods or using the Savanna Burning Abatement Tool version 3 (SavBAT 3)[137].
- Savanna sequestration project:
    - 'Net abatement from sequestration is the mean annual difference between the carbon stored during the project years and during the baseline period' (CER 2024m).
- Savanna emissions avoidance project:
    - 'Abatement for emissions avoided is calculated from the difference between mean baseline and annual project emissions. This reflects the change in emissions due to change in fire management practices' (CER 2024m).

Discounts applied

- Savanna sequestration project:
    - 20% permanence period discount for 25-year permanence period; and
    - 5% buffer for risk of reversal for both 100-year and 25-year permanence periods (DoEE 2019).
- Savanna emissions avoidance project:
    - when abatement is positive, up to 10% of ACCUs are set aside as an *uncertainty buffer* to cover potential losses in the future. The buffer is capped at 5% of the average annual baseline emissions and is not returned at the end of the project;
    - when abatement is negative (project emissions exceed baseline emissions), credits are withdrawn from the uncertainty buffer. If the buffer is depleted, no credits are issued until it returns to a positive balance (CER 2024m).

[136] Savanna emissions avoidance projects do not have a permanence period because 'once emissions have been reduced or avoided, there has been a permanent 'avoidance of emissions" (DoEE 2019).
[137] SavBat v3 is 'a standard tool used by the Australian Government to assess GHG emissions from wildfires, which automates the GIS processes and mathematical equations required to estimate the net abatement for savanna burning projects' (Sangha et al. 2021).

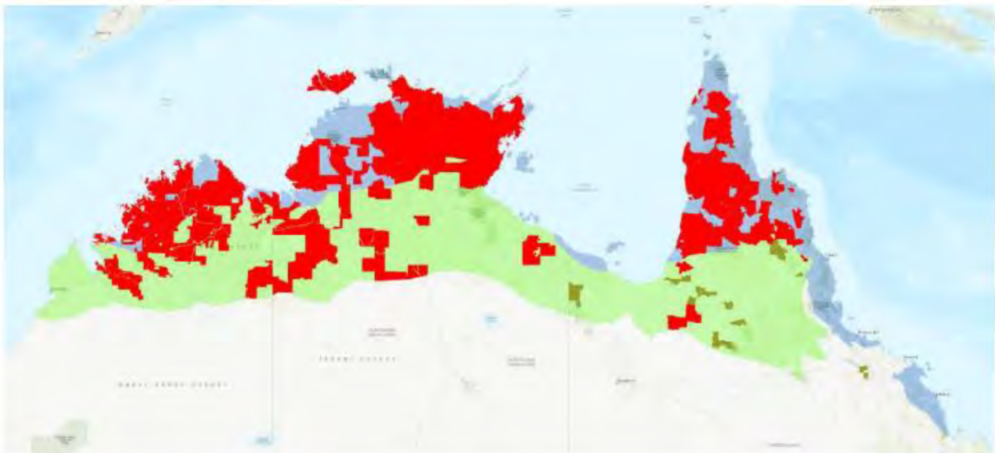
Monitoring, reporting, and audits

- Project area must be monitored for the weed species, Gamba Grass.
- Records of all data used for abatement calculations must be retained.
- Participants must submit reports to the Clean Energy Regulator. Reports must be submitted at least every 2 years for emissions avoidance projects and at least every 5 years for sequestration offsets projects. The information to be reported includes details of the burning activities (location, date and extent), a statement that livestock density has not increased as a result of the project, abatement calculations, weed monitoring and management activities, vegetation fuel type map, annual project management plans and fire permits (CER 2024m).
- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.

11.1.5.2 Current uptake

As at 28 February 2025, there were 20 projects registered using this method, of which 6 (or 30%) have been awarded a total of 192,732 ACCUs. There are 7 projects located in Queensland. An additional 86 projects are registered across Australia using savannah burning methods that are now revoked method. Figure 39 below illustrates the projects that are registered using the savanna fire methods in red. The blue shading depicts the high rainfall savanna, and the green shading depicts the low rainfall savanna.

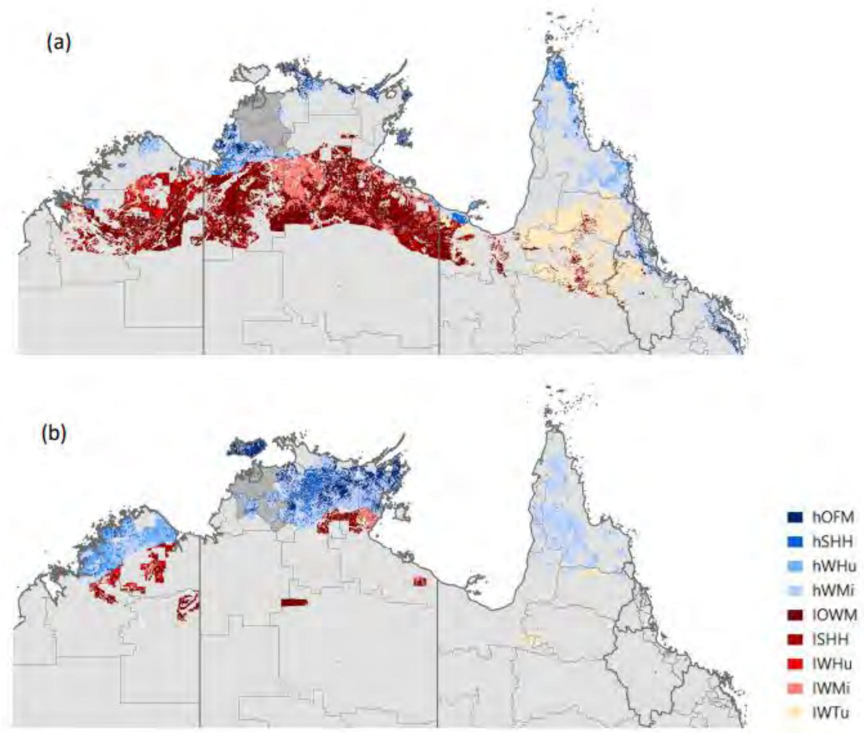
Figure 39: Map of projects registered using the savanna fire methods



Source: Adapted from CER (2025d)

Fitch et al. (2022) identified the potential areas across northern Australia that are suitable for new savannah burning projects (a), and the areas with current ACCU Scheme savanna burning sequestration projects that could additionally include sequestration (b) which are depicted in Figure 40 below. The different colours denote different vegetation types. Darker grey area is the Gamba exclusion zone.

Figure 40: (a) suitable areas for new projects; (b) existing projects that could expand



Source: Adapted from Fitch et al. (2022)

Furthermore, Fitch et al. (2022) estimated that the carbon sequestration potential across Australia (amount that is biophysically possible) via savannah burning is 6.19 Mt CO_2e per year covering 80 Mha (block and belt plantings), and Fitch et al. (2022) deemed this to be economically viable. Evidently, there remains much larger project development potential in Queensland than that which has occurred to date.

11.1.6 Avoided clearing of native regrowth (closed) (vegetation)

11.1.6.1 Description

This method[138] applies to projects that avoid emissions by not clearing native forest that would otherwise have been cleared for cropping or grazing (CER 2024h). This method expired on 31 March 2025. The Queensland Government is leading the development of a new method designed to replace and improve this method, the Improved Avoided Clearing of Native Regrowth (IACNR) (Queensland Government 2025). The proposed timeframe provided by the Queensland Government is to have the documentation for the method finalised and presented to the Emissions Reduction Assurance Committee in July 2025 (Queensland Government 2025). The following information summarises the requirements for the expired avoided clearing of native regrowth method.

[138] This method is set out in the *Carbon Credits (Carbon Farming Initiative—Avoided Clearing of Native Regrowth) Methodology Determination 2015*.

Requirements

- The project land must have native forest cover[139], unrestricted clearing must be permitted, at least 2 clearing events must have occurred on the land and it must have been used for cropping or grazing after each clearing event, and the land cannot contain plantations environmental plantings.
- Project proponents must have evidence available of the native forest cover, unrestricted clearing permission, clearing history, details of regeneration after clearing events, and land use history.
- Project area must be at least 0.2ha.

Project activities

Project proponents must manage native forest areas to reduce risks from fire, weeds, and feral animals. Fertiliser use is prohibited in the project area, and biomass removal is restricted to only 10% of fallen timber that may be taken annually for non-commercial, personal use.

Tree thinning is allowed for ecological reasons under strict conditions:

- Biomass must stay on-site;
- Native forest cover must be preserved;
- Carbon stocks cannot fall below the most recently reported levels; and
- Thinning must be accounted for in FullCAM modelling.

Permanence and crediting

- Permanence period: 25 or 100 years.
- Crediting period: 25 years.

Carbon Abatement Calculation

ACCUs are awarded to producers who can demonstrate an increase in carbon abatement from the total project areas compared to the baseline, less the project emissions. FullCAM modelling is used to calculate the baseline scenario (where ordinarily, the land would be cleared) and the project scenario (where no land clearing occurs); the difference between the baseline and project scenarios is the additional carbon stored because of the project (ERF n.d.).

Discounts applied

- 20% permanence period discount for 25-year permanence period.
- 5% buffer for risk of reversal for both 100-year and 25-year permanence period projects.

Monitoring, reporting and audits

- Project proponents must monitor the project area for fires and other natural disturbances.
- Project proponents must keep records of the project's eligibility, FullCAM baseline and project data, abatement calculations, thinning events, fires and other natural disturbances (CER 2024h).

[139] Land has ***native forest cover*** if it is dominated by trees that are located within their natural range, have attained a crown cover of at least 20% of the area of land and have reached a height of at least 2 metres. 'Crown cover is the amount of land covered by the outer edges (diameter) of a tree crown or group of tree crowns' (ERF n.d.)

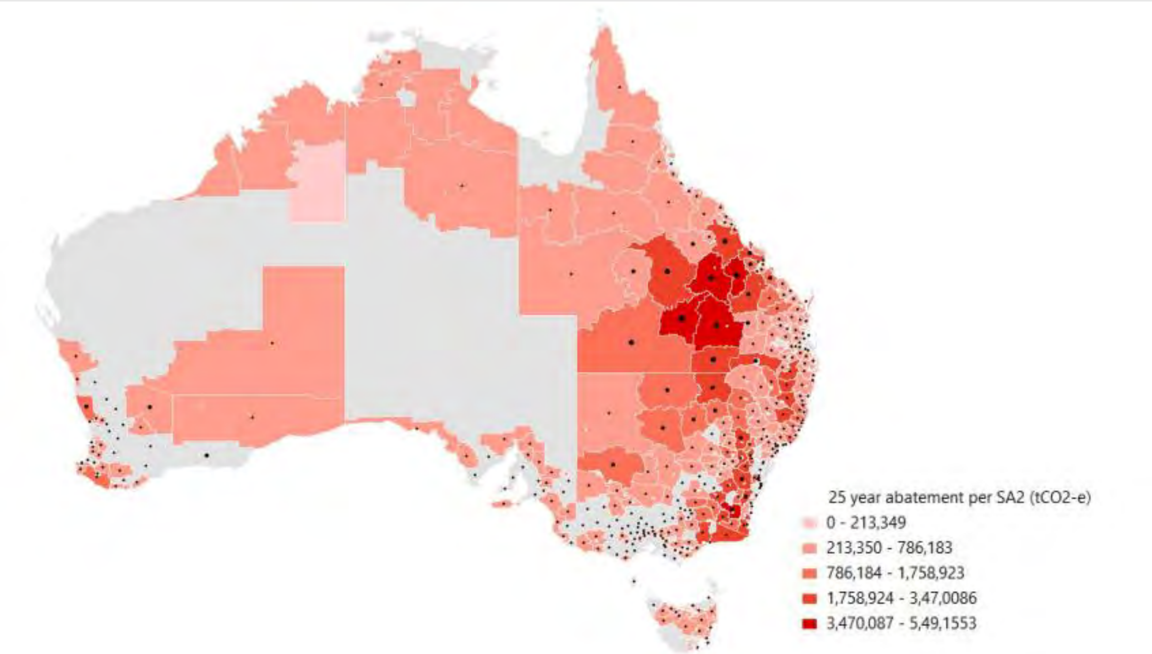
- Reports due every 6 months to 5 years and must include the information described in the dot point above.
- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.

