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Frameworks for Carbon Sequestration with Improved Accessibility for Graziers

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Executive Summary

In the face of escalating environmental challenges, including climate change and biodiversity loss, there is an urgent need to develop innovative frameworks that encourage and reward carbon sequestration and responsible environmental management by landholders.

The Australian Carbon Credit Units (ACCU) Scheme, formerly known as the Emission Reduction Fund (ERF), constitutes a voluntary initiative encouraging the adoption of practices and technologies for emissions reduction and removals through carbon sequestration. It plays a pivotal role in incentivizing landholders, communities, and businesses to undertake projects that mitigate greenhouse gas emissions.

To date, carbon sequestration methods developed by the Australian Government have certain limitations which represent a barrier-to-entry for land managers who may otherwise participate in carbon sequestration projects. Given the expansive area occupied by grazing enterprises in Australia, this sector offers significant potential for large scale carbon abatement. As such, there is a need to devise strategies aimed at incentivizing responsible land management practices while simultaneously minimizing the obstacles that may hinder participation in emerging ecosystem service markets. This effort seeks to strike the balance between encouraging sound land management practices and ensuring sustainable agricultural production.

This report aims to identify and address existing gaps in the ACCU Scheme method options by conceptually developing novel approaches that can bridge these gaps, ultimately expanding opportunities for landholders to engage in carbon markets.

Despite the widespread appeal of the ACCU Scheme, land managers face notable barriers-to-entry into the market. In particular, vegetative regeneration methods, such as the recently retired Human-Induced Regeneration (HIR) method, have restrictively narrow definitions pertaining to what can and cannot count towards sequestration. For instance, the HIR method has the requirement that sequestration can only be counted in land that achieves and sustains forest cover. In this case, forest (or forest cover) is defined as native vegetation that is above 2m in height and with more than 20% canopy cover. This threshold may not align with the production objectives of land managers, especially on landscapes where forest cover is not compatible or achievable. Limitations such as these may exclude land managers from participating meaningfully in the carbon market, and may limit abatement opportunities because they are seen to be incompatible with ongoing grazing activities.

There is no clear reason, from a carbon sequestration perspective, why it is necessary to achieve forest cover to quantify abatement and generate carbon credits. Indeed, providing flexibility by removing the forest cover threshold might accommodate land managers whose lands are not conducive to reaching the 20% threshold but could still contribute to additional carbon sequestration. For example, land that currently has <5% canopy cover that may have the potential to support a woodland with 15% canopy cover, could achieve a minimum 10% increase in tree cover with associated carbon sequestration potential. However, without a financial incentive, the land remains cleared.

The key enabling requirement is an ACCU Scheme regeneration method that does not require 20% canopy cover thresholds to be met. If this was available, a land manager would have an incentive to remove the activities that are suppressing regeneration and support the woodland's growth to its 15% canopy cover potential, or otherwise be maintained at a predetermined level that is compatible with

livestock production goals. In turn, offsets (such as ACCUs) or insets (removals against the business's emissions profile) could be awarded for any new and additional sequestration.

Secondly, land that already meets the definition of forest cover is ineligible under vegetative methods such as the HIR method. For degraded forest land, there are no vegetative methods that incentivise regeneration of this forest from its current degraded state to its potential ecological benchmark. For example, degraded forest that currently has 40% canopy cover, and an ecological benchmark condition of 60% canopy cover, has potential for regeneration. An increase in canopy cover in this instance would also have the co-benefits of enhancing biodiversity and ecosystem services, along with sequestering additional carbon. If methods were available that made regeneration of degraded forest an eligible activity, then the restoration of native forests, such as pockets of remnant forest on or adjacent to grazing land, would be financially incentivised and potentially economically viable.

A key consideration in addressing these barriers is the potential attractiveness of partial regeneration as a solution, which not only promises environmental benefits but also holds the potential to release large tracts of land for mixed land uses, balancing sequestration goals with primary production. In answering the need for more accessible carbon project opportunities, two distinct frameworks have been conceptually developed:

i) restoring degraded forests to their ecological benchmarks, and ii) regenerating sparse woody vegetation cover on otherwise cleared (or mostly cleared) land.

This report will not only delineate the conceptual foundations of these frameworks but will also provide a roadmap for future development, assess their limitations, and outline potential policy issues. Within the agricultural sector, carbon abatement projects are not viable unless they maintain or improve agricultural production and land value and/or provide a financial incentive that makes the project economically viable. The frameworks effectively solve the issues of previous restrictive methods by removing unnecessary thresholds and providing the option for offsetting or insetting, which aim to incentivise the frameworks' uptake. The conceptual development of these frameworks contributes to the evolution of land management strategies that harmonize ecological sustainability with the needs of landholders to meet broader environmental objectives.

Restoring Degraded Forests Framework

This framework enables degraded forests to be restored to their ecological benchmarks and quantifies the increase in carbon sequestration. This framework aims to incentivise restoration of degraded forests by quantifying new and additional carbon sequestration from active forest restoration. The framework recognises the gap in potential sequestration between a forest in a degraded state, and that forest's ecological benchmark. As the forest is restored, the additional carbon is modelled and measured: carbon sequestration is quantified as the composition and structure of the forest improves towards its ecological benchmark, resulting in increased rates of carbon sequestration and healthier vegetation communities. Forest restoration techniques may include active forest management and the removal or management of forest cover suppressors, such as unrestrained grazing.

Key Technical Features

Proposed quantification method:

- Forest growth model (e.g., 3-PG) with defined and verified presets for key Australian forest species.

Key departures from the HIR method include:

- The quantification and verification approach could be used for either insetting or offsetting.
- The absence of the forest cover threshold (i.e., the 20% canopy cover rule) or requirement for land to be free of forest cover to be eligible in a CEA. The method would operate in forest land (>20% canopy cover).
- In addition to removing vegetation suppressors, the proponent may actively support regeneration through activities such as weeding, conducting cool burns, seeding or planting tube-stock of woody vegetation that is native to the area, adding tree guards to protect saplings, and other activities that protect native vegetation.
- The land used for this framework must, at an early stage in the project's life, have a measured and verified baseline, from which a starting point can be established. This will include evidence that:
 - the CEA has been classified as degraded forest in the baseline period,
 - the CEA included forested land that remained in a relatively stable state of degradation (i.e., any state below its ecological benchmarks) for a satisfactory proportion of the baseline period,
 - the degradation of the forest is due to suppression activities,
 - that the removal of suppression activities will promote forest restoration,
 - that restoration will correspond to an increase in canopy cover,
 - there are plans in place to reasonably manage the threat of sequestration reversal (caused by natural factors such as fires, drought, or diseases), and
 - the natural ecological benchmarks and associated attainable canopy covers (accepting reasonable margins for error) for the vegetation communities in the CEAs have been reported by an experienced professional (i.e., a person with an ecology, botany, biology, environmental science, or equivalent tertiary qualification and experience in applied ecology).
- Canopy cover and ecology metrics (including aspects such as species richness, abundance, and the overall vegetation composition and structure) must be recorded early in the project's life, and for a widespread array of points across the project area – these figures will contribute to the development of a baseline starting point.

Hypothetical Case Study

Framework	Restoring Degraded Forests Framework
Location	Central Far North Queensland
Rainfall (annual long-term average)	700 mm
Dominant woody vegetation	Acacia (wattle) woodland, with some eucalypt and melaleuca woodland
Total carbon estimation area	24,000 ha
Baseline canopy cover (average)	25%
Baseline land use	Grazing
Estimated attainable canopy cover, based on known ecological benchmarks	60-80%
Suppression activities	Unrestricted heavy grazing; overstocking; poor fire management
Suppression management activities	Additional exclusion fencing; additional water points; rotational grazing and paddock spelling;

	cool burns; cattle browsing grasses (reducing fuel loads); reduced stocking density (later)
Restorative management activities	Targeted weeding; targeted seeding of native woody vegetation in patchy areas;
Final canopy cover (at 25 years)	70%
Change in canopy cover (over 25 years)	+45%
Quantification methods	Not determined. May be possible to use models such as 3-PG or direct measurement

Regenerating Sparse Woody Framework

The framework quantifies regeneration, or partial regeneration, without the requirement of the forest exceeding 20% canopy cover thresholds. This framework aims to incentivise the partial regeneration of land whilst allowing for canopy cover density to be capped, either by natural factors or active management (e.g., thinning). This framework recognises that many proponents cannot justify the loss of primary productivity that may be associated with regenerating land beyond 20% canopy cover. In many instances, it may be possible for the proponent to maintain a sufficient level of primary productivity while simultaneously partially regenerating land (i.e., increase forest canopy cover, but not beyond 20%, and maintaining it at this predetermined density). The carbon sequestered via the growth of the forest is modelled, and the framework allows for the proponent to maintain the forest at the predetermined density. This option may increase the accessibility of the carbon market, opening it up to a large area of land - particularly cleared grazing land where the increase of forest cover would not adversely impact grazing, providing canopy cover is limited to a density below 20%. The removal of the 20% canopy cover threshold may prove to be a removal to a significant barrier-to-entry for many landholders.