11.1.6.2 Current uptake

Participation in this method is low. As of 28 February 2025, there were 16 projects registered using this method, all of which are based in Queensland. Of the 16 projects, 11 projects have been issued with a total of 535,629 ACCUs. The projects are located in central and southern regions of Queensland, including the Rockhampton, Banana, North Burnett, South Burnett, Fraser Coast, Maranoa, Murweh Shire and the Southern Downs. The size of the project areas ranges from 59ha up to 20,272ha.

Fitch et al. (2022) estimated that the carbon sequestration potential across Australia (amount that is biophysically possible) via avoided clearing of native regrowth is 9.2 Mt CO_2e per year covering 1.38 Mha. Fitch et al. (2022) caveat this by positing that the economic sequestration potential is lower at 7.74 Mt CO_2e per year (this is the economically feasible sequestration amount). That estimate is based on the assumptions that there is a 15-year baseline, clearing costs are$144/ha/yr, initial costs are $10/ha/yr, and the ACCU price is $30 t CO_2e. Fitch et al. (2022) identified the economic carbon sequestration potential across Australia by location which is depicted in Figure 41 below. The red colour denotes regions with economic potential for avoided clearing of native regrowth projects (darker red means more carbon sequestration potential) and the black dots are proportional to the total area available in each region.

Figure 41: Potential extent of economically viable future avoided clearing projects



Source: Adapted from Fitch et al. (2022)

Evidently, there remains much larger project development potential in Queensland than that which has occurred to date.

11.1.7 Beef cattle herd management (suspended) (agriculture)

11.1.7.1 Description

This method[140] applies to projects that improve beef cattle herd productivity and thereby reduce the emissions intensity of meat produced. The method is due to expire on 30 September 2025. During 2024, the Emissions Reduction Assurance Committee (ERAC) undertook a periodic review of the method and found evidence that it no longer complied with the Offsets Integrity Standard[141] (DCCEEW 2024b). Accordingly, on 17 December 2024, ERAC ordered the suspension of the method so that new applications cannot be processed. The order will remain in place until the method expires on (DCCEEW 2024b). The following information summarises the requirements for the suspended beef cattle herd management method.

Eligibility

- Project proponents must have cattle herd data showing positive liveweight gains for each year for 3 years (full data) or 2 years (limited data) from within the past 7 years (known as the emission intensity reference period).
- During the emission intensity reference period, the herd must have met the following requirements and continue to meet those requirements until the end of the project:
    - Separate business operation (a separate livestock inventory must be maintained for the cattle herd that is involved in the project);
    - Herd continuity (if there is/was a change in business ownership or structure, the same animals must be on the livestock inventory before and after the change);
    - Movement of cattle (movement of cattle to or from the herd (other than by birth or as feral animals or cleanskins) must be a purchase or sale for fair value, be for a genuine business purpose, and result in a physical movement from one property to another);
    - Co-grazing (project herd cattle cannot be grazed with other cattle, unless the other cattle are part of a herd of eligible herd management project, or the cattle or other cattle are under an arm's length agistment arrangement);
    - Herd management (cattle must be grazed in Australia, feed principally by grazing or forage, and must be managed in a way consistent with Australian and New Zealand Standard Industrial Classification); and
    - Animal identification (each animal in the herd must be identifiable).
- Feedlot or dairy operation in ANZSIC Class 0143 or ANZSIC Class 0160 are **ineligible**.

Project Activities

Eligible project activities to reduce the emissions intensity of the herd include:

- improving feed quality;
- supplement feeding (e.g. phosphorus);
- installing new fences;

[140] This method is set out in the *Carbon Credits (Carbon Farming Initiative—Beef Cattle Herd Management) Methodology Determination 2015.*
[141] See the ERAC (2024) report titled, 'Beef cattle herd management method: Periodic review report' for details.

- planting improved pastures (e.g. leucaena, stylos and desmanthus);
- improving herd genetics; and/or
- increasing density of water points (CER 2024a).

Reducing emissions intensity is positively correlated with improving beef cattle production metrics including mortality rates, weaning rates, conception rates, and liveweight gain. Examples of methods to improve these metrics including planting improved pastures of leucaena, stylos and desmanthus, reducing stocking rates to the land's carrying capacity if the property is initially overstocked (this could be done by culling dry female cattle for example), vaccinating a herd against Pestivirus, improving genetics by selecting for reproduction efficiency in breeder cows or by introducing improved genetics via bulls, and feeding supplements to breeders (e.g. phosphorus) and steers (e.g. dry lick consisting of urea, salt and protein meal) (Bowen et al. 2019; Bowen and Chudleigh 2018; Murphy et al. 2024; DAF 2024).

Ineligible project activities include:

- clearing land of perennial woody vegetation for grazing for the purpose of the project (if the land would have been cleared even if the project was not undertaken, then the clearing is permitted);
- feeding non-protein nitrogen to the herd, such as urea or nitrates; or
- merely relocating the herd.

Crediting period

The crediting period is 7 years.

Emissions abatement calculation

- Emissions abatement is calculated using the Beef Cattle Herd Management Calculator.
- Data collected includes liveweights[142], cattle numbers, entry/exit records, and movement reasons.
- The beef cattle herd management calculator requires the following data for each project year:
    - o for cattle remaining in the herd for 12 months, number and average liveweight at the start and end of the year for each livestock class;
    - o for cattle that left the herd during the 12 months, number and average liveweight at the start of the year for each livestock class, and exit date, number and average liveweight at exit, and exit reason (e.g. live export, slaughter);
    - o for the cattle that enter the herd during the 12 months, for each livestock class, entry date, method of entry (e.g. birth, purchase), number of cattle and average liveweight on entry and at the end of the year.

[142] The cattle weights can be determined in several ways. First, the cattle from each class can be weighed and then the average weight can be calculated. Second, a statistically valid sample from the class of cattle can be weighed and then the average weight can be calculated. Third, for cattle that are bought and sold, the average weight can be calculated from the data in the relevant sales records and receipts. Fourth, for cattle that are over 3 years of age, their weights can be estimated from the hot standard carcase weights of all cattle of the relevant livestock class culled from the herd during the project year (hot standard carcase weights for the cattle can be converted to liveweights using the abattoir records of the dress out percentage for the group of cattle or a default dress out percentage of 55%).

- The data for the emission intensity reference period is used to calculate baseline emissions for the herd.
- Net abatement amount for each year is calculated by first subtracting 4% from the herd's historical baseline emissions (on account of a variation to emissions from environmental factors outside of the projects control), and then calculating the difference between this amount and the herd's emissions following the implementation of the project activities (CER 2024a).

Monitoring, reporting and audits

- Project proponents must monitor land grazed by herd, each animal in the herd for the Beef Cattle Herd Management Calculator data, and details of project activities (e.g. if a diet change involved, must monitor for things like the days the animals experience the dietary change and the dietary value of supplements).
- Project proponents must keep self-contained and separate records for project herds, covering business operation, herd continuity, and cattle movements, and any dietary change activities like feed descriptions and nutritional specifications. Records must be retained for 7 years.
- Reports due every 6 months to 2 years.
- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.

11.1.7.2 Current uptake

Participation in this method is low. As of 28 February 2025, there were 15 projects registered using this method, 11 of which are based in Queensland. Of these, 3 projects (or 20%) have been issued a total of 1,044,037 ACCUs. The project proponents using this method are large beef producers that own significant cattle numbers. For example, the Paraway Pastoral Company Ltd had 53,246 head of cattle on baseline reference day. Table 60Table 60 below details the 15 registered projects.

Table 60: ACCU Scheme Project Register – beef cattle herd management method

Project Proponent	Project Description	Year Registered	Project location	ACCUs issued	Total head of cattle owned by project proponent[143]
Paraway Pastoral Company Ltd & Corporate Carbon Solutions Pty Ltd	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2016	NSW, QLD	300,776	53,246 head of cattle[144]
Commonwealth Hill Proprietary Ltd & Corporate Carbon Solutions Pty Ltd (Jumbuck)	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2016	WA	0	Own 261,700 head of sheep and 45,120 head of cattle[145]

[143] The total head of cattle owned by proponent is not necessarily the total head of cattle involved in the project.
[144] Corporate Carbon (N.D.) *Project operations and outcomes*, Corporate Carbon website, accessed 10 February 2025.
[145] Jumbuck (2019) *We are Jumbuck*, Jumbuck website, accessed 10 February 2025.

Indigenous Land and Sea Corporation	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2016	NT, QLD, WA	0	NK
Hewitt Cattle Australia Pty Ltd	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2016	QLD	0	Own over 200,000 head of cattle[146]
Consolidated Pastoral Company Pty Ltd	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2018	NT, QLD, WA	366,994	300,000 head of cattle carrying capacity[147]
A. A. Company Pty Ltd (AACo)	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2019	NT, QLD	376,267	Own 455,000 head of cattle[148]
Corporate Carbon Advisory Pty Ltd	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2019	NT, QLD	0	NK
Regenco Pty Ltd	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2022	WA, NT	0	NK
The North Australian Pastoral Company Pty Ltd	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2022	NT, QLD	0	Own 200,000 head of cattle[149]
Stanbroke Pty Ltd	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2022	QLD	0	Own 200,000 head of cattle[150]
Argyle Foods Pastoral Pty Ltd	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2022	NSW	0	NK
Cunningham Cattle Company Pty Ltd	Adopting measures to reduce cattle emissions per kilogram of liveweight produced	2022	QLD	0	Own 65,000 head of cattle[151]
Corporate Carbon Advisory Pty Ltd	Adopting measures to reduce cattle emissions per	2025	WA	0	NK

[146] Hewitt (N.D.) *Feeding the world with a system that lasts forever*, Hewitt website, accessed 10 February 2025.
[147] CPC (N.D.) *Our Properties*, CPC website, accessed 10 February 2025.
[148] AACo (N.D.) *The Art of Australian Beef*, AACo website, accessed 10 February 2025.
[149] NAP (N.D.) *Properties*, NAP website, accessed 10 February 2025.
[150] Stanbroke (N.D.) *The Stanbroke Story*, Stanbroke website, accessed 10 February 2025.
[151] Cunningham Cattle Co (N.D.) *About Us*, Cunningham Cattle Co website, accessed 10 February 2025.

	kilogram of liveweight produced				
Corporate Carbon Advisory Pty Ltd	Adopting one or more of the following activities including increasing ratio of weight to age of the herd, reducing average age of the herd, reducing proportion of unproductive animals in herd, changing ratio of livestock classes within herd to increase total annual liveweight gain of herd.	2022	Nation Wide	0	NK
Australian Country Choice Holdings Pty Ltd	Reduce emissions intensity of beef cattle production by reducing number of unproductive breeding animals and time period for young cattle before they reach market age.	2022	QLD	0	300,000 head of cattle carrying capacity[152]

Source: Adapted from CER (2025d)

Estimates of the potential for expansion of this method are not known. The investment analysis of a case study farm business enterprise adopting this method is provided at section 4.4 Beef cattle herd management method of this report above.

11.1.8 Default values soil carbon sequestration (agriculture)

11.1.8.1 Description

Like the soil organic carbon method described in section 11.1.1 above, the estimating sequestration of carbon in soil using default values method[153] (default values soil carbon sequestration method) applies to projects that remove carbon from the atmosphere and store it in soil, but instead of being measurement based, this method is model-based. Projects earn ACCUs by increasing soil carbon through eligible land management activities.

Eligible Activities

One or more project management activities must be undertaken, including:

1. **sustainable intensification –** implement two of the following:
    a. nutrient management;
    b. soil acidity management;
    c. new irrigation;
    d. pasture renovation.

[152] Australian Country Choice (N.D.) *Properties*, Australian Country Choice website, accessed 10 February 2025.
[153] This method is set out in the *Carbon Credits (Carbon Farming Initiative—Estimating Sequestration of Carbon in Soil Using Default Values) Methodology Determination 2015*.

2. **stubble retention** – retain stubble after crop harvest where it was previously removed by baling or burning.
3. **conversion to pasture** – change land cropped for at least 5 continuous years into permanent pasture[154].

Requirements

To qualify for this method, the key requirements for projects are:

1. introduce new soil carbon storage practices (excluding existing ones);
2. occur on land with FullCAM data and be eligible land (as determined by Sequestration Value Maps);
3. occur on land that was grazed, cropped, or fallowed at least once in the past 5 years;
4. land must exclude forest land, organosols, settlements including dwellings or other structures, land recently cleared of native forest cover or drained of a wetland within the baseline emissions period, and land unsuitable for project activities.

Permanence and Crediting

- Permanence period: 25 or 100 years. ACCUs must be relinquished if the project ends early or reverses (even if the land is sold, the activities to maintain soil carbon stocks must be continued, unless the project is revoked and ACCUs relinquished (ERF 2015)).
- Crediting period: 25 years.

Calculating carbon abatement using modelling

Under this method, modelling is used to calculate the amount of carbon captured. The CFI Mapping Tool is used to measure the amount of carbon stored in the project area from each project activity. Net carbon abatement is estimated by subtracting the baseline emissions (livestock, fertilisers, crop residue, and irrigation energy use over the 5 years before the project) from the project emissions and factoring this into the net abatement equation (ERF 2015).

Discounts Applied

- 20% permanence period discount for 25-year permanence period.
- 5% buffer for risk of reversal for both 100-year and 25-year permanence period projects.

Specialist Skills

A qualified person must prepare a strategy for each management action to ensure that actions improve productivity and increase soil carbon (CER 2024c).

Monitoring, Reporting & Audits

- Project emissions must be monitored throughout the project and records must be kept (e.g. emissions from livestock, synthetic fertilisers, lime, residue, tillage and soil landscape modification, irrigation energy, and biochar).
- Reports due every 6 months to 5 years, including carbon abatement calculations, project progress, and any reversal events (CER 2024c). Whilst a project proponent can complete

[154] s9, *Carbon Credits (Carbon Farming Initiative—Estimating Sequestration of Carbon in Soil Using Default Values) Methodology Determination 2015.*

the reports themselves, the reporting requirements are technical, so some participants may prefer to engage a carbon project service provider to prepare the reports.

- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.
- Records must be retained for 7 years.

11.1.8.2 Current uptake

No projects have been registered using this method.

11.1.9 Fertiliser in irrigated cotton (agriculture)

11.1.9.1 Description

The reducing greenhouse gas emissions from fertiliser in irrigated cotton method[155] (fertiliser in irrigated cotton method) applies to irrigated cotton projects aiming to reduce greenhouse gas emissions by improving nitrogen fertiliser use efficiency. Emissions reductions are achieved by lowering synthetic fertiliser use or increasing yield without increasing fertiliser rates.

Eligible activities

Each year, at least one new fertiliser management action must be undertaken (e.g. adjusting rate, timing, method, or fertiliser type). Actions must align with myBMP (Best Management Practice) standards and aim to either:

- increase lint yield without increasing fertiliser; or
- reduce fertiliser use without reducing lint yield.

Examples of Suitable Activities

Suitable actions may include (but are not limited to) one or more of the following:

a. modifying the synthetic fertiliser application rate;

b. modifying the synthetic fertiliser application timing;

c. modifying the synthetic fertiliser application method (e.g. via spreading or placement at depth in the soil);

d. applying a different type of synthetic fertiliser that increases the nitrogen available to the plant or reduces nitrogen losses from the soil, or both.

Requirements

To undertake this method, the following requirements must be met:

- Project area must have grown cotton for at least 3 of the 6 years before the crediting period;
- Project proponent must have records from this period must include fertiliser data (product name, mass applied and nitrogen content), area fertilised, planting density, lint yield, irrigation, and green manure use;
- Crop residues must not be burned during the project (project proponents are <u>not</u> ineligible if burning was conducted prior to project).

[155] This method is set out in the *Carbon Credits (Carbon Farming Initiative—Reducing Greenhouse Gas Emissions from Fertiliser in Irrigated Cotton) Methodology Determination 2015*.

Green Manure
Emissions from green manure (legume crops planted between cotton crops) are considered, but only from above-ground biomass (CER 2024e).

Calculating Net Abatement Amount

The method used to calculate the amount of carbon dioxide equivalent net abatement is as follows:

1. Step 1 is to calculate the annual project area abatement amount for each project area and each year in t CO2-e as follows:

   $$annual\ project\ area\ abatement\ amount\ =\ baseline\ emissions\ -\ project\ emissions$$

2. Step 2 is to calculate the net abatement amount for the reporting period by adding up all annual project area abatement amounts greater than zero.

The baseline emissions and project emissions are calculated using the Irrigated Cotton Calculator based on inputs including region, volume of fertiliser applied, nitrogen content, cotton area, green manure area, and lint yield.

Crediting period

The crediting period is 7 years.

Monitoring, Reporting & Audits

- Project proponents must monitor details of the irrigated cotton area, planting density (in kilograms of cotton seed planted per hectare), irrigation status, lint yield, synthetic fertiliser (amount of nitrogen applied, mass of synthetic fertiliser applied, nitrogen content of fertiliser), and green manure (area planted and planting density).
- Records must be retained for 7 years.
- Reports due every 6 months to 2 years. Reports must include mapping of cotton fields, details of activities undertaken and the irrigated cotton calculator inputs and outputs (CER 2024f).
- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.

11.1.9.2 Current uptake

No projects have been registered using this method.

11.1.10 Animal effluent management (agriculture)

11.1.10.1 Description

This method[156] applies to the treatment of animal effluent, the liquid waste stream generated from piggeries and dairies, by diverting waste from anaerobic ponds to alternative treatment systems (e.g. digesters or covered ponds), which capture and destroy methane or convert it into biomethane. ACCUs are earned based on demonstrated emission reductions (CER 2024g).

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[156] This method is set out in the *Carbon Credits (Carbon Farming Initiative—Animal Effluent Management) Methodology Determination 2019*.

Eligible project activities

Projects must involve one or more of the following:

- **biogas generation for biomethane**: capture and upgrade biogas from effluent into biomethane.
- **biomethane production**: treat biogas to produce biomethane for combustion as a natural gas substitute.
- **emissions destruction**: generating biogas from effluent, capturing biogas and destroying the methane component by combustion.
- **emissions avoidance**: aerobically treat effluent removed of volatile solids to reduce methane and nitrous oxide emissions compared to anaerobic ponds.

Examples of project types

- Non-biomethane project: involves emission avoidance or emissions destruction or both.
- Biomethane conversion and displacement project: involves installation of biogas upgrading systems at a project biomethane facility.
- Biomethane displacement-only project: involves installation of a biogas upgrading system at a project biomethane facility that produces biomethane.
- Restarting biomethane conversion and displacement project: builds on past project commenced under an earlier methodology, adding biomethane capability.
- Restarting biomethane displacement-only project: involves reviving a past biomethane-producing project commenced under an earlier methodology.

Crediting period

Varies from 7 to 12 years, depending on the project type.

Specialist skills

Due to complexity, projects may require professionals such as:

- registered professional engineers;
- certified energy managers; and
- certified measurement and verification professionals (CER 2024g).

Calculating emissions reductions

Carbon abatement is calculated by subtracting project emissions (e.g. fuel and electricity use) from the amount of emissions destroyed or avoided (CER 2024g).

Monitoring, reporting and audits

- Project proponents must monitor the parameters used to calculate the carbon abatement amount, which are measured by equipment or devices that must be calibrated by a qualified technician (CER 2024g).
- Project proponents must submit a quality assurance plan (includes records of maintenance requirements, details of monitoring data including frequency and compliance records).
- Reports are due every 6 months to 2 years.

- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.

11.1.10.2 Current uptake

Participation in this method is low. As of 28 February 2025, the number of projects on the ACCU Scheme Project Register using this method was 21, 3 of which are based in Queensland. Of the 21 projects registered, 4 projects (19%) have been awarded ACCUs (none of the projects that received ACCUs are based in Queensland). Both dairies and piggeries have undergone projects using this method.

11.1.11 Plantation forestry (vegetation)

11.1.11.1 Description

This method[157] applies to projects that plant, maintain or transition to forestry. ACCUs are awarded based on increased carbon stored in trees, debris, and harvested wood products, minus emissions from project activities (such as controlled burning, fossil fuel use or fertilising) (CER 2024j).

Eligible Project Types

1. establishing new plantation forests[158]
    - land must not have been a plantation in the past 7 years;
    - requires planting/seeding and maintenance; and
    - rotations must not exceed 60 years and the periods between rotations must not exceed 24 months.
2. conversion to long-rotation plantations[159]
    - during the 7 years prior to project commencement, land must have been a short-rotation plantation and was not cleared of native forest;
    - land is located within 100 km of a National Plantation Inventory (NPI) region (see Figure 42 below for map of NPI regions); and
    - requires thinning or pruning to extend rotation by at least 10 years compared to original short rotation (CER 2024j).
3. avoiding conversion of plantation to non-forested land[160]
    - land must be within 50 km of an NPI region;
    - during the 7 years prior to project commencement, the plantation forest was harvested and the land was not cleared of native forest; and
    - must meet clearfell age and harvest timing requirements.
4. transition for plantation forest to permanent planting[161]

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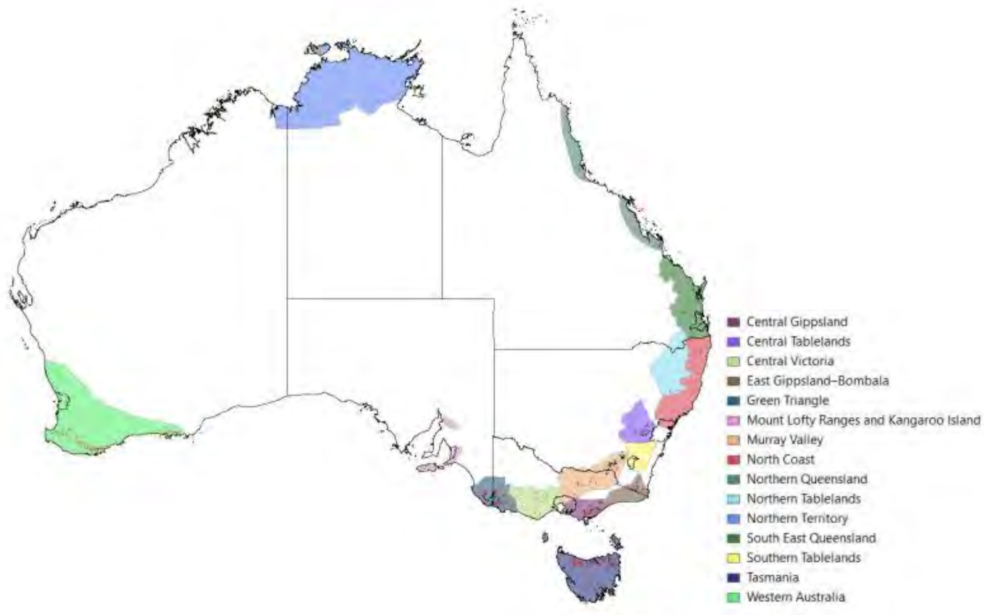
[157] This method is set out in the *Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2022.*
[158] Schedule 1, *Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2022.*
[159] Schedule 2, *Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2022.*
[160] Schedule 3, *Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2022.*
[161] Schedule 4, *Carbon Credits (Carbon Farming Initiative—Plantation Forestry) Methodology Determination 2022.*

- converts existing plantation forest to permanent forests. Land must have had a plantation forest within the previous 7 years;
- where necessary, planting, seeding or coppicing to establish a permanent planting with a stocking density of at least 200 stems per hectare; and
- during the 7 years prior to the project commencing, the land was not cleared of native forest.