Key Technical Features

Proposed quantification method:

- FullCAM operates by modelling the growth curve of regenerating vegetation. Many parameters are involved in controlling the features of the curve, though it is primarily based on a maximum biomass raster developed by the CSIRO. FullCAM models the growth curve all the way to the natural ecological benchmark of the ecological community at a geographical point.
 - Therefore, if the project is using the naturally capped framework (i.e., the final canopy cover, then FullCAM modelling can run for the full course of the project as normal. The model is calibrated for the growth curve of the maximum biomass of that location.
 - However, if the project is using the actively capped framework, then FullCAM modelling should run as normal (i.e., following the growth curve) until the point in time that the CEA reaches the desired proponent-set density. After this point, the proponent manages the regrowth via thinning to maintain this density. From this point on, the sequestration measured should only account for the growth of the remaining trees. Therefore, a discount must be applied to the FullCAM growth curve to account for the stabilisation of the stem density, while also accounting for the continued sequestration as the remaining trees mature.

Key departures from the HIR method include:

- The absence of the forest cover threshold (i.e., the 20% canopy cover rule). The proponent will be awarded for any eligible increase in new and additional sequestration, without the need for the final canopy cover to exceed 20%.
- In addition to removing vegetation suppressors, the proponent may actively support regeneration through activities such as weeding, conducting cool burns, seeding or planting tube-stock of woody vegetation that is native to the area, adding tree guards to protect saplings, and other activities that protect native vegetation.
 - The application of synthetic fertiliser is prohibited, due to concerns regarding emissions intensity and eutrophication risk.

Hypothetical Case Study

Framework	Regenerating Sparse Woody Framework, Actively Capped
Location	Central far north Queensland
Rainfall (annual long term average)	700 mm
Dominant woody vegetation	Acacia (wattle) woodland
Total carbon estimation area	17,000 ha
Baseline canopy cover (average)	0%
Baseline land use	Grazing
Estimated attainable canopy cover, based on known ecological benchmarks	70%
Suppression activities	Unrestricted heavy grazing; overstocking; poor fire management
Suppression management activities	Additional exclusion fencing; additional water points; rotational grazing and paddock spelling; cool burns; cattle browsing grasses (reducing fuel loads); reduced stocking density (later)
Regeneration management activities	Tree guards around saplings; targeted weeding; targeted seeding of native woody vegetation in patchy areas;
Final canopy cover (at 25 years)	15%
Change in canopy cover (over 25 years)	+15%
Quantification method	May be possible using FullCAM with calibration and testing
Total new and additional sequestration (t CO ₂ -e) over 25 years	320,000
Total ACCUs (25 years, with 25% discount)	240,000
Gross revenue (assuming \$40/ACCU)	\$9,600,000

Framework	Regenerating Sparse Woody Framework, Naturally Capped
Location	Western Pilbara
Rainfall (annual long term average)	300 mm
Dominant woody vegetation	Acacia (wattle) woodland, with hummock grasslands
Total carbon estimation area	17,000 ha
Baseline canopy cover (average)	0%
Baseline land use	Grazing
Estimated attainable canopy cover, based on known ecological benchmarks	15%
Suppression activities	Unrestricted heavy grazing; overstocking; poor fire management
Suppression management activities	Additional exclusion fencing; additional water points; rotational grazing and paddock spelling; cool burns; cattle browsing grasses (reducing fuel loads); reduced stocking density (later)
Regeneration management activities	targeted weed control; targeted seeding of native woody vegetation in patchy areas;
Final canopy cover (at 25 years)	15%
Change in canopy cover (over 25 years)	+15%
Quantification method	May be possible using FullCAM with calibration and testing
Total new and additional sequestration (t CO ₂ -e) over 25 years	100,000
Total ACCUs (25 years)	100,000
Gross revenue (assuming \$40/ACCU)	\$4,000,000

Disclaimer: the figures used in this case study are for illustrative purposes only. Further research is required to develop and test the tools, assumptions, and rules for development of a method.

Recommendations

The carbon market in Australia is currently undergoing multiple critical shifts. Following the ACCU Review, the Clean Energy Regulator has overhauled the pre-existing Emission Reduction Fund, replacing it with the ACCU Scheme. This transition comes with new, stakeholder-focused ways of developing methods, led by DCCEEW. The imminent development of the Integrated Farm and Land Management (IFLM) method and the forthcoming Proponent-Led Method Development Process represent significant opportunities to launch the frameworks discussed in this report into recognised carbon market channels.

Accordingly, it is recommended that the Queensland Government Department of Agriculture and Fisheries ('the Department') presents the frameworks described in this report to DCCEEW as feedback pertaining to the development of the IFLM. DCCEEW are actively engaging industry stakeholders to participate in the IFLM development. They are seeking feedback from the industry as to what is reasonable and applicable. Given the timelines outlined by DCCEEW, this is a time-sensitive recommendation. This report clearly outlines key barriers-to-entry and provides solutions to these barriers through conceptual frameworks, noting technical avenues and potential limitations. This information would be valuable to DCCEEW as they consider the technical aspects of the activities included under the IFLM. Therefore, this window of opportunity provides an ideal platform for the

uptake and wider discussion of the ideas and concepts outlined through the frameworks presented in this report.

Secondly, it is recommended that the Department seeks to lodge (or oversee the lodgement of) an expression of interest into the Proponent-Led Method Development Process once that pathway is established. Failing the successful uptake of the frameworks into the IFLM, this pathway would represent a promising avenue to develop methods that align with the goals of the frameworks set out in this report. The details presented here would allow for comprehensive expressions of interest and agendas that would drive innovation towards accessible and high-integrity methods that align with the Restoring Degraded Forests and Regenerating Sparse Woody frameworks. Given that the Proponent-Led Method Development Process is in its infancy, the Department would have sufficient time to assess if the IFLM satisfactorily incorporates the elements of the frameworks before it decides whether the lodgement of an expression of interest is needed.

Thirdly, it is recommended that the Department seeks to actively participate in the development of methods that align with the frameworks. In particular, the Department is well placed to advocate for land managers and the production constraints they face. Through its interactions with graziers and the agricultural sector more broadly, the Department understands the need for improved accessibility into the carbon market, as well as the need to incentivise carbon sequestration so that optimal land management and environmental conservation becomes an economically viable opportunity for land managers. The details pertaining to barriers-to-entry and the science of regeneration, as presented in this paper, would inform the advocacy that the Department may undertake on behalf of the agricultural sector. Active engagement in the development of methods, especially at this critical transitional period within the ACCU Scheme, is critical to guiding a sustainable and carbon-engaged agricultural sector that seeks to increase its carbon sequestration.

The proposed frameworks for restoring degraded forests and regenerating sparse woody landscapes offer innovative approaches to carbon abatement, outlining key conceptual, technical, and policy challenges. These frameworks successfully provide more accessible pathways into the carbon market. If these frameworks become legislated options for inseting and offsetting, land manager participation in the carbon sequestration market can be expected to increase substantially, and an incentive will exist to vegetate extensive areas of Australia that would otherwise remain degraded or cleared.