Figure 42 below illustrates the National Plantation Inventory regions in Australia. 'Within each NPI region red areas are the current distribution of hardwood plantations, and black areas are the distribution of softwood plantations' (Fitch et al. 2022)

Figure 42: National Plantation Inventory regions in Australia



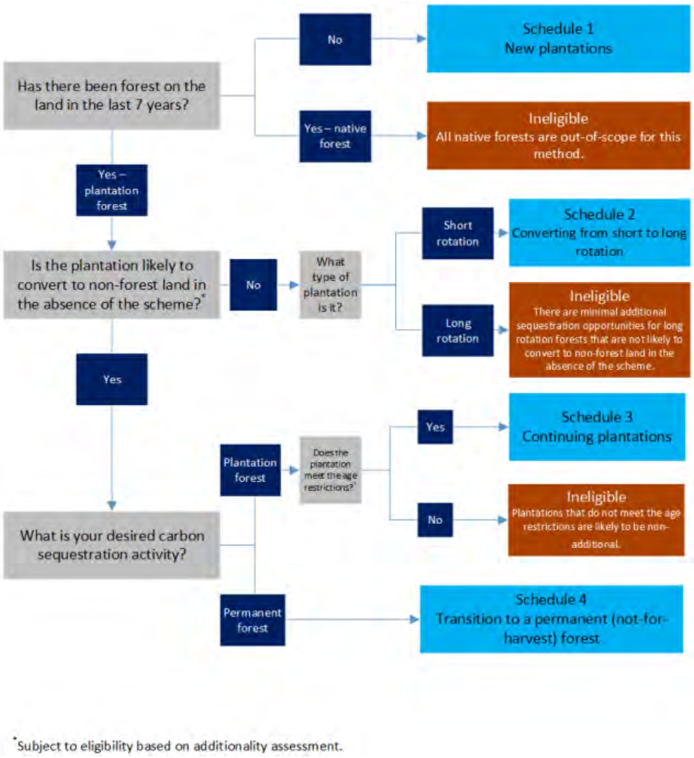
Source: Adapted from Fitch et al. (2022)

Species rules

- Schedules 1, 3, and 4 allow any non-weed species capable of achieving forest cover.
- Schedule 2 (long-rotation conversions) has species restrictions.

Figure 43 below illustrates the plantation forestry method decision tree published by the Clean Energy Regulator.

Figure 43: Plantation Forestry Method Decision Tree



Source: Adapted from CER (2024k)

Permanence and crediting

- Permanence period: 25 or 100 years.
- Crediting period: 25 years.

Carbon abatement calculation

- FullCAM modelling is used to calculate carbon abatement by comparing project and baseline carbon storage (CER 2024k).
- The FullCAM model models scenario simulations for the baseline scenarios, projects scenarios, and long-term project scenarios (ERF 2022).

Discounts applied

- 20% permanence period discount for 25-year permanence period (except in limited cases[162]); and
- 5% buffer for risk of reversal for both 100-year and 25-year permanence period projects (CER 2025h).

Specialist skills

Specialist skills may be required for the use of FullCAM.

[162] Additional discount rates applied to projects with 25-year permanence period that are short rotation plantations under Schedule 1, short or long rotation plantations under Schedule 3 or permanent non-environmental plantings under Schedule 4.

Monitoring, reporting & audits

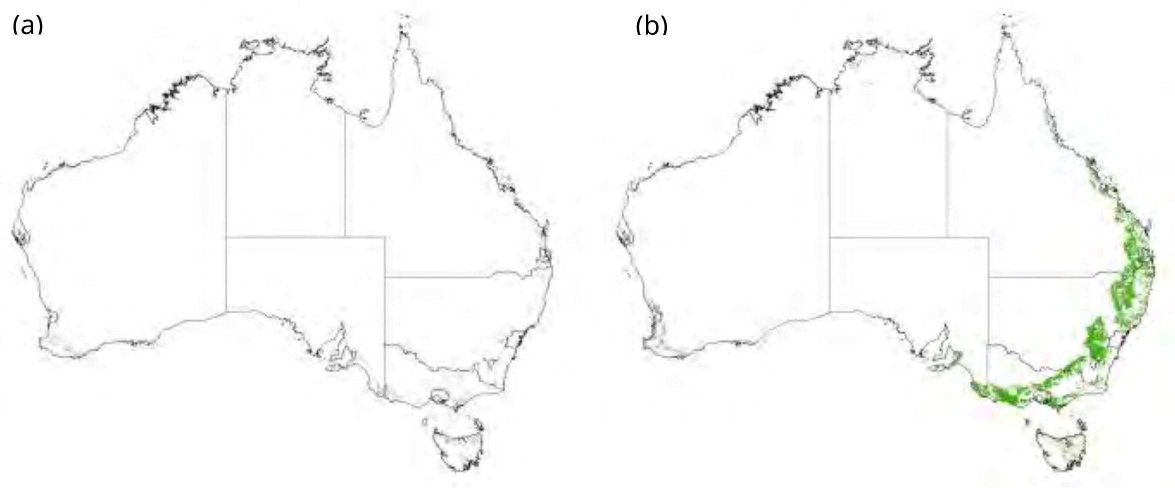
- Project proponents must monitor the project area for natural disturbances forest development.
- Project proponents must keep records relating to salvage harvesting, and monitoring of management actions, natural disturbances and forest development condition.
- Reports due every 6 months to 5 years. The offsets report must include the 'calculated project abatement, the required monitoring, and documentation of project activities' (CER 2024k).
- At least 3 audits must be conducted by Category 2 National Greenhouse and Energy Auditors.
- **Low-risk projects** (project area of ≤200ha, under Schedule 1 new plantations or Schedule 2 conversion of short to long rotation forests) only require an initial audit and must accept geospatial monitoring and compliance checks conducted by the CER (CER 2024k).

11.1.11.2 Current uptake

Participation in this method is low. As of 28 February 2025, there were 120 projects across Australia registered under this method, of which 25 projects (or 20.8%) have been awarded 510,864 ACCUs in total. In Queensland, there are 3 projects registered using this method and none of these have received ACCUs. These projects are located in the Hinchinbrook shire, Fraser Coast region and Lockyer Valley region.

Fitch et al. (2022) identified in Figure 44 below the areas of Australia that would be suitable for conversion of short to long rotation forestry in **(a)**, and the areas capable of being developed for new plantation forestry in **(b).**

Figure 44: (a) Potential area for the conversion of short- to long-rotation plantations; (b) potential area for new plantation establishment



Source: Adapted from Fitch et al. (2022).

Furthermore, Fitch et al. (2022) estimated that the carbon sequestration potential across Australia (amount that is biophysically possible) via plantation forestry is 630 Mt CO_2e per year. Fitch et al. (2022) caveat this by positing that the economic sequestration potential is much lower at 31.8 Mt CO_2e per year (this is the economically feasible sequestration amount).

Evidently, there remains much larger project development potential in Queensland than that which has occurred to date.

Evidently, this method is limited in its suitability for primary producers located in the areas idenfied in green in the map above. Nevertheless, there remains much larger project development potential in Queensland than that which has occurred to date.

11.2 Reef Credit Scheme methods

Reef Credit scheme projects must be carried out in accordance with approved methodologies, which outline the implementation process, eligible activities and measurement methods. Currently, there are four available methodologies, including: (1) improved nitrogen use efficiency method (DIN method); (2) gully rehabilitation method (gully method); (3) grazing land management method; and (4) wastewater method. A fifth methodology, known as the constructed wetlands method, is currently being reviewed for approval. Furthermore, there are two new methodologies currently undergoing assessment, namely the method for determining reef credits from reduced hillslope erosion in grazing lands and the method for determining reduction in DIN and Fine Sediment using P2R Projector calculations.

The section below describes each methodology, and their requirements, which are in addition to the general Reef Credit scheme requirements already described above.

11.2.1 DIN

Projects using the DIN method[163] aim to reduce the loss of dissolved inorganic nitrogen (DIN) into the GBR catchment through improved soil and nutrient management practices (Eco-Markets 2024a).

Project scope

1. Eligible land uses: sugarcane, bananas, grains, fodder (not limited to these).
2. Crediting period: annually for 10 years.
3. Credit: 1 reef credit earned per kilogram of DIN prevented from entering the GBR catchment (Eco-Markets 2024a).

Project activities

Project activities that reduce DIN loss may include (but are not limited to):

- adjusting nitrogen application to match crop yield;
- reducing fertiliser rates;
- increasing fallow areas;
- improving fertiliser delivery;
- land use change to lower N input systems; and
- other practices like GPS-guided machinery, legume planting and/or zonal tillage (DIN Methodology v1.1; Eco-Markets 2024a).

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[163] The rules for the DIN method are set out in the *Method for accounting reduction in nutrient run-off through managed fertiliser application – version 1.1* dated 31 March 2020 and authored by James Schultz and Jennifer Sinclair (**DIN Methodology v1.1**)

Project land

Project land must:

1. have been cultivated and fertilised with nitrogen-based fertiliser during the baseline; and
2. be under the legal management of the project proponent (DIN Methodology v1.1).

Leakage

Leakage occurs if fertiliser application increases or there is or a move to higher risk land management practices outside the project area but on land managed by the same land owner/manager. Projects must assess and account for leakage risks each monitoring period.

Land Management Plan

A Land Management Plan must be prepared for the property, kept up to date throughout the crediting period and submitted at the end of each monitoring period with the application for reef credits (DIN Methodology v1.1). It must include:

- Maps and descriptions of baseline soil, nutrient and irrigation management activities including nitrogen application rates and fertiliser types;
- Description of soil, nutrient and irrigation management activities in each project monitoring period including N application rates and fertiliser types, and proposed future activities for the remainder of the crediting period;
- Impact analysis for land use changes to zero-N systems (if applicable).

Project accounting

The DIN method adopts a modelled approach using the Queensland Government Paddock to Reef Projector (**P2R projector**)[164] to estimate DIN loss in the baseline and monitoring periods (DIN Methodology v1.1). Reef credits are issued for each kilogram of DIN that is prevented from entering the GBR during the monitoring period. The model takes into account 'significant factors that influence DIN loss including soil, nutrient and water management activities, geomorphology, climate, soil type and spatial location' (DIN Methodology v1.1). These factors are measured throughout the project and the measurement data is inputted into the model.

The P2R projector is used to determine:

1. quantity of applied nitrogen lost as DIN for each year of the baseline period;
2. total nutrient loss rates for the monitoring period for each Reef Credit Accounting Zone (RCAZ) within the project area;
3. the proportion of applied nitrogen lost as DIN for the current project monitoring period (DIN Methodology v1.1).

The baseline scenario represents the conditions that would have continued if the Reef Credit scheme project was not undertaken and is based on the average annual DIN loss over the 7 years preceding the project state date using historical nitrogen fertiliser application rates. Evidence of fertiliser use during the baseline period must be provided by project proponents (DIN Methodology v1.1).

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[164] Truii (2024) *P2R Projector*, P2R Projector website accessed 28 March 2025; The P2R Projector is supported by the Queensland Government's Catchment Load Modelling Program.

Monitoring

Project proponents must submit a monitoring report each monitoring period and must monitor the project for compliance with the land management plan, document project activities undertaken and unplanned disturbances. Furthermore, documentary evidence of nitrogen application events during the monitoring period must be included (e.g. evidence of equipment calibration, date and rate of nitrogen application, fertilizer receipts, farm management diaries, soil testing results, and rainfall records) (DIN Methodology v1.1).

11.2.2 Gully

Projects using the gully method[165] involve gully rehabilitation within the GBR catchment aimed to reduce fine sediment run-off from rural landscapes.

Project scope

1. Eligible land: best suited to rural landscapes with gully erosion.
2. Crediting period: every 5 years for 25 years.
3. Credit: 1 reef credit is earned for every 538kgs of fine sediment prevented from entering the Reef catchment (Eco-Markets 2024a).

Project activities

The gully method aims to reduce sediment loss from gully erosion through rehabilitation. Interventions may include:

- engineered structures (rock chutes, grade controls);
- gully reshaping and capping;
- drainage diversion structures (e.g. contour-banks and flow-spreaders);
- soil amelioration (e.g. with gypsum and other non-toxic chemical stabilisers);
- revegetation of treated gullies and gully catchments;
- grazing management in treated gullies and gully catchments;
- other proponent-defined interventions (formalised in Gully Rehabilitation and Management Plan) (Gully Methodology v1.4).

Activities must follow the Reef Trust Phase IV Gully Toolbox, align with regional NRM Plans, avoid causing new erosion, comply with all laws and regulations, and include ongoing site maintenance and management of weeds and pest animals.

Project land

To qualify:

- during the baseline period, the land must have gully erosion contributing sediment to the GBR;
- current rate of gully erosion must not be attributed to post-2017 land management changes;

[165] The rules for the gully method are set out in the Method of accounting for reduction in sediment run-off through gully rehabilitation – version 1.4 dated 30 September 2020 and authored by Andrew Brooks, Timothy Pietsch, Robin Thwaites, John Spencer, James Daley, Nicholas Doriean, Justin Stout, James Schultz, Jenny Sinclair and Rachel Chiswel (**Gully Methodology v1.4**).

- gully erosion will continue without intervention; and
- project proponent must have legal right to manage land (Gully Methodology v1.4).

Exclusions

Ineligible treatments include:

- gully reshaping in sodic soils without the surface application of topsoil, mulch, or rock;
- gully plug dams;
- treatments that risk increasing downstream pollution;
- high intensity grazing on sodic dispersive/slaking alluvial soils; and
- any activities on the negative list outlined in the Reef Credit Standard or Method (Gully Methodology v1.4).

Project mapping

Proponents must map the project using any of the following either Aerial or Terrestrial LiDAR, UAV (drone)-derived photogrammetry, air-photo photogrammetry, ortho-rectified aerial photographs or satellite imagery, or cadastral database (Gully Methodology v1.4).

Leakage

Leakage occurs if erosion increases outside the project area but on land managed by the same land owner/manager. Proponents must assess and address this risk during project application and each monitoring period.

Gully rehabilitation and management plan

Each project must develop a Gully Rehabilitation and Management Plan that sets out the project design, implementation and monitoring, and must be signed off by a suitably qualified person[166]. The plan must contain:

- project design and engineering details;
- gully mapping and site access;
- stock and land management plans;
- maintenance plan (e.g. fire, pest and weeds);
- Workplace Health and Safety Plan;
- heritage/cultural assessment;
- soil analysis and projected fine sediment yields; and

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[166] A suitably qualified person means someone with the following qualifications and/or experience:

1. 'Professional training in the field of geomorphology and/or soil conservation; and/or
2. Is certified by one of the following professional bodies:
   a) EIANZ CEnvP Specialist Geomorphologist (Professional Geomorphologist certification developed by the Australian and New Zealand Geomorphology Group and EIANZ).
   b) Certified Practicing Soil Scientist (CPSS, Australian Soil Science Society)
   c) Certified Practicing Erosion and Sediment Control (CPESC, International Erosion Control Association); and/or
3. A person approved as suitably trained by the Reef Credit Secretariat' (Gully Methodology v1.4).

- a comprehensive project monitoring proposal[167].

Monitoring requirements

Monitoring must include:

- topographic surveys (e.g. repeat high-resolution aerial LiDAR survey, repeat terrestrial LiDAR survey, hand-held LiDAR surveys or equivalent);
- water quality/quantity monitoring (e.g. rain gauges, samplers, flow meters, cameras); and
- for gullies with a treated area > 1 ha an autosampler must be added.

Typically, monitoring will be required more frequently in the early years of a project, thereafter declining (e.g. water quality/quantity monitoring required annually for the first 3 years, declining thereafter; topographic monitoring will need to occur immediately after intervention and then at intervals of 5 to 10 years) (Gully Methodology v1.4).

Project accounting

Fine sediment yield reductions are estimated based on empirical and modelled data, including:

- empirical measurements of rainfall and water runoff;
- sediment production at gully head scarp modelled from retreat rates and change in gully area over time; and
- sediment transport loads using a combination of empirical data and modelling.

Record keeping

Project proponents must prepare and submit monitoring reports each monitoring period that document the project's compliance with the Gully Rehabilitation and Management Plan, land management activities and any unplanned disturbances to the project area (Gully Methodology v1.4, s 6). For example, proponents must report monitoring setup and water quality monitoring results, such as laboratory results, photos of equipment, flow hydrographs, and time-lapse camera imagery.

11.2.3 Grazing land management

Projects using the grazing land management method[168] aim to reduce fine sediment run-off into the GBR catchment by increasing pasture cover on grazing land, enhancing soil health, farm productivity, and resilience. Sediment reductions are based on a hillslope soil loss model, the Revised Universal Soil Loss Equation (RUSLE) model (Eco-Markets 2024a).

Project scope

1. Eligible land: best suited to grazing operations.
2. Crediting period: every 5 years for 25 years.
3. Credit: 1 reef credit is earned for every 538kgs of fine sediment prevented from entering the Reef catchment (Eco-Markets 2024a).

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[167] 'This must include a combination of some form of topographic monitoring, coupled with water quality and quantity monitoring that will enable sediment loads to be determined for the post intervention period' (Gully Methodology v1.4).
[168] The rules for the grazing land management method are set out in the Reef Credit method for accounting fine sediment abatement through improved grazing land management – version 1.0 dated September 2024 and lead authors being Ben Silverwood and Andrew Yates (**Grazing Land Management Methodology v1.0**).

Project land

- Land must have been primarily used for grazing for the 7 years before the project; and
- No broad scale clearing of woody vegetation took place on land within the last 7 years[169] (Grazing Land Management Methodology v1.0).

Project activities

Project activities must aim to reduce fine sediment loss by implementing improved grazing land management practices that increase ground cover, be consistent with regional NRM plans, comply with all laws and regulations, and demonstrate additionality. Activities may include (but not limited to):

- matching stocking to forage budgets;
- rotational grazing and wet season spelling;
- infrastructure investment, such as fencing and water;
- fire management; and
- land condition remediation (e.g. weed, pest control, pasture and nature vegetation management) (Grazing Land Management Methodology v1.0).

Exclusions

Projects cannot involve:

- irrigation;
- additional fertiliser use;
- broadscale clearing of woody vegetation; or
- activities on the negative list contained in the Reef Credit Standard (Grazing Land Management Methodology v1.0).

Additionality

Project proponents must use the Reef Credit Additionality Tool to demonstrate additionality. For example, if current reef regulations require a minimum standard of 50% ground cover, then only improvements above that minimum legal standard are eligible for credits (Grazing Land Management Methodology v1.0).

Leakage

Leakage occurs if erosion increases elsewhere in the reef catchment due to displacement of grazing activities. Proponents must assess and address this risk during project application and each monitoring period.

Grazing land management plan

Project proponents need to prepare a comprehensive Grazing Land Management (GLM) Plan that must be updated each monitoring period, detailing:

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[169] 'Land that has been broadly cleared of woody vegetation can be included in the RCAZ for a crediting period if the following conditions are met: at least 14 years must have passed since the last clearing of the land; and the 7 years immediately following the clearing must not be part of the baseline scenario used for assessing that land. This means that the land can be credited towards conservation goals after a 14-year period, provided the first 7 years after clearing are excluded from the baseline assessment' (Grazing Land Management Methodology v1.0).

- grazing enterprise and all land managed by the project proponent in the reef catchments;
- baseline grazing land management practices;
- leakage risk assessments and strategies;
- soil sampling and rainfall monitoring plans;
- mapping and spatial files (e.g. project area, land subject to risk of leakage, paddocks, ground cover trends, soil stratification, soil sampling locations, rainfall monitoring locations);
- planned project grazing land management activities and monitoring approaches (e.g. pasture biomass, forage budgets, stock numbers, leakage risk, disturbance events) (Grazing Land Management Methodology v1.0).

Project accounting

Credits are based on the difference in fine sediment runoff between the RUSLE[170] data for the project period and the baseline RUSLE data using historical ground cover data. RUSLE is a 'predictive model used to determine hillslope soil erosion rates by factoring in the effects of rainfall, soil type, slope, land cover, and conservation practices' (Grazing Land Management Methodology v1.0).

Monitoring and reporting

For each monitoring period, project proponents must prepare and submit monitoring reports documenting the projects compliance with the method and GLM plan, any disturbance events within the project area and all land management activities. Records of monitored data like rainfall, pasture biomass, forage budgets, grazing charts, stock movements, project management activities, disturbance events and broadscale clearing events must be maintained and reported (Grazing Land Management Methodology v1.0).

11.2.4 Wastewater

Projects using the wastewater method[171] involve using managed algal bioremediation to remove DIN in wastewater discharged from a site or facility (Eco-Markets 2024a).

Project scope

- Eligible land: best suited to municipal wastewater treatment, agricultural run-off and aquaculture facilities.
- Crediting period: quarterly for 15 years.
- Credit: 1 reef credit is earned for every kilogram of DIN prevented from entering the Reef catchment (Eco-Markets 2024a).

Project activities

Project activities must:

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[170] The rules for the wastewater method are set out in the *Method for accounting DIN reduction in wastewater through managed algal bioremediation operations – version 1.3* dated 3 August 2023 and authored by Dan Mulder and Nio Neveux (**Wastewater Methodology v1.3**).

[171] The rules for the grazing land management method are set out in the Reef Credit method for accounting fine sediment abatement through improved grazing land management – version 1.0 dated September 2024 and lead authors being Ben Silverwood and Andrew Yates (**Grazing Land Management Methodology v1.0**).

- use managed algal bioremediation to remove DIN;
- be located on or adjacent to an operational wastewater discharge site;
- comply with all laws and regulations (Wastewater Methodology v1.3, s2.3).

Project land

Project land must:

- include an operational site or facility that regularly discharges wastewater;
- be managed by the project proponent who is legally entitled to do so; and
- have sufficient space for the bioremediation system (Wastewater Methodology v1.3, s2.2).

Operations management plan

Project proponents must prepare an operations management plan outlining the DIN reduction strategies, which must be submitted each monitoring period. The plan must include:

- mapping of the project area at commences and for the monitoring periods;
- details of incoming water quality, DIN concentrations, and the water-quality monitoring programs;
- descriptions of project activities and expected DIN reductions; and
- information on compliance with legal and regulatory requirements in relation to any implemented wastewater treatment solution (Wastewater Methodology v1.3, s4).

Project accounting

The reduction in DIN due to project activities is measured by a monitoring approach based on flow variance, water management activities, seasonal impacts like rainfall and spatial. DIN reduction is calculated as the difference between incoming DIN mass and outgoing DIN mass discharged from the system location (Wastewater Methodology v1.3).

Uncertainty and leakage

- A 2% uncertainty factor is deducted from reef credits due to limits in accuracy of measuring equipment and testing methods of DIN levels.
- A 1% uncertainty factor on account of the risk of leakage is deducted from reef credits (Wastewater Methodology v1.3).

Wastewater management

Project areas using this method must be closed systems such as livestock production or processing facilities, municipal treatment plants, or aquaculture facilities, which are subject to licencing requirements (Wastewater Methodology v1.3, s5.6.3).

Monitoring and record keeping requirements

For each monitoring period, project proponents must prepare and submit monitoring reports documenting the projects compliance with the method, the operations management plan, any disturbance events within the project area and all land management activities. Documentary evidence of DIN reduction events during the monitoring period must be included in the reports, such as equipment calibration evidence, date and time records for DIN measurements, laboratory analysis documentation for incoming and outgoing water quality measurements, the facilities effluent volumes and rainfall records (Wastewater Methodology v1.3, s6).

DIN testing standards

Independent analysis by a NATA accredited laboratory is required for dissolved inorganic forms of nitrogen (i.e. ammonia, nitrite, and nitrate) or analysis following the Approved Methods for the Sampling and Analysis of Water Pollutants in Australia, specifically;

- ammonia concentration: APHA (1998) 4500-NH3;
- nitrite concentration: APHA (1998) 4500-NO2; and
- nitrate concentration: APHA (1998) 4500-NO3 (Wastewater Methodology v1.3, s6.1).

Collection of water samples, storage conditions and holding time must be completed in accordance with the DETSI 'Monitoring and Sampling Manual: Environmental Protection (Water) Policy' (2018).

Wastewater Volume Monitoring

All inflows and outflows of wastewater from the project area must be measured using fit-for-purpose flow meters, which must be installed and calibrated per section 6.3 of the methodology (Methodology v1.3, s6.3).

11.2.5 Constructed wetlands

The constructed wetlands method is currently under review and proposes to prevent DIN entering waterways in the GBR catchment by utilising constructed wetlands. Wetland treatment systems are designed to replicate natural processes of wetlands that minimise runoff and erosion and increase natural filtration by holding nutrient-laden water on-site longer (Eco-Markets 2025). The proposed project crediting period is 25 years and one reef credit is equal to 1 kg of DIN prevented from entering the Reef catchment.