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List of Abbreviations and Terminology

Abbreviation	Description
ERF	Emissions Reduction Fund
CER	Clean Energy Regulator
ACCU Scheme	Australian Carbon Credits Scheme
CEA	Carbon Estimation Area. Non-contiguous areas stratified from Forest Potential and Future Forest Potential areas, with consideration given to the approximate age class and species composition of existing vegetation communities.
GIS	Geographical Information System
ACCU	Australian Carbon Credit Units, each equivalent to 1 tonne CO ₂ -e
HIR	Human-Induced Regeneration
IA	Integrity Ag
t CO ₂ -e	Tonnes of Carbon Dioxide Equivalent Green House Gas
Forest Cover	Native vegetation >20% canopy cover and >2m in height
Forest Potential	Areas demonstrating regeneration (below 20% canopy cover and with minimum stem counts as per the Method) that, if managed appropriately, are likely to become a Forest (native woody vegetation higher than 2m and greater than 20% canopy cover).
Sparse woody	Woody vegetation with 5-20% canopy cover
Forest woody	Woody vegetation with >20% canopy cover; largely synonymous with Forest Cover.
LiDAR	Light Detection and Ranging
IFLM	Integrated Farm and Land management Method
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DAF	The Department of Agriculture and Fisheries
The Department	The Department of Agriculture and Fisheries
ERAC	Emissions Reduction Assurance Committee

1 Introduction

1.1 Background

The Australian agricultural sector occupies a prominent position in the context of climate change impacts and opportunities. Producers within this sector contend with some of the most challenging environmental conditions globally, including prolonged droughts, intense flooding, wildfires, and disease outbreaks, all of which exert significant influence on farm production and income levels. ABARES estimates that climate change impacts caused a loss of more than 23% of potential profits (an average of -\$29,200 per farm per year) across the agriculture sector from 2001-2020 (Hughes *et al.*, 2022). The sector, in response, is demonstrating a commitment to adaptation and innovation, bolstering resilience, and making investments in the potential of a low-emissions future. Nevertheless, there is a recognized imperative for an expedited transition. Given the ongoing evolution of climate patterns and the heightened frequency and intensity of extreme weather events, a shared dedication to collaborative and innovative solutions remains a critical aspect of the sector's journey forward.

The Australian Government has set specific emissions reduction targets: a 43% decrease from 2005 levels by 2030, with a long-term goal of achieving net zero emissions by 2050. In line with this, all state and territory governments have pledged to attain net zero emissions by 2050 or earlier, with many of them establishing interim targets. This collective effort reflects a more ambitious approach to reducing emissions across Australia, necessitating comprehensive actions throughout the economy. Importantly, the agricultural sector in Australia will play a vital role in achieving these targets. To lower emissions in agriculture, it is imperative to sustain ongoing mitigation efforts, employ innovative technologies, and incentivise carbon abatement.

In the face of escalating environmental challenges, including climate change and biodiversity loss, there is an urgent need to develop innovative frameworks that encourage carbon sequestration and responsible environmental management by landholders. To date, carbon sequestration methods developed by the Australian Government have certain limitations which represent a barrier-to-entry for land managers who may otherwise participate in carbon sequestration projects. Given the expansive area occupied by grazing enterprises in Australia, this sector offers significant potential for large scale carbon abatement. As such, there is a need to devise strategies aimed at incentivizing responsible land management practices while simultaneously minimizing the obstacles that may hinder participation in emerging ecosystem service markets. This effort seeks to strike the balance between encouraging sound land management practices and ensuring sustainable agricultural production.

This report aims to identify and address existing gaps in accessible method options by conceptually developing novel approaches that can bridge these gaps, ultimately expanding opportunities for landholders to engage in carbon markets. A key consideration is the potential attractiveness of partial regeneration as a solution, which not only promises environmental benefits but also holds the potential to release large tracts of land for mixed land uses, balancing sequestration goals with

primary production. In answering the need for more accessible carbon project opportunities, two distinct frameworks have been conceptually developed:

i) restoring degraded forests to their ecological benchmarks, and ii) regenerating sparse woody vegetation cover on otherwise cleared (or mostly cleared) land.

This report will not only delineate the conceptual foundations of these frameworks but will also provide a roadmap for future development, assess their limitations, and outline potential policy issues. Within the agricultural sector, carbon abatement projects are not viable unless they maintain or improve agricultural production and/or provide a financial incentive that makes the project economically viable. The frameworks effectively solve the issues of previous restrictive methods by removing unnecessary thresholds and providing the option for offsetting or insetting, which aim to incentivise the frameworks' uptake. The conceptual development of these frameworks contributes to the evolution of land management strategies that harmonize ecological sustainability with the needs of landholders to meet broader environmental objectives.

2 Existing ACCU Scheme Method Limitations

The Australian Carbon Credit Units (ACCU) Scheme, formerly known as the Emission Reduction Fund (ERF), constitutes a voluntary initiative encouraging the adoption of practices and technologies for emissions reduction and carbon sequestration. It plays a pivotal role in incentivizing landholders, communities, and businesses to undertake projects that mitigate greenhouse gas emissions or sequester carbon. Enacted through various federal legislation, such as the *Carbon Credits (Carbon Farming Initiative) Act 2011* and the *Carbon Credits (Carbon Farming Initiative) Rule 2015* (Australian Government, 2023a; Australian Government, 2023b), the ACCU Scheme allows participants to earn ACCUs, where each ACCU represents one tonne of carbon dioxide equivalent (tCO₂-e) emissions stored or avoided (Clean Energy Regulator, 2023).

This scheme provides opportunities for farmers, including graziers, to actively engage in emissions reduction efforts and sequester carbon. Participants implementing approved ACCU methods can accrue ACCUs, tradable units that can be sold to generate income streams through market sales. ACCUs can be sold, either to the Australian Government through a carbon abatement contract, or to private buyers (such as businesses seeking to offset emissions). As such, the ACCU price is set by the market demand and supply. Despite fluctuations in its value, the accrual and selling of ACCUs continues to be a profitable endeavour for eligible landholders who successfully implement ACCU Scheme projects. The economic returns from these projects may arise from selling ACCUs, and/or by using the ACCUs to offset the emissions of a company to produce 'carbon neutral' projects. Typically, these economic returns incentivise carbon abatement by offsetting potential losses in productivity that may be associated with carrying out the project. The projects can also generate more market appeal for a company's product through socially responsible practices (i.e., carbon abatement), justify higher produce prices, and diversify income. The ability for primary producers to access this market has led to genuine, largescale, and additional carbon abatement together with positive environmental outcomes.

In this context, a "method" refers to the specific types of projects undertaken to decrease emissions and earn Australian carbon credit units (ACCUs). These methods provide detailed instructions on

how to conduct project activities and measure the resulting reduction in emissions. Essentially, a method serves as a legislated set of instructions for achieving emission reduction goals and earning carbon credits. There are numerous methods available under the ACCU Scheme, with opportunities for industry and the land sector. Within opportunities for the land sector, there are agricultural methods, savanna burning methods, and vegetation methods. Due to the potential for widespread application of the vegetation methods, together with current issues with these methods, this report will primarily focus on vegetation methods. Vegetation projects generate abatement by removing carbon dioxide from the atmosphere and storing it as carbon in plants as they grow (a process known as sequestration). Examples of vegetation activities include:

- reforestation (a type of regeneration)
- revegetation, (a type of regeneration) or
- protecting native forest or vegetation that is at imminent risk of clearing.

Despite the widespread appeal of the ACCU Scheme, land managers face notable barriers to entry into the market. In particular, vegetative regeneration methods, such as the recently retired Human-Induced Regeneration (HIR) method, have restrictively narrow definitions pertaining to what can and cannot count towards sequestration. For instance, the HIR method has the requirement that sequestration can only be counted in land that achieves and sustains forest cover. In this case, forest (or forest cover) is defined as native vegetation that is above 2m in height and with more than 20% canopy cover. This threshold may not align with the production objectives of land managers, especially on landscapes where dense forest cover is not compatible or achievable. Limitations such as these may exclude land managers from participating meaningfully in the carbon market.

Secondly, land that already meets the definition of forest cover is ineligible under vegetative methods such as the retired HIR method. For land where this forest cover is degraded, there are no vegetative methods that incentivise regeneration of this forest from its current degraded state to its potential ecological benchmark. For example, this may translate as a potential increase in forest cover from 40% canopy cover to 60% canopy cover. An increase like this would have the co-benefits of restoring a degraded forest, enhancing biodiversity and ecosystem services, and sequestering additional carbon. If methods were to allow for these types of situations, then the restoration of native forests, such as pockets of remnant forest on or adjacent to grazing land, would be financially incentivised and potentially economically viable.

There is no clear reason, from a carbon sequestration perspective, why it is necessary to achieve forest cover to quantify abatement and generate carbon credits. Indeed, providing this flexibility might accommodate land managers whose lands are not conducive to reaching the 20% threshold but could still contribute to additional carbon sequestration. For example, land that currently has <5% canopy cover that may have the potential to support a woodland with 15% canopy cover, could achieve a minimum 10% increase in tree cover with associated carbon sequestration potential. However, without a financial incentive, the land remains cleared.