11.3 Land Restoration Fund projects

Table 61: Summary of details of 26 projects contracted by the Land Restoration Fund in investment rounds 1 (2020), 2 (2021) and 3 (2023)

Project proponent	Location	ACCU method/s	Co-benefits	Description
Investment Round 1 (2020)				
Indigenous Land and Sea Corporation	Cook shire	Savanna fire management	Great Barrier Reef, Wetlands, Threatened ecosystems, Threatened wildlife, Native vegetation, Coastal ecosystems, Diversity and human rights, Employment and skills, Resilience and connectivity, First Nations participation, First Nations location	The Central Cape York Regional Savanna Fire Project is a 15-year, $28.85 million collaboration between the Queensland Government and the Indigenous Land and Sea Corporation on behalf of an alliance of Indigenous landholders. The Project aims to manage almost 1 million hectares of Cape York Peninsula under significantly improved fire regimes based on Indigenous cultural burning practices, whilst providing a meaningful increase in indigenous, environmental and socio-economic co-benefits in the area.
AgriProve Pty Ltd	Gladstone region	Soil carbon	Great Barrier Reef, Threatened ecosystems, Threatened wildlife, Soil health, Employment and skills	The Multi-species pasture cropping to sequester carbon in soil in Gladstone project is a 15 year, $779k collaboration between the Queensland Government and AgriProve Pty Ltd, improving soil health, reducing erosion, raising productivity and enhancing biodiversity, whilst delivering employment and social co-benefits in the area. The Mt Tom project will build organic carbon in the soil by increasing pasture biomass and cover, and by implementing grazing management practices that avoid erosion. The owners are fencing off waterways and riparian zones to keep stock out, allowing waterways to rehabilitate, whilst managing weeds with selective spraying. Soil carbon sampling will be conducted at intervals throughout the project period to measure the amount of carbon sequestered.
GreenCollar	North Burnett region	Avoided clearing of native regrowth and human-induced regeneration	Great Barrier Reef, Threatened ecosystems, Threatened wildlife, Native vegetation, Diversity and human rights, Employment and skills, Resilience and connectivity	The Beef and Conservation for the Future (BC4) Project is a 10 year, $2.1 million collaboration between the Queensland Government and GreenCollar. The Project aims to improve water quality in the Burnett River, improve the extent and condition of threatened ecosystems and threatened species habitat, improve landscape connectivity and demonstrate the financial and health benefits that can come from a diversified on-farm income. Goondicum Station is 7,000ha of prime agricultural land at the head of the Burnett River. The project involves two carbon methods that will protect 1,544ha of established native vegetation on land that has been historically cleared. The project will improve water quality runoff into the Burnett River, through the reduction of sediment and nutrients via timed, managed grazing practices and installation of new fences to reduce grazing pressure around creeks.
Indigenous Land and	North Burnett region	Reforestation by environmental	Great Barrier Reef, Coastal Threatened ecosystems, Threatened wildlife, Native vegetation, Diversity	The Environmental Plantings in the Burnett Catchment Project is a 16-year, $2.63 million collaboration between the Queensland Government and the Indigenous Land and Sea Corporation on behalf of an Indigenous landholder. The Project aims to create 160 hectares of environmental

Sea Corporation		or mallee plantings	and human rights, Employment and skills, Resilience and connectivity, First Nations location, First Nations participation	plantings on Mimosa Station, located near Gayndah, Queensland. Whilst building on existing land management skills, the project will provide opportunities for capacity building, training and employment in revegetation, monitoring and conservation for the Indigenous landholders of the property, and support the development of transferrable skills enhancing employment opportunities elsewhere.
CO2 Australia Limited	Goondiwindi region	Reforestation by environmental or mallee plantings	Native vegetation, Threatened ecosystems, Threatened wildlife	Restoring box-gum grassy woodland for threatened species of the Nandewar bioregion project is a 16 year, $1.96 million collaboration between the Queensland Government and Co2 Australia Limited to deliver over 100ha of degraded land restored to a natural functioning ecosystem, providing habitat for threatened species, landscape connectivity and climate resilience. The project area was originally grazed by sheep, which has resulted in severe degradation of the soil and vegetation. This project will revegetate the area to a healthy woodland capable of supporting threatened native wildlife. Income diversification from the project will allow the land manger to cease sheep grazing on the property, which, combined with pest animal management and weed control on site, will further assist with the establishment of the environmental plantings and enhance native species regeneration.
GreenCollar	South Burnett region	Avoided clearing of native regrowth	Great Barrier Reef, Native vegetation, Threatened ecosystems, Threatened wildlife, Diversity and human rights, Employment and skills, Resilience and connectivity	The Ivanhoe Timber Retention Project is a 5 year, $693k collaboration between the Queensland Government and GreenCollar. The Project aims to deliver environmental outcomes including improved water quality run-off, and extent and condition of threatened species habitat whilst diversifying on-farm income and extending socio-economic benefits to the community, through change in property management practices. Ivanhoe Station covers 2,892ha of prime agricultural country in the South Burnett. With above average rainfall, the landscape lends itself to diverse agricultural, silviculture and horticulture productivity. The owners previously relied on clearing vegetation in a regular cycle to make way for cattle grazing and timber harvesting. By retaining and supporting vegetation regrowth, instead of clearing it, the project will produce multiple co-benefits for the environment and the local economy.
GreenCollar	Banana shire	Avoided clearing of native regrowth	Great Barrier Reef, Native vegetation, Threatened ecosystems, Threatened wildlife, Diversity and human rights, Employment and skills	The Burnham Regenerative Production Project is a 10-year, $787k collaboration between the Queensland Government and GreenCollar. The Project aims to improve GBR water quality, threatened ecosystems and threatened species habitat by retaining and regenerating vegetation that have been historically cleared. The project will also support businesses and jobs in the local community.
APN Cape York	Aurukun shire	Savanna fire management	Wetlands, Coastal ecosystems, Threatened ecosystems, Threatened wildlife, Native vegetation, Diversity and human rights, Employment and skills, Resilience and connectivity, First Nations location, First Nations participation	The Northern Aurukun Savanna Burning Project is a 15-year, $8.49 million collaboration between the Queensland Government and APN Cape York. The Project aims to deliver emissions avoidance and enhanced health of environmental assets in the Cape York Peninsula through practicing traditional burning techniques and aiding cultural preservation whilst building skills, opportunities and socio-economic resilience for the community.

GreenCollar	Tablelands region	Human-induced regeneration	Threatened ecosystems, Threatened wildlife, Native vegetation, Employment and skills, Resilience and connectivity, First Nations participation	The Kinrara Dry Tropics Regeneration Project is a 15 year, $4.97 million collaboration between the Queensland Government and GreenCollar. The Project aims to enhance the significant biodiversity values of the region, strengthening financial resilience through diversification of on farm income and extending socio-economic benefits to the community, through change in livestock management and targeted regeneration activities. Kinrara Station has over 23,597ha of unique landscape incorporating a beef grazing and eco-tourism enterprise. The Project will see a shift from set stocking to timed, managed grazing in areas to allow the natural regeneration of native vegetation. The property adjoins Kinrara National Park and with the wetland protection areas on Kinrara, the project site is of high ecological significance.
CO2 Australia Limited	Douglas shire	Reforestation by environmental or mallee plantings	Great Barrier Reef, Threatened ecosystems, Threatened wildlife, Native vegetation, Employment and skills	Saltwater Creek Carbon Project is a 16-year, $3.74 million collaboration between the Queensland Government and CO2 Australia Limited to deliver improvement in the biodiversity levels, connectivity between remnant native vegetation, and water quality entering the local waterways and reaching the GBR, with added socio-economic benefits of employment and income generation for the region.
CO2 Australia Limited	Tablelands region	Reforestation by environmental or mallee plantings	Threatened ecosystems, Threatened wildlife, Native vegetation, Employment and skills, Resilience and connectivity	Tablelands Regional Integrated Agriculture Carbon Project is a 16-year, $7.43 million collaboration between the Queensland Government and CO2 Australia Limited to deliver improvement in the biodiversity levels, connectivity between remnant native vegetation, and water quality entering the local waterways and reaching the GBR, with added socio-economic benefits of employment and income generation for the region.
Investment Round 2 (2021)				
The trustee of DLF Family Trust	Paroo region	Human induced regeneration	Wetlands, Threatened ecosystems, Threatened wildlife, Native vegetation, Employment and skills, Community resilience, First Nations by location, First Nations by participation	The Murra Murra Native Forest Regeneration Project is a $5 million, 10-year partnership between the Queensland Government and The DLF Family Trust. The project will regenerate mulga and eucalyptus forests and wetlands on the Kooma homelands through destocking and the exclusion and control of stock and feral animals. The project activities will also restore or improve condition in over 17,000 hectares of threatened ecosystems from 13 different regional ecosystems.
AgriProve Pty Ltd	Rockhampton region	Reforestation by environmental or mallee plantings and soil carbon	Great Barrier Reef, Coastal Ecosystems, Threatened Ecosystems, Threatened Wildlife, Native Vegetation, Soil Health, Employment and Skills, Community socio-economic resilience	The Swartz Carbon Project is a $792,000, 15-year partnership between the Queensland Government and Agriprove. The project will combine soil sequestration with environmental planting to improve the health of soil and native vegetation ecosystems at Calliweera station, near Rockhampton. Increases in soil carbon and groundcover at the project site will aid water retention and reduce runoff and erosion, benefiting the GBR and surrounding ecosystems and wildlife. Environmental plantings will connect remnant native vegetation and improve habitat for over 30 threatened flora and fauna species identified on the property.
Christophe Bur	Fraser Coast region	Avoided clearing of native regrowth	Great Barrier Reef, Wetlands, Threatened wildlife, Native vegetation	The ZP LRF projects is a $147,900, 5-year partnership between the Queensland Government and Mr Christophe Bur. The project will use the avoided clearing method to sequester carbon in existing native forests, prevent sediments flowing to the reef, increase threatened species habitat – including for koalas – and improve the condition of soil and vegetation around creek banks.

Gondwana Rainforest Trust	Douglas shire	Reforestation by environmental or mallee plantings	Threatened ecosystems, Threatened wildlife, Native vegetation, Employment and skills, Diversity and human rights, First Nations participation, First Nations location	The Reforesting Wawu Dimbi (Place of Spirits) Daintree Project is a $1.35 million, 15-year partnership between the Queensland Government and Gondwana Rainforest Trust. The project will employ 12 Indigenous people to undertake a reforestation project on 39 hectares of land in the Daintree. Jabalbina Yalanji Aboriginal Corporation will partner with the project to deliver training and employment outcomes for young Kuku Yalanji people working on Country. The project will restore cleared land into a functional rainforest ecosystem and create new habitat for endemic species including the endangered Southern Cassowary.
GreenCollar	Banana shire	Avoided clearing of native regrowth	Great Barrier Reef, Threatened ecosystems, Threatened wildlife, Native vegetation, Diversity and human rights	The Nioka Native Vegetation Project is a $878,500, five-year partnership between the Queensland Government and Greencollar. The project, situated on a 2,000 hectare organic beef farm in the Brigalow Belt, will protect 472 hectares of native vegetation that has historically been cleared for grazing. By retaining vegetation, the project will reduce sediment flowing to the GBR and provide potential habitat for threatened species including glossy black cockatoos and koalas.
South Endeavour Trust	Tablelands region	Reforestation by environmental or mallee plantings	Great Barrier Reef, Threatened ecosystems, Threatened wildlife, Native vegetation, Employment and skills	The Rock Road Wildlife Corridor project is a $2.95 million, 16-year partnership between the Queensland Government and South Endeavour Trust. The Project involves the planting of 204,000 trees over 60 hectares to deliver a state significant wildlife corridor in the uplands of the Atherton Tablelands. The Project will complete a 1.8km long, 800m wide corridor that will support the free movement of a range of threatened and near-threatened wildlife to and from the World Heritage Area.
GreenCollar	Murweh shire	Avoided clearing of native regrowth	Wetlands, Threatened ecosystems, Threatened wildlife, Native vegetation, Employment and skills, Resilience and connection, Diversity and human rights	The Calabah Native Vegetation Project is a $1.23 million, five-year partnership between the Queensland Government and GreenCollar. The avoided clearing project will protect native vegetation across four aggregated grazing properties spanning 4,706 hectares. By improving interconnectedness of native vegetation, the project will provide important refuges for declining wildlife and enhance the condition and resilience of threatened ecological communities in the heart of the Mulga Lands Bioregion.
Investment Round 3 (2023)				
Landscape Ecological Services Pty Ltd	Cairns region	Reforestation by environmental or mallee plantings	Great Barrier Reef, Wetlands, Coastal Ecosystems, Threatened Ecosystems, Threatened Wildlife, Native Vegetation, Employment and Skills, Local & Community Benefits	The Babinda Swamp Forest Restoration Project is an 11-year, $1.5 million collaboration between the Queensland Government and Landscape Ecological Services Pty Ltd. The project aims to restore 35 hectares of endangered ecosystems, wetland vegetation and threatened species habitat, while delivering socio-economic co-benefits by upskilling and employing regional workers, bringing new income streams to the community, and building local expertise in delivering environmental projects.
South Endeavour Pty Limited as trustee for South Endeavour Trust	Tablelands region	Reforestation by environmental or mallee plantings	Great Barrier Reef, Wetlands, Threatened Ecosystems, Threatened Wildlife, Native Vegetation, Employment and Skills, Local & Community Benefits	The Rainforest Restoration to Join World Heritage Listed Maalan and Wooroonooran National Parks Project is a 16-year, $1.905 million collaboration between the Queensland Government and South Endeavour Trust. The project will replant 35 hectares of endangered high-altitude rainforest on the Atherton Tablelands to create a wildlife corridor between the World Heritage listed Maalan and Wooroonooran National Parks, benefiting threatened and near threatened species, restoring riparian vegetation within the Great Barrier Reef catchment, and providing jobs for First Nations people.