The key enabling requirement is an ACCU Scheme regeneration method that does not require 20% canopy cover thresholds to be met. If this was available, a land manager would have an incentive to remove the activities that are suppressing regeneration and support the woodland's growth to

its 15% canopy cover potential, or otherwise be maintained at a predetermined level that is compatible with livestock production goals. In turn, offsets (such as ACCUs) or insets (removals against the business's emissions profile) could be awarded for any new and additional sequestration.

Grazing enterprises cover an extensive amount of Australia. Much of this land may have the potential to support woodland or shrubland stands with 15-20% canopy cover. Despite its ecological potential to support woody vegetation, this land may currently be cleared and would otherwise stay cleared unless it became financially viable (through ACCUs) for the land manager to regenerate that land. Alternatively, degraded forests exist across Australia in patches of land near or adjacent to grazing operations. These degraded forests would likely remain degraded unless the landowners became financially incentivized to manage forest suppression and restore the forest towards its ecological benchmark. The sequestration potential of these extensive areas could be unlocked if land managers were financially compensated and/or incentivised, through appropriate ACCU Scheme methods, to manage the suppressors of native regeneration, thereby allowing the land to regenerate towards its ecological equilibrium. For many land managers, removing the somewhat arbitrary 20% canopy cover threshold would be analogous to removing notable barriers to participating in the carbon market. In the face of climate change and economic uncertainty, the development and implementation of such methods would assist Australian agriculture by diversifying income streams, incentivising additional sequestration and land regeneration, and supporting industry-led and national emissions targets.

In its current form, the ACCU Scheme, while commendable in its goals, presents barriers that hinder Australian land managers' participation. Addressing the identified limitations, particularly the 20% canopy cover threshold and financial challenges, could enhance the scheme's inclusivity. As the Australian Government moves forward with reforms, a balanced approach that considers the economic realities of land managers is crucial for ensuring the scheme's effectiveness and promoting sustainable land management practices across the country.

3 Quantifying Regeneration

3.1 The Science of Regeneration

Regeneration science plays a pivotal role in carbon market methods, particularly concerning the regeneration of native vegetation. In the Australian context, diverse ecological communities such as acacia woodlands (including wattles and mulga), eucalypt woodlands (including *Eucalyptus*, *Corymbia*, and *Angophora* genera), and melaleuca woodlands (includes myrtles, tea trees, and paperbarks) are integral components of the landscape. The science of regeneration focuses on restoring and enhancing these ecosystems, which not only contributes to biodiversity conservation but also offers significant carbon sequestration potential.

Different vegetation communities, like acacia, eucalypt, and melaleuca woodlands, require tailored regeneration approaches. Understanding the ecological nuances of each community is crucial. For instance, mulga ecosystems thrive in arid regions, demanding regeneration strategies that can withstand water scarcity. Eucalypt woodlands, found in a variety of climates, may necessitate diverse approaches based on factors such as soil type and temperature. For regeneration practices to be effective, they must be informed by an understanding of the landscape ecology and physiology associated with the distinct vegetation communities in question.

Many Australian native vegetation communities have adapted to harsh conditions to be hardy, resistant plants, capable of regenerating from significant stress events. These stress events have historically included droughts, floods, and wildfires. Since European colonisation, the stress events have come to include a wider variety of activities which suppress native regeneration. These activities are known as suppressors. Suppressors include, but are not limited to:

- grazing pressure: heavy and/or unrestricted,
- overstocking,
- invasive species: weeds and/or pest animals,
- mechanical or chemical destruction and/or suppression of woody regeneration, and
- poor fire management: widespread high-intensity fires (hot burns).

Regeneration and/or restoration efforts often necessitate the mitigation or complete removal of suppressors. In agricultural scenarios, this may be a costly endeavour, and likely requires an economic incentive to pay for activities required to control suppressors (e.g., additional fencing), or to compensate for potential losses in productivity (e.g., partial destocking). It is important that land managers are not forced or coerced into undertaking activities that reduce primary production. Likewise, it is important that land managers have options to be financially incentivised to engage in practices that improve the environment without significant compromises on agricultural production.

Fortunately, revegetation of land towards its natural state (either through regeneration or restoration) usually results in several environmental benefits. Regeneration science extends beyond the immediate ecological benefits and encompasses the ecosystem services provided by restored landscapes. Scientifically informed regeneration practices contribute to enhanced water quality, soil fertility, and habitat restoration. In the context of carbon markets, robust regeneration

science ensures that these ecosystems become efficient carbon sinks. Advice for land managers emphasizes the role of diverse vegetation in sequestering carbon and underscores the long-term carbon storage potential inherent in successfully regenerated landscapes. Other environmental benefits may include:

- increased sequestration of greenhouse gases,
- decreased emissions,
- improved hydrology,
- decreased localised pollution,
- reduced risk to endangered species,
- improved soil health,
- decreased erosion,
- improved ecosystem resilience,
- improved ecosystem services,
- increased biodiversity,
- and in some cases, there may be a long-term increase in primary productivity.

Regeneration science must account for the diverse landscape conditions across Australia. Mulga woodlands, often found in semi-arid to arid regions, may require strategies that enhance water retention and minimize soil erosion. In contrast, eucalypt woodlands, widespread across different climates, demand adaptive approaches. Melaleuca woodlands, typically associated with wetlands, require regeneration methods that consider water table fluctuations. The adaptation of regeneration practices to specific landscape conditions ensures ecological resilience and promotes successful carbon sequestration.

Accurate measurement of regeneration is fundamental to the credibility of carbon market methods. Scientifically robust metrics include vegetation cover, biodiversity indices, and soil carbon content. For mulga woodlands, the focus may be on establishing thresholds for arid-adapted species. Eucalypt woodlands may involve monitoring canopy cover and the presence of keystone species. In melaleuca woodlands, measurements could include monitoring changes in water table levels and the diversity of wetland species. In the context of vegetation-related carbon markets, measuring success oftentimes includes a combination of modelling sequestration and mapping increases in canopy cover over time. Utilizing advanced technologies such as satellite imaging and remote sensing provides accurate and scalable data for measuring regeneration success.

Scientific advice for land managers engaging in regeneration efforts emphasizes adaptive management. This involves continuously assessing the success of implemented practices and adjusting strategies accordingly. For mulga landscapes, adaptive approaches may involve decreasing an over-reliance on pulling events, or opting for pulling (simply pulling mulga over, allowing it to regenerate) instead of chaining (resulting in uprooted mulga, often followed by raking and burning). Eucalypt woodlands might benefit from adaptive fire management practices to stimulate regeneration and reduce the risk of hot burns. In melaleuca woodlands, adaptive strategies could include monitoring hydrological changes and adjusting thinning techniques. For all vegetation communities, it would be beneficial to limit grazing pressure, so it is important that stocking densities do not overshoot the carrying capacity for the land that livestock are living on.

Scientific guidance on adaptive management ensures that regeneration efforts remain effective and resilient in the face of changing environmental conditions.

The science of regeneration, when applied to diverse Australian landscapes, offers a pathway for land managers to access carbon markets sustainably. By understanding the unique characteristics of different vegetation communities and landscapes, implementing scientifically measured success metrics, and adopting adaptive management, land managers can play a vital role in both ecological restoration and carbon sequestration efforts.

3.2 Quantifying Regeneration for the Carbon Market

In the context of carbon market methods, accurately quantifying the success of regeneration efforts is pivotal. A robust methodological framework involves a combination of field measurements and advanced technologies. Remote sensing, a key component, plays a crucial role in providing comprehensive and scalable data for quantifying vegetation regeneration.

Remote sensing technologies, such as satellite imagery and LiDAR (Light Detection and Ranging), offer a bird's-eye view of landscapes, allowing for precise monitoring of vegetation dynamics. These technologies enable the collection of data on key indicators like vegetation cover, species composition, and structural characteristics over large spatial scales. This information is invaluable for assessing the effectiveness of regeneration initiatives.

Incorporating vegetation indices derived from remote sensing data is fundamental in quantifying regeneration. Indices like NDVI (Normalized Difference Vegetation Index) provide quantitative measures of vegetation health and vigour. The proportion of canopy cover is an especially important metric when assessing trends in sparse and woody cover. Changes in these indices over time offer insights into the progress of regeneration, helping graziers and land managers make informed decisions.

Advancements in machine learning algorithms enhance the precision of regeneration quantification. These algorithms can process vast datasets from remote sensing technologies, discerning subtle changes in vegetation characteristics. By training algorithms with ground-truthed data, they become adept at identifying and quantifying regeneration patterns, providing a more nuanced understanding of landscape dynamics.

While remote sensing offers a broad overview, ground-based field measurements remain essential for calibration and validation. Field data, including vegetation sampling and species identification, corroborate remote sensing results, ensuring the accuracy of quantification. This integrated approach aligns scientific rigor with on-the-ground reality, enhancing the reliability of regeneration assessments.

Carbon accounting and forest growth models are also useful tools, often necessary to discern abatement levels resulting from revegetation. FullCAM, short for Full Carbon Accounting Model, is a sophisticated tool designed for carbon accounting in the context of land use, land-use change, and forestry activities. Developed by the Australian government, FullCAM integrates complex algorithms and satellite data to assess and quantify carbon sequestration in forests. In a potential

carbon sequestration framework, FullCAM plays a pivotal role by providing a comprehensive method for estimating and verifying the amount of carbon stored in vegetation.

Within a carbon sequestration framework, FullCAM serves as a key component for verifying and quantifying the carbon sequestration achieved through specific land management activities. It ensures accuracy and transparency in assessing the carbon offsets or insets associated with projects aiming to enhance carbon sequestration. Despite certain limitations, it remains an essential tool that facilitates reliable and data-driven carbon accounting, supporting the implementation and success of carbon sequestration initiatives.

Alternatively, the 3-PG model, or Physiological Processes Predicting Growth, is a forest growth model used to simulate the growth and development of forest ecosystems. Distinct from a carbon accounting model, it incorporates physiological processes within trees, such as photosynthesis, respiration, and biomass allocation, to predict how forests will respond to various environmental conditions and management practices. In the context of a potential carbon sequestration framework, 3-PG serves as a valuable tool to estimate the carbon sequestration potential of a given forest area and may be useful in quantifying abatement in regenerating degraded forests.

In summary, the quantification of regeneration for carbon market methods is a multidimensional process that integrates remote sensing technologies with traditional field measurements. This holistic approach empowers land managers to accurately assess the impact of regeneration initiatives on their lands. As carbon markets increasingly recognize the value of verified and quantifiable regeneration, the synergy between remote sensing and field-based methodologies becomes instrumental in providing credible data for carbon credit generation and participation in carbon market mechanisms.

4 Review of Selected ACCU Scheme Methods

A concise examination of key Australian Carbon Credit Unit (ACCU) Scheme methods, including native forest from managed regrowth, reforestation by environmental or mallee plantings, and the now retired Human-Induced Regeneration (HIR), is essential to the conceptual development of new carbon sequestration frameworks that are accessible, useful, and address current market gaps. The following review outlines the key components of ACCU Scheme methods that would be most applicable to revegetation efforts. By gaining insights into the strengths and weaknesses of current methods, this review will identify areas for improvement and innovation. This knowledge enables the development of frameworks that can address specific challenges faced by land managers, contributing to the evolution of effective and tailored solutions for sustainable carbon sequestration initiatives in agricultural landscapes.

4.1 Human-Induced Regeneration of a Permanent Even-Aged Forest

To meet the eligibility criteria of the human-induced regeneration (HIR) method, the proponent must show evidence that for at least the last 10 years the land has been non-forest and that current management prevents native forest cover. Additionally, the land must not have been cleared within the last seven years (Australian Government, 2018a).

Land must be restored and must exceed 20% canopy cover and >2m tree height as an outcome of implementing the project.

Under the HIR method, eligible activities to induce regeneration include excluding livestock and implementing measures to prevent grazing, managing the timing and extent of grazing, humane management of feral animals, controlling non-native plant species, and committing to permanently cease mechanical or chemical destruction or suppression of native regrowth. These activities collectively contribute to the regeneration of native forests and subsequent carbon sequestration. Successful regeneration relies on existing natural seed beds, rootstocks, or lignotubers in the project area.

Carbon credits, represented by ACCUs, are earned when carbon is stored as a result of the specified project activities. The quantification of the carbon store is determined using the Full Carbon Accounting Model (FullCAM) tool, providing a standardized and rigorous approach to measure changes in carbon stock resulting from the project. This model allows for a comprehensive evaluation of the carbon sequestration potential facilitated by the regeneration efforts.

The HIR method incorporates a permanence obligation, necessitating that the project must be maintained permanently, with options of 25 or 100 years. This ensures the sustained environmental benefits of the regeneration efforts over an extended period. The ACCUs generated through this method can be traded in the carbon market, either through government contracts or in the private sector, providing a financial incentive for landholders to engage in activities that contribute to carbon sequestration and ecosystem restoration.

The HIR method of the ACCU Scheme established a structured framework to facilitate and measure the human-induced regeneration of permanent even-aged native forests. It was widely popular and

contributed heavily towards the availability of carbon credits before it was retired in September 2023. Pre-existing HIR projects were allowed to continue with the project as planned.

4.2 Native Forest from Managed Regrowth

Eligible activities under the Native Forest from Managed Regrowth method involve allowing native vegetation to regenerate and become forest by ceasing activities that suppress or destroy the regrowth. Proponents are required to replace previous land management practices with new approaches that facilitate the regeneration of native trees. The ACCU Scheme sets specific criteria for regeneration, requiring it to arise from existing natural seed beds, rootstocks, or lignotubers within the project area, while direct seeding or planting is not permitted (Australian Government, 2018b).

Projects under native forest from managed regrowth allow native vegetation to grow and become forest by stopping activities involving the chemical or mechanical destruction or suppression of native vegetation, with the cessation of these activities allowing native trees to regenerate and become forest. The project area must be currently non-forested, must have been cleared at least once for pastoral use, and there must have been forest cover on that land prior to clearing. Some pre-existing woody vegetation cover is permitted, but if present may require an additional baseline calculation.

To estimate changes in carbon stock resulting from the project, the Full Carbon Accounting Model (FullCAM) is employed as the modelling tool. This tool provides a standardized and scientifically rigorous approach to quantify the carbon stored in trees as they grow.

As a sequestration project, the Native Forest from Managed Regrowth method is subject to a permanence obligation, requiring the project to be maintained permanently for a specified duration of either 25 or 100 years. This ensures the sustained benefits of carbon sequestration over the long term. The generated ACCUs, representing stored carbon, can be traded in the carbon market, providing financial incentives for landholders to engage in sustainable land management practices that contribute to carbon sequestration and biodiversity conservation.

The Native Forest from Managed Regrowth method offers a structured framework within the ACCU Scheme to quantify and incentivize the regeneration of native vegetation on previously cleared land.

4.3 Reforestation by Environmental or Mallee Plantings

Under the Reforestation by Environmental or Mallee Plantings method, eligible activities involve planting a mix of trees, shrubs, and understory species either native to the local area or specific species of mallee eucalypts. The objective is to reduce greenhouse gas emissions by storing carbon in the growing trees and shrubs. The carbon stock within the project's vegetation, including trees, shrubs, and debris, is calculated using the Full Carbon Accounting Model (FullCAM), a standardized modelling tool that assesses and quantifies the carbon stored in growing vegetation (Australian Government, 2018c).

The Reforestation by Environmental or Mallee Plantings method involves a comprehensive assessment of the net abatement during the project's reporting period. This assessment considers factors such as emissions due to fires and fuel use, ultimately determining the net abatement eligible for Australian carbon credit units (ACCUs). As a sequestration activity, this method requires a permanence obligation, meaning the project must commit to maintaining the carbon sequestered in vegetation or soil for either 25 or 100 years.

Projects following this method can be established on eligible land in Australia, excluding external territories. The ACCUs generated through the Reforestation by Environmental or Mallee Plantings method are tradable commodities, providing a financial avenue for participants to engage in sustainable land management practices that contribute to carbon sequestration and environmental conservation.

The Reforestation by Environmental or Mallee Plantings method provides a structured framework within the ACCU Scheme to quantify and incentivize carbon sequestration through the establishment and maintenance of vegetation on previously cleared land.

4.4 Limitations with Existing Methods

None of these methods address the barriers-to-entry outlined in Section 2: namely, the restrictively narrow definition about eligible sequestration via the 20% canopy cover threshold (as in the HIR method), and the exclusion of land that already has forest cover, even if that forest is degraded. This excludes all land that currently has more than 20% canopy cover and cleared (or mostly cleared) land that cannot support more than 20% canopy cover (for either natural or production-oriented reasons). This excluded land represents a significantly large area of grazing land throughout Australia with the potential for new and additional sequestration.