GreenCollar	Murweh shire	Human-induced regeneration	Threatened ecosystems, native vegetation	The Drysdale Family Nature Legacy Project is a 5-year, $1.54 million collaboration between the Queensland Government, GreenCollar, and the Drysdale family. The project aims to regenerate and retain native vegetation including threatened ecosystems where Gidgee and Brigalow Regional Ecosystems meet. The project aims to restore native vegetation through improved grazing management practices to enhance the biodiversity values of the region including potential habitat for koalas and restoring habitat next to the Parrattamow Creek Nature Refuge, and to strengthen on-farm financial resilience for future generations.
Wintergreen Capital Pty Ltd as trustee for Wintergreen Capital Trust	Tablelands region	Reforestation by environmental or mallee plantings	Great Barrier Reef, Threatened Ecosystems, Threatened Wildlife, Native Vegetation, Employment and Skills, Local & Community Benefits	The Restoration of High-altitude Cloud Forest for Threatened Species and Connectivity - Atherton Tablelands Project is a 16-year, $1.224 million collaboration between the Queensland Government and the Wintergreen Capital Trust. The project aims to restore full rainforest cover in the Upper Barron by closing two gaps in a large contiguous area of high-altitude rainforest. The project will benefit threatened and near threatened species, restore riparian vegetation within the Great Barrier Reef catchment, and provide jobs for First Nations people.
Emerald Forest Land Pty Ltd as trustee for Emerald Forest Land Trust	Tablelands region	Reforestation by environmental or mallee plantings	Great Barrier Reef, Threatened Ecosystems, Threatened Wildlife, Native Vegetation, Employment and Skills, Local & Community Benefits	The Rainforest Restoration to part complete a corridor between Tumoulin and Maalan National Parks Project is a 16-year, $1.41 million collaboration between the Queensland Government and Emerald Forest Land Pty Limited as trustee for the Emerald Forest Land Trust. The project aims to contribute to the restoration of a priority wildlife corridor between Tumoulin and Maalan National Parks on the Southern Atherton Tablelands. This will involve the planting of 75,000 trees over 22 hectares of historically cleared rainforest. The project will benefit a range of threatened species including Cassowary, Spotted-tail Quoll, Lemuroid Ringtail Possum, and a number of threatened rainforest frog species.
Rainforest Rescue	Douglas shire	Reforestation by environmental or mallee plantings	Great Barrier Reef, Wetlands Coastal Ecosystems, Threatened Ecosystems, Threatened Wildlife, Native Vegetation, Employment and Skills, First Nations participation	The Tranquillity Upper Daintree Restoration Project is a 15-year, $1.38 million collaboration between the Queensland Government and Rainforest Rescue. The project aims to restore approximately 30 hectares of historically cleared land in the World Heritage Upper Daintree. The rainforest species planted for the project will be collected from the Rainforest Rescue portfolio of properties in the Daintree and propagated at their Cow Bay Nursery. The plantings will restore ecosystems and create new habitat for wildlife while sequestering carbon and delivering environmental co-benefits. Rainforest Rescue will partner with Jabalbina Yalanji Aboriginal Corporation to deliver training and employment opportunities that will support their organisational plans and restoration goals.
Kowanyama Aboriginal Shire Council	Carpentaria Shire Cook Shire	Savanna Fire Management 2018 (sequestration and emissions avoidance)	Wetlands, Threatened Ecosystems, Threatened Wildlife, Native Vegetation, Employment and Skills, Local & Community Benefits, First Nations location, First Nations participation	The Oriners - Sefton Culture Carbon & Co-Benefits Savanna Burning Project is a 6-year, $6.56 million collaboration between the Queensland Government and Kowanyama Aboriginal Shire Council. The project aims to improve the ecological condition of wetlands, threatened species habitat, threatened ecosystems and native vegetation while upskilling Indigenous employees and creating opportunities to work on Country through the delivery of fire management activities. The project will carry out baseline biodiversity inventory and feral animal management and will measure and verify its outcomes using the Accounting for Nature ‘savanna condition’ method.

Green Collar	North Burnett region	Avoided clearing of native regrowth	Great Barrier Reef, Coastal Ecosystems, Threatened Ecosystems, Native Vegetation, Employment and Skills	The Lochern Avoided Clearing Land Restoration Fund Project is a 5-year, $2.8 million collaboration between the Queensland Government and GreenCollar. The project aims to protect 1,937 hectares of native vegetation, including state and regionally significant biodiversity corridors, that has historically been cleared. By retaining and regenerating native vegetation, the project aims to improve the condition of threatened ecosystems, and improve landscape connectivity, while strengthening financial resilience for the property's landholders through diversification of on-farm income.

Source: Adapted from Queensland Government Land Restoration Fund Register (2025c)

Table 62: Summary of methodologies available under the Reef Credit Scheme

Methodology	Improved nitrogen use efficiency (DIN method)	Gully rehabilitation (Gully method)	Grazing land management method	Wastewater method	Constructed wetlands method (*draft method under assessment*)
Pollutant	DIN	Sediment	Sediment	DIN	DIN
Reef credit	One reef credit is earned for every kilogram of DIN prevented from entering the Reef catchment.	One reef credit is earned for every 538kgs of fine sediment prevented from entering the Reef catchment.	One reef credit is earned for every 538kgs of fine sediment prevented from entering the Reef catchment.	One reef credit is earned for every kilogram of DIN prevented from entering the Reef catchment.	One reef credit is earned for every kilogram of DIN prevented from entering the Reef catchment.
Best suited to	Sugarcane	Rural landscapes with demonstrated gully erosion	Grazing operations	Municipal wastewater treatment, aquaculture facilities and agricultural run-off	
Activities	Soil and nutrient practice change	Landscape rehabilitation and construction	Fine sediment savings through improved grazing land management practices	Algal bioremediation at sewerage treatment plant	Utilise constructed wetlands to prevent dissolved inorganic nitrogen from entering waterways
Project Crediting Period	Every year for 10 years	Every 5 years for 25 years	Every 5 years for 25 years	Quarterly for 15 years	25 years
Independent Audit & Credit Issuance	Annually	On rainfall event	On rainfall event	Quarterly	On rainfall event
Project activities	Project activities include (but are not limited to): • efficient nitrogen fertiliser application • maintenance of green trash blanket including as fallow cover on final ratoon • machines and implements operating on the same wheel spacings under GPS guidance • maintaining row widths at 1.8 - 2 metres	Gully rehabilitation interventions may include: • engineered control structures • gully reshaping or capping • drainage diversion structures • soil amelioration • revegetation • grazing management • any other interventions undertaken to rehabilitate gullies	Project activities may include: • matching stocking to forage budgets • rotational grazing and wet season spelling, 'period of rest' • infrastructure investment i.e. fencing and water • fire management • land condition remediation i.e. pasture and nature vegetation management, weed	Project activities must: • remove the quantity of DIN through a managed algal bioremediation solution • be located within or adjacent to a site or facility discharging wastewater, that was operational during project activities be compliant with all federal, state and local government regulations.	

	• planting sugarcane fallow land to legumes or alternative crops • zonal tillage		control, feral animal control • other interventions undertaken to increase ground cover and land condition		

Source: Adapted from Eco-Markets (2025)

11.4 Nature Repair Market Scheme method

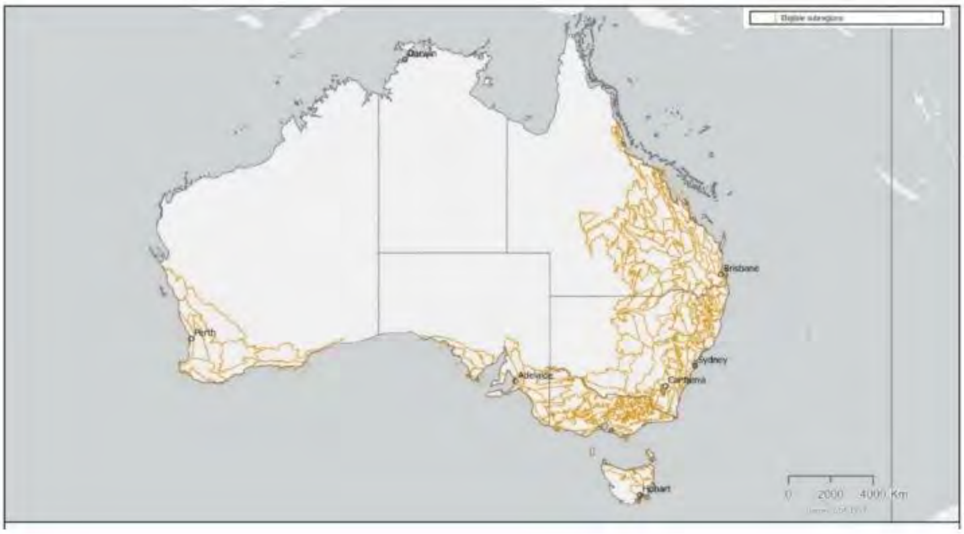
The replanting native forest and woodland ecosystems method is the first (and currently only) method available under the Nature Repair Market. Projects under this method[172] are designed to enhance or protect biodiversity in native species by replanting native forest and woodland ecosystems on historically cleared land in a way that will improve the extent and condition of native vegetation or support ecological connectivity (s6 *Replanting Methodology 2025*). The period for achievement of the project outcome is 25 years after the initial plantings (s10 *Replanting Methodology 2025*).

The method rules detail several requirements regarding planting activities, Aboriginal persons or Torres Strait Islanders engagement[173], how to measure biodiversity, and monitoring, record keeping and reporting requirements (CER 2025c).

Land eligibility requirements

Projects can take place on land without native forest cover that was previously cleared. The eligible regions are illustrated in Figure 45 below.

Figure 45: Map of regions that are eligible under the method



Source: Adapted from CER (2025c)

Relinquishment

Relinquishment of a biodiversity certificate can be required by the CER if:

- the project is cancelled prior to the expiration of the permanence periods; and
- the biodiversity outcomes are reversed through non-natural disturbance such as mismanagement of the project or clearing vegetation (CER 2025c).

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[172] The rules for this method are set out in the *Nature Repair (Replanting Native Forest and Woodland Ecosystems) Methodology Determination 2025* (**Replanting Methodology 2025**).

[173] Project proponents must engage appropriately with relevant Indigenous representatives on the design and implementation of the project **if the project area is subject to Indigenous land interests**, including native title areas, Aboriginal land rights land, areas subject to an Indigenous Land Use Agreement, or areas of land with undetermined claimant applications (within the meaning of the *Native Title Act* 1993) (CER 2025c). 'However, if there are no land interests, the project proponent may still engage with relevant Aboriginal persons or Torres Strait Islanders for the project area in relation to the design and implementation of the replanting project. This would also contribute to the project being designed and implemented in a culturally informed way' (CER 2025c).