4.5 Proposed Solutions

Two frameworks to address the barriers to entry and bridge existing gaps: the Restoring Degraded Forests and Regenerating Sparse Woody frameworks. These two methods are outlined in Sections 5 and 6 respectively. They are conceptually developed before the technical avenues for their implementation are outlined, followed by an outlining of potential policy issues. Finally, a hypothetical case study of each framework is provided to demonstrate a worked example of the framework.

5 Restoring Degraded Forest Framework

5.1 Conceptual Development

The Restoring Degraded Forest framework operates on the principle of incentivizing the restoration of degraded forests by quantifying the additional carbon sequestration resulting from active restoration efforts. In this framework, degraded forests are restored to their ecological benchmarks, with the difference in carbon content quantifiably measured and awarded to the proponent as an inset or offset. The key motivation behind this approach lies in recognizing the substantial gap in potential carbon sequestration between a forest in a degraded state and its ecologically benchmarked condition.

The framework employs a systematic process wherein the carbon sequestration potential is quantified as the composition and structure of the forest progressively improves towards its ecological benchmark. This assumes that the ecological benchmark of that vegetation community or regional ecosystem is known and recorded. Improvement is achieved through active forest management techniques, which may include the removal or effective management of factors suppressing forest cover, such as uncontrolled grazing. Restoration may come from removing the suppressors of native regeneration (e.g., heavy grazing pressure prohibiting saplings from maturing) and/or active regeneration efforts (e.g., conducting cool burns through the ecosystem to encourage native regeneration events). By strategically addressing these limiting factors, the framework aims to enhance the health of vegetation communities and elevate carbon sequestration rates. The entire process involves modelling and measuring the new and additional carbon sequestration as the forest undergoes restoration. Once verified and adjusted through necessary discounting processes, the calculated carbon offset or inset is awarded to the proponent, serving as a tangible incentive for the successful restoration of degraded forests.

For example: Paddock A contains forest with a canopy cover averaging 30%. Paddock A was heavily grazed, and the only trees on this paddock were mature trees that were well established when grazing was introduced. Unrestrained grazing had resulted in soil erosion and no juvenile trees; all saplings were either snapped or eaten. The vegetation community of Paddock A had a known ecological benchmark that suggested a canopy cover of 60% was achievable. Once the framework was implemented, the unrestrained grazing over Paddock A was managed to allow for the succession of saplings to develop beyond their vulnerable juvenile stage, and the forest was restored from 30% canopy cover to 60% canopy cover. The associated change in t CO₂-e from this increase was modelled. After verification processes were carried out and necessary discounts were applied to the t CO₂-e figure, that figure was awarded to the proponent in the form of an offset or inset, thereby incentivising the restoration.

5.2 Technical Avenues

The Restoring Degraded Forest framework is recommended to utilise a forest growth model to predict and quantify carbon stores that are new and additional, resulting from a proponent-induced increase in forest density, which is represented by an increase in canopy cover (a relatively easy to measure proxy for forest density). Typically, ACCU Scheme methods have historically used FullCAM, the Australian Government's carbon accounting model, to quantify sequestration. While it would

be efficient to recommend the use of this widely used tool, it is not feasible. Unlike its application in the now retired HIR method, FullCAM is not suitable for measuring and quantifying sequestration in the Restoring Degraded Forest framework. FullCAM is calibrated to initiate growth from zero biomass, lacking a direct link to canopy cover. While this is appropriate for regeneration scenarios where regeneration typically starts from minimal biomass and progresses to its full potential, the Restoring Degraded Forest framework requires regeneration to commence at a specific point in the tree's growth curve, corresponding to a designated canopy cover. This unique requirement results in a growth curve distinct from the one modelled by FullCAM, even when adjusted to start before the project initiation. Therefore, a more comprehensive model that accommodates various variables is necessary to accurately assess the complex dynamics involved in the framework. measuring additional sequestration from partially mature stands that have an already established canopy cover (i.e., >5%) as a starting point; FullCAM needs to use a canopy cover of near 0% as the starting point, therefore it is not suited to this framework.

Instead, a useful and popular forest growth model that can be used for this framework is 3-PG (Trotsiuk *et al.*, 2020). This model, also known as Physiological Processes Predicting Growth, is a forest growth model that simulates the development of forest ecosystems. It integrates key physiological processes in trees, including photosynthesis, respiration, and biomass allocation, to forecast how forests will react to different environmental conditions and management strategies. Specifically relevant to carbon sequestration frameworks, 3-PG acts as a valuable tool, enabling the estimation of carbon sequestration potential in specific forest areas.

The model can be employed to project how changes in forest management, such as afforestation, reforestation, or sustainable forest practices, might influence carbon sequestration over time. By inputting data on factors like climate, soil conditions, and tree species, 3-PG can simulate the growth of trees and predict the resulting carbon storage in biomass. This information is crucial for assessing the effectiveness of carbon sequestration initiatives and providing quantitative data to support carbon offset calculations within the framework. Essentially, 3-PG aids in understanding and forecasting the impact of different land management strategies on carbon sequestration, facilitating informed decision-making in the context of a carbon sequestration framework.

Implementing the quantification of sequestered carbon in the Restoring Degraded Forests framework could leverage the 3-PG model, which is available as an R package. The model provides a flexible and user-friendly R interface for Fortran re-implementations of 3-PG, including key extensions from the original model.

The 3-PG model comprises five sub-models, each addressing crucial aspects of forest growth. The light sub-model calculates light absorption, the productivity sub-model assesses net and gross primary productivity, the water sub-model utilizes the Penman–Monteith equation to compute tree transpiration and soil evaporation, the allocation sub-model distributes net primary productivity to roots, stems, and foliage based on various factors, and the mortality sub-model estimates density-dependent and density-independent mortality.

Given the model's complexity, it involves a substantial number of parameters, many of which are species-specific. To streamline this process for use with the framework, collaboration with ecologists and scientists familiar with 3-PG is recommended to develop presets or guidelines for

the parameters corresponding to a list of key native species. This approach aligns with the use of presets in FullCAM (developed for use in the HIR method), setting a manageable precedent for this type of model simplification.

Once presets for each key Australian species are established, a user-friendly interface, possibly in the form of a Shiny app, could be developed to facilitate accessibility for those unfamiliar with R. Furthermore, climate data is essential for the model, and it can be sourced from the Bureau of Meteorology or the PROFOUND database, as detailed in the R implementation's vignette (Trotsiuk *et al.*, 2023).

The 3-PG model generates multiple outputs, with stem, root, and foliage biomass being particularly noteworthy. These outputs can be converted into carbon equivalent quantities, providing a reliable basis for crediting carbon sequestration in the context of the Restoring Degraded Forests framework.

Note the following technicalities:

- The framework is designed to allow for the awarding of offset opportunities (such as the ability to sell ACCUs accrued from the project) as well as the option to receive inseting opportunities (such as the ability to use the carbon sequestration achieved through the project to partially or wholly counterbalance the enterprise's emissions).
- Despite the framework's explicit indifference to offset or inset opportunities, it is recommended that this framework operates with specific similarities to the already verified and developed HIR method, to reduce the burden of developing new rules from scratch. The streamlining of terminology and concepts is also likely to facilitate the ease of participation in, and understanding of, the new framework.

Similarities to the HIR method include:

- The importance of record keeping and auditing processes.
- The proponent must provide evidence of suppression (causing degradation with reference to a corresponding ecological benchmark).
- Where relevant, maps and models should be validated with field work.
- The necessity for nomenclature pertaining to Carbon Estimation Areas (CEAs), permanence period, stratification, project area, etc.
- Emissions from implementing the project must be regularly accounted for and discounted from the awarded sequestration.

Departures from the HIR method include:

- The quantification and verification approach could be used for either inseting or offsetting.
- The absence of the forest cover threshold (i.e., the 20% canopy cover rule) or requirement for land to be free of forest cover to be eligible in a CEA. The method would operate in forest land (>20% canopy cover).
- In addition to removing vegetation suppressors, the proponent may actively support regeneration through activities such as weeding, conducting cool burns, seeding or

planting tube-stock of woody vegetation that is native to the area, adding tree guards to protect saplings, and other activities that protect native vegetation.

- The application of synthetic fertiliser is prohibited, due to concerns regarding emissions intensity and eutrophication risk.
- The land used for this framework must, at an early stage in the project's life, have a measured and verified baseline, from which a starting point can be established. This will include evidence that:
 - the CEA has been classified as degraded forest in the baseline period,
 - the CEA included forested land that remained in a relatively stable state of degradation (i.e., any state below its ecological benchmarks) for a satisfactory proportion of the baseline period,
 - the degradation of the forest is due to suppression activities,
 - that the removal of suppression activities will promote forest restoration,
 - that restoration will correspond to an increase in canopy cover,
 - there are plans in place to reasonably manage the threat of sequestration reversal (caused by natural factors such as fires, drought, or diseases), and
 - the natural ecological benchmarks and associated attainable canopy covers (accepting reasonable margins for error) for the vegetation communities in the CEAs have been reported by an experienced professional (i.e., a person with an ecology, botany, biology, environmental science, or equivalent tertiary qualification and experience in applied ecology).
- Canopy cover and ecology metrics (including aspects such as species richness, abundance, and the overall vegetation composition and structure) must be recorded early in the project's life, and for a widespread array of points across the project area – these figures will contribute to the development of a baseline starting point.

Departures from the HIR method, specific to carbon quantification, include:

- A forest growth model, such as 3-PG, will be used to estimate the forest's species composition and structure (with respect to the canopy cover) for the baseline starting point.
- As restoration occurs (typically through an increased in germination and sapling survival rates), new events will be added to the model to reflect the restoration.
- Disturbance events, such as high-intensity fires, will be reflected in the model.
- The proponent will be awarded for eligible carbon sequestration that is new and additional, with care not to double count existing carbon stocks or sequestration that would occur under a business-as-usual scenario.

Points warranting further consideration:

- The baseline period should be extended from 10 years to 15 years, to account for climatic variability and higher integrity. This is in line with current trends within the department now responsible for method development, DCCEW.
- Consideration should be given as to the appropriateness and capability of 3-PG (or similar) to accurately model the new and additional biomass resulting from restoration.

- Consideration should be given to the eligible suppression activities in addition to the eligible management strategies that support regrowth.
- Once fully developed, LiDAR or ground-truthed measure-model approaches (as per the ‘hybrid’ approach of the IFLM) may be more suitable for quantifying the sequestration under this framework than a 3-PG only approach.
- More research is needed:
 - into the relationship between canopy cover and stem density.
 - into the technicalities of setting and manipulating canopy cover as an input and output of the model.
 - investigating the relationship between canopy cover and restoration trajectories for typical Australian ecosystems (e.g., Acacia, melaleuca, and eucalypt woodlands) – this investigation should seek to answer the question: to what extent does canopy cover (as measured through remote sensing) provide a useful proxy for forest restoration and additional sequestration?
 - There may be alternatives to canopy cover that are easy to measure and provide a more accurate proxy as to the increase in sequestration resulting from forest restoration.
- Flexibility should be built into the framework to allow for the stabilisation of a forest canopy cover level below the reported ecological benchmark (despite a successful restoration). Instead of a focus on whether the restoration hit the reported ecological benchmarks, the focus should be on improved ecosystem health and increased sequestration. Likewise, the proponent should only be awarded based on the actual new and additional increase in sequestration, not the predicted amount (with reference to ecological benchmarks). The benchmarks should only be used as an indication as to whether significant restoration and sequestration increases are possible for the vegetation community, and they may also be used for forward abatement estimates and feasibility assessments.
- Project-related emissions must be accounted for, including emissions resulting from land degradation in non-CEA areas within the project area as a result of the project (e.g. rotational grazing that improves the CEA might have adverse effects on another part of the property as a result. The emissions from this is project-related, and must be accounted for and applied as a discount to any potential crediting).

5.3 Potential Policy Issues

The implementation of a new framework for carbon sequestration introduces inherent possibilities for policy issues and implications, given the intricate interplay between environmental objectives, economic factors, and regulatory structures. Any innovative approach designed to incentivize carbon sequestration or offsetting/insetting activities requires a meticulous examination of its alignment with existing policies, potential impacts on diverse stakeholders, and the efficacy of regulatory mechanisms. Policy concerns may emerge in areas like land use, economic incentives, and equity, underscoring the necessity for a comprehensive assessment of the framework's implications to ensure seamless integration into broader policy agendas without unintended consequences. It is imperative to understand and address these potential policy challenges for the

successful implementation and long-term sustainability of any emerging carbon sequestration initiative.

As a minimum, potential policy issues may include:

- The public perception of a carbon sequestration method that awards proponents for restoring forests that already exist.
- Issues around integrity, specifically pertaining to newness and additionality (i.e., asking the question: would the landholder support the restoration of this forest under a business-as-usual scenario?). There are difficulties in asking proponents to prove that they would not otherwise undertake restoration efforts.
- Issues around integrity, specifically pertaining to proof that suppression activities are truly causing a state of sustained degradation below the ecological benchmarks. Additionally, there is a need for further evidence that the removal of these suppressors, and further management of the trees, will result in restoration that is in line with modelled sequestration.
- The need to understand the reasonable canopy cover attainable as per the ecological benchmark for a vegetation community within a CEA may be complex and resource intensive.
- The costs for implementing a project such as this may be comparable to ACCU Scheme projects (such as the now retired HIR method), but with significantly lower returns. While removing the 20% canopy over threshold removes a barrier-to-entry for some producers, the lower return on investment may provide a barrier-to-entry for others. More cost-effective ways of registering, implementing, verifying, and auditing projects such as this are essential.
 - In particular, significant costs are associated with the work needed to create and verify landscape ecology metrics and models of the project area and CEAs, involving fieldwork, remote sensing (potentially including LiDAR), and advanced GIS capabilities.
- In some cases, forest degradation can be caused by an encroachment of woody weeds (and not from the loss of natural vegetation, as is addressed by this framework). In these instances, forest restoration would result in a decrease in biomass, despite providing restoring the forest towards its natural state. This may occur if the forest is overrun by invasive woody weeds, in which case forest restoration would result in the removal of these woody weeds and a resulting decrease in carbon stocks. These types of scenarios outline the importance of defining terms and outlining rules; the risk of restoration resulting in decreases in carbon sequestration or carbon stocks should be addressed.
- In line with the concept of risk-of-reversal discounts used in many ACCU Scheme methods, discounts or regulatory buffers should be applied to this framework to account for natural fluctuations of the forest away from its natural benchmark over the course of the permanence period.

5.4 Hypothetical Case Study

A hypothetical case study has been developed to provide a worked example, demonstrating what a realistic scenario using the Restoring Degraded Forests framework may look like.

Situated in central Far North Queensland, a 24,000-hectare paddock within a larger cattle station serves as a hypothetical case study for the application of the framework. During the baseline period (i.e., fifteen years prior to the project's registration), the paddock was characterized by patchy woody cover, heavily suppressed by overgrazing and poor fire management. The key woody species included acacia-dominated communities interspersed with larger eucalypts and occasional patches of melaleuca. During this period, the case study paddock maintained an average canopy cover of approximately 25%.

Ecological assessments confirmed that the case study paddock was stable in a degraded state, and native regeneration was being suppressed. Adjacent paddocks had remnant forest communities that were inaccessible to livestock. The species composition of the remnant forest reflected that of the case study paddock. The adjacent paddocks, protected from overgrazing, demonstrated higher canopy covers of 60-80%, reflecting the potential of the ecological communities within the case study paddock.

At the project's initiation, baseline species ecology metrics and canopy cover were measured through extensive field work. This required numerous survey points across the project area to spatially discern vegetation cover across the paddock. These metrics were integrated into the 3-PG model, a Physiological Processes Predicting Growth model, to establish a baseline starting point for the project. Over the next 25 years, the project was assumed to achieve restoration through the control of suppression activities, and through the active implementation of forest restoration.

Suppressors, namely unrestricted heavy cattle grazing, were proposed to be managed through 'water and wires' – a combination of exclusion fencing, rotational grazing, and additional water points to distribute grazing pressure more evenly. Initially, cattle were proposed to be temporarily removed during the monsoon season to allow the paddock to recover and regenerate. Controlled cool burns were applied following the monsoon to manage fuel loads and stimulate regeneration, complemented by seeding of native woody plants in patchy areas. Once a substantial number of saplings outgrow their vulnerable juvenile stage, cattle may be gradually reintroduced, marking the commencement of a dual-use approach, balancing primary production (grazing) with carbon farming. This process was proposed to be repeated annually during the first ten years of the project, allowing for increased native germination and increased sapling survival rates. Economic returns were projected to fund the project and compensate for a gradual reduction in cattle numbers to achieve a consistently healthy stocking density.