Starting state assessment

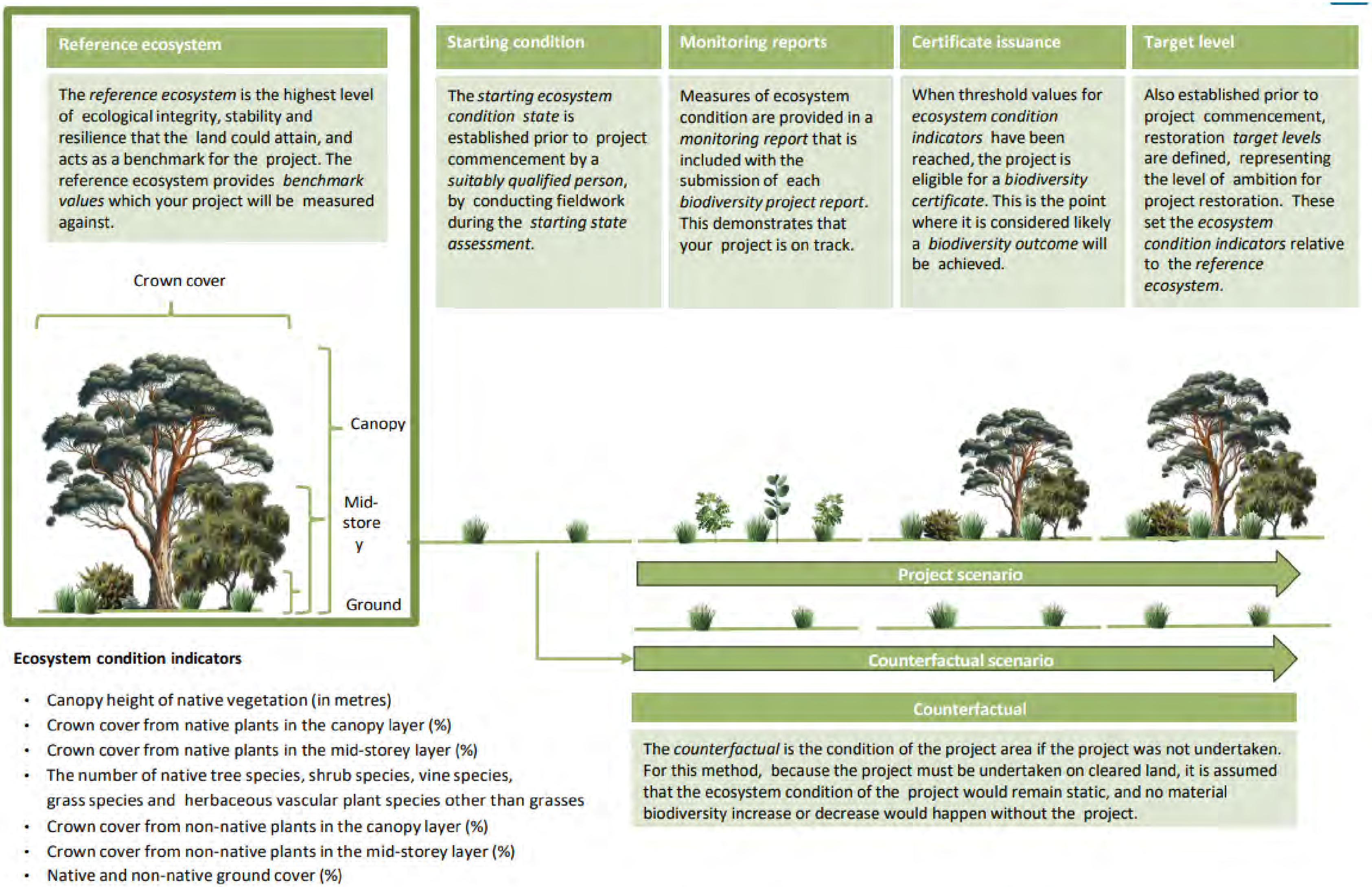
Project proponents must engage a suitably qualified person[174] to conduct a starting state assessment (involves a field survey and ecosystem assessment), develop a project plan, and be involved in monitoring and preparing monitoring reports throughout the project (CER 2025c).

Project outcomes

Project proponents must track the project area's ecosystem condition to deliver the biodiversity outcome (CER 2025c). Ecosystem condition refers to project land condition, which is tracked by measuring a range of ecosystem condition indicators at key stages throughout the project. These indicators are compared against reference ecosystems and benchmark values. Once the ecosystem condition indicators reach certain threshold values, project proponents can apply for a biodiversity (CER 2025c). This process is illustrated in Figure 46 below.

[174] Suitably qualified person means someone with qualifications in ecology, botany or an equivalent discipline; at least 3 years, post the award of the qualification, working as an ecologist or botanist or equivalent; and who has practised as an ecologist or botanist or equivalent within the past 3 years (CER 2025c).

Figure 46: Timeline of ecosystem condition through key checkpoints



Source: Adapted from CER (2025c)

Culturally significant entities

Project proponents can undertake, at their option, a project aiming to produce a biodiversity outcome that is also informed by the enhancement or protection of culturally significant entities, which are places, things, matters or processes within the project area that are culturally significant to Aboriginal persons or Torres Strait Islanders (e.g. a totem species) (CER 2025c).

Management activities

Project proponents must undertake management activities to support the achievement and maintenance of the biodiversity outcome and to minimise threats. Fire can be used as a management tool in the project area provided specific method requirements are met. Grazing pressure must be carefully managed throughout the project, and until the plantings are established (90% of trees reach 1.5m in height), livestock grazing must be excluded. No earlier than 10 years after the project registration, ecological thinning may be conducted provided it aligns with achieving the biodiversity outcome (CER 2025c).

Prohibited activities

Project proponents must not, throughout the permanence period:

- disposed, dump of burn rubbish within the project area;
- conduct any ground and rock disturbance, including ploughing, ripping or equivalent, other than that which is necessary for establishing plantings; and
- destruct or remove native plant biomass, including woody debris, standing dead trees, rocks, soil, fruits, nuts, and seeds (with some exceptions, including using some fallen timber for personal use, thinning for ecological purposes, harvesting of fruits, nuts and seeds, and activities conducted in accordance with traditional Indigenous practices or native title rights) (CER 2025c).

Reporting, auditing and certificate issuance

Project proponents must report at least every 5 years. Reporting includes:

- Category B report – to be submitted at least every 5 years when a biodiversity certificate hasn't been issued. The report must include an assessment of the project implementation against the project plan.
- Initial category A report – must be submitted with an application for a biodiversity certificate. An audit, prepared by a registered greenhouse and energy auditor, must also be provided.
- Subsequent category A report – must be submitted at least every 5 years from issuance of a biodiversity certificate and must provide an assessment of the project implementation against the project plan (CER 2025c).

Stacking

Project proponents seeking to register a stacked project under both the ACCU scheme and Nature Repair Market scheme must submit 2 separate applications to CER and comply with the separate methodologies and legislative requirements under each scheme (CER 2025c). A project that generates ACCUs by sequestering carbon in woody vegetation and debris (such as a project using the Reforestation by Environmental and Mallee Plantings – FullCAM 2024 method) can also generate a biodiversity certificate under the Nature Repair Market scheme 'for the biodiversity outcome from improvement in the extent and condition of native vegetation' (CER 2025c). However, to be eligible for this stacking opportunity, project proponents must submit the ACCU project registration application first (CER 2025c). If project proponents start planting trees for a Nature Repair Market biodiversity project and have not registered an ACCU project, the project proponent will not be able to claim the carbon benefit from the plantings (CER 2025c).

11.5 Cassowary Credit Scheme method

The rainforest replanting method[175] is the scheme's first method and was released in May 2025. The method involves planting stems or direct seeding on heavily modified or cleared land to improve rainforest condition and extent in the Australian Wet Tropics Bioregion. The project crediting period is 25 years and the permanence period is at least 25 years. Project activities include site preparation and fencing, planting and direct seeding, and ongoing maintenance. The project is credited by calculating Condition Improvement Units by measuring the change in rainforest condition over the project management area.

Eligible activities

Projects must:

- be located in the Wet Tropics Bioregion, in locations where the pre-clearing Broad Vegetation Group is classified as 'Rainforest and scrubs', and project land cannot contain existing remnant native vegetation or high value regrowth. Furthermore, project land cannot have been deliberately cleared within 5 years prior to the project application (unless ownership changed subsequent to clearing);
- comply with laws and regulations;
- be new rainforest plantings similar to natural rainforest;
- allow access by native rainforest biodiversity to the project area (unless the rainforest replanting requires protection);
- only use wildlife friendly netting, fencing or other infrastructure;
- holes created prior to planting must be filled or checked daily 24 hours after creation;
- plantings must be rainforest plant species native to the project area or widely accepted as being native to the surrounding geographic area or that could occur naturally under plausible scenarios of climate change for the project area; and
- not cause loss or degradation of rainforest biodiversity outside of the project area (Rainforest Replanting Method v1.1).

Approved operator

Project proponents must engage an Approved Operator (except if Eco-Markets Australia grant approval for another operator) to:

- undertake project activities including preparing and planting the site and conducting ongoing maintenance;
- to provide seeds/seedlings for replanting;
- to draft the project plan, permanence plan, monitoring reports, protection notifications and to apply for credits; and

[175] The rules for the rainforest replanting method are set out in the Rainforest Replanting Methodology for the Cassowary Credit Scheme Version 1.1 dated May 2025 and authored by Cath Moran, Bronwyn Robertson, Penny Scott, Don Butler, Kylie Freebody, Keith Smith and Travis Sydes (**Rainforest Replanting Method v1.1**).

- to conduct monitoring throughout the project (Rainforest Replanting Method v1.1).

Prohibited activities

Projects under the scheme must not:

- take place in locations designated for future clearing (e.g. transport corridor);
- involve planting potentially invasive non-native plant species;
- pose risk to native fauna, flora and ecosystems;
- cause decline in native ecosystem conditions; and
- degrade or move (for the purpose of generating a lower baseline condition) native vegetation (Rainforest Replanting Method v1.1).

Project accounting

Project accounting occurs by quantifying the change in condition of the project planting over time. Condition is determined by measuring several indicators including native tree canopy cover, species richness of native plant recruits, and density of medium-large stems of native trees (Rainforest Replanting Method v1.1). Non-native grass cover and non-native plant abundance must be kept below specified threshold levels throughout the project. During the project, compulsory field measurements of the condition indicators must occur for the baseline condition and 5, 10, 15 and 25 years after the initial planting. The baseline condition is the condition of the site prior to the project activities being undertaken (typically zero) (Moran et al. 2025). Target scores are set for the condition indicators and are detailed at Appendix C of the method rules (Rainforest Replanting Method v1.1). If a project achieves a change in condition above the target level in years and maintains non-native grass cover and non-native plant abundance below threshold levels, then cassowary credits can be claimed based on field measurements (Moran et al. 2025). Cassowary credits can only be applied for after 2 years from the initial planting (Rainforest Replanting Method v1.1).

Only rainforest condition improvement attributable to the Cassowary Credit scheme project activities will be awarded credits (and not a benefit that would have accrued in the absence of the project). This is calculated by measuring the change in condition in a counterfactual scenario. For example, where an ACCU scheme reforestation by environmental planting project is undertaken together with a Cassowary Credit scheme rainforest replanting method project, the counterfactual scenario will account for the rainforest condition of the ACCU scheme planting that must achieve at least 20% canopy cover and the associated stem density, pursuant to the ACCU scheme requirements. Any canopy cover and stem density exceeding that threshold and any condition score reflecting native plant recruitment (which is not an ACCU scheme requirement) will be attributed to the Cassowary Credit scheme project (Moran et al. 2025).

Deductions

- Risk of reversal buffer: 5%. Retained by Eco-Markets Australia; and
- Withholding credits: 5%. These credits are retained by Eco-Markets Australia until the end of the 25-year crediting period, upon which the withheld credits are released to the project proponent, provided all project targets are met (Rainforest Replanting Method v1.1).

Monitoring and reporting

Monitoring of projects must be performed by an Approved Operator with monitoring reports recording the compulsory field measurements due in years zero, 5, 10, 15, 20 and 25. Monitoring reports are also required to accompany an application for cassowary credits. Monitoring reports must assess the rainforest condition indicators in relation to the target scores and non-native grass cover and non-native plant abundance in relation to the threshold values (Rainforest Replanting Method v1.1).

Furthermore, project proponents must prepare several additional reports including a report of the baseline condition and the commencement of project activities, annual reports, and notification of planting dates and any protections or reversals (Rainforest Replanting Method v1.1).

Current uptake

Currently, there is one project using the rainforest replanting method being conducted by the Cassowary Coast Regional Council, which is also undertaking an ACCU scheme project on the same parcel of land. The project area is 1 ha.