Improved land management practices included:

- regular paddock spelling,
- controlled cattle browsing (managing the timing and extent of grazing)
- promoting browsing on grasses to mitigate fire fuel loads,
- occasional cool burns,
- improving stocking densities to match the land's carrying capacity, and

- targeted weeding and seeding.

The combination of controlled suppressors and active restorative management contributed to the gradual restoration of the forest toward its ecological benchmark. Annual progress was modelled on 3-PG, with credits awarded for sequestration that surpassed baseline levels.

Estimated abatement and ACCU numbers are not provided here as 3-PG parameter values for Australian species would need to be developed first, and this is outside the scope of this report.

Table 1. Hypothetical Case Study Summary: Restoring Degraded Forests Framework

Framework	Restoring Degraded Forests framework
Location	Central Far North Queensland
Rainfall (annual long-term average)	700 mm
Dominant woody vegetation	Acacia (wattle) woodland, with some eucalypt and melaleuca woodland
Total carbon estimation area	24,000 ha
Baseline canopy cover (average)	25%
Baseline land use	Grazing
Estimated attainable canopy cover, based on known ecological benchmarks	60-80%
Suppression activities	Unrestricted heavy grazing; overstocking; poor fire management
Suppression management activities	Additional exclusion fencing; additional water points; rotational grazing and paddock spelling; cool burns; cattle browsing grasses (reducing fuel loads); reduced stocking density (later)
Restorative management activities	Targeted weeding; targeted seeding of native woody vegetation in patchy areas;
Final canopy cover (at 25 years)	70%
Change in canopy cover (over 25 years)	+45%
Quantification methods	Not determined. May be possible to use models such as 3-PG or direct measurement

6 Regenerating Sparse Woody Framework

6.1 Conceptual Development

The Regenerating Sparse Woody framework is designed to quantify carbon sequestration resulting from the regeneration or partial regeneration of land without imposing a mandatory 20% canopy cover threshold, a notable departure from existing methods such as the HIR method. The framework's primary objective is to incentivize the partial regeneration of land, allowing for the quantification of new and additional carbon sequestration without the obligation for the forest to exceed 20% canopy cover. This innovative approach acknowledges the challenges faced by landholders in justifying the potential loss of primary productivity associated with regenerating land beyond the specified canopy cover threshold. It also addresses the need for carbon market opportunities in areas where the ecological equilibrium is naturally below 20% canopy cover, or where the canopy cover needs to be maintained at a level below this for productivity reasons.

Proponents using this framework have the flexibility to cap canopy cover density, either through natural factors (i.e., the land reaching its ecological equilibrium) or active management practices. This feature accommodates scenarios where maintaining primary productivity is paramount, allowing proponents to simultaneously partially regenerate land while keeping the canopy cover at or below a predetermined density. The framework models the carbon sequestered through forest growth and provides proponents the option to maintain the forest at the designated density. This approach enhances the accessibility of the carbon market, particularly for vast areas of cleared grazing land. By eliminating the 20% canopy cover threshold, a significant barrier to participation is removed, potentially expanding the uptake of carbon sequestration initiatives.

This framework is divided into two options: i) actively capped, and ii) naturally capped. Actively capped regeneration projects actively manage tree stands to maintain them at a predetermined density, typically via ecological thinning practices. This would typically be employed by producers who have cleared land that, if suppression activities were removed, would naturally support vegetation with a natural propensity for dense stands; however, the producer has a need to maintain low density woodlands for production purposes (e.g., grazing).

Example – regeneration, actively capped: Paddock B was historically cleared and used for grazing. Only a few large trees existed on the otherwise treeless slopes – a canopy cover averaging less than 5%. Once the framework was implemented, grazing was strategically managed through additional fences to allow for the regeneration of native saplings. Tree guards were also placed around emerging saplings, and they were protected until they had developed beyond their vulnerable juvenile stage. The land that previously had an average canopy cover of less than 5% was regenerated to a canopy cover of 15%, and it was maintained at this level. The proponent conducted ecological thinning on patches that were becoming too dense and hampering productivity, so long as the canopy cover did not fall below 15%. The associated change in t CO₂-e from this increase was modelled. After verification processes were carried out and necessary discounts were applied to the t CO₂-e figure, that figure was awarded to the proponent in the form of an offset or inset, thereby incentivising the regeneration.

Conversely, naturally capped regeneration projects support the growth of trees to reach their natural ecological equilibrium, without the need to thin the native woody vegetation. This type of project would typically be used by producers who have cleared land that, if suppression activities were removed, would support vegetation that naturally has a relatively low maximum density.

Example – regeneration, naturally capped: Paddock C was historically cleared and used for grazing. Only a few large trees existed on the otherwise treeless slopes – a canopy cover averaging less than 5%. Once the framework was implemented, grazing was strategically managed through additional fences to allow for the regeneration of native saplings. Tree guards were also placed around emerging saplings, and they were protected until they had developed beyond their vulnerable juvenile stage. The land that previously had an average canopy cover of less than 5% was regenerated to the maximum achievable canopy cover which, for this vegetation community, was 15%. It was maintained at this level through well-managed potential suppressors (such as heavy grazing). There was no need for ecological thinning because the vegetation community was at its limit at 15% canopy cover. The associated change in t CO₂-e from this increase was modelled. After verification processes were carried out and necessary discounts were applied to the t CO₂-e figure, that figure was awarded to the proponent in the form of an offset or inset, thereby incentivising the regeneration. In the scenario of Paddock C, the final canopy cover reached 15%, reflecting the ecological equilibrium or carrying capacity of the vegetation community.

6.2 Technical Avenues

The Regenerating Sparse Woody framework is recommended to utilise a forest growth carbon accounting model, such as FullCAM. In this way, the measurement and quantification of carbon would be similar in technicalities to the HIR method: FullCAM is utilized to assess, measure, and quantify the amount of carbon sequestered by trees in landscapes where native trees are beginning to grow. This tool employs advanced algorithms, species-specific presents, and spatial points on a model (a maximum biomass raster developed by the CSIRO) which predicts the natural growth curve for that point in space. This measurement approach is augmented by analysing satellite data and ground-truthing GIS classifications with intensive field work. By assuming this same systematic approach for the Regenerating Sparse Woody framework, FullCAM can be used to assist in determining the impact of tree growth on carbon sequestration in landscapes that would otherwise lack tree cover.

Unlike the HIR method, there would be no requirement for the 20% canopy cover threshold. Therefore, the need for the land to transition to ‘forest,’ as per the traditional definition (i.e., native vegetation that is above 2m in height and with more than 20% canopy cover) would be voided. Instead, the requirement would hold that land with the propensity for woodland growth is regenerated from less than 5% canopy cover to a canopy cover of less than 20% – either a natural limit or a predetermined, proponent-set level. The canopy cover must then be maintained at this predetermined level for the permanence period in order to be awarded the associated abatement.

Note the following technicalities:

- The framework is designed to allow for the awarding of offset opportunities (such as the ability to sell ACCUs accrued from the project) as well as the option to receive insetting

opportunities (such as the ability to use the carbon sequestration achieved through the project to partially or wholly counterbalance the enterprise's emissions).

- Despite the framework's explicit indifference to offset or inset opportunities, it is recommended that this framework operates with specific similarities to the already verified and developed HIR method, to reduce the burden of developing new rules from scratch. The streamlining of terminology and concepts is also likely to facilitate the ease of participation in, and understanding of, the new framework.

Similarities to the HIR method include:

- Registration, record keeping and auditing processes.
- The land used for this framework must, at the time of registration, have less than 5% canopy cover over the land. This is due to the way the FullCAM model functions and mitigates the risk of counting sequestration that is not entirely new and additional.
 - Typically, this would include historically cleared pastures and treeless plains that, prior to clearing, supported native woodland.
- The proponent must provide evidence of suppression.
- The proponent must provide evidence that the land can regenerate with a native woodland ecosystem (to at least the predetermined canopy cover level) if the suppression is removed.
- FullCAM will be used to measure and record the amount of sequestration.
- Where relevant, maps and models should be validated with field work.
- The land must satisfy baseline conditions, which may include the necessity to exclude any areas that achieved canopy cover exceeding 5% at any time during the baseline period (note that this figure is different to the threshold used in the HIR method)
- The land must not have been cleared within the last 7 years, as per current legislation.
- The necessity for nomenclature pertaining to Carbon Estimation Areas (CEAs), permanence period, stratification, project area, etc.
- Emissions from implementing the project must be regularly accounted for and discounted from the awarded sequestration.

Departures from the HIR method include:

- The absence of the forest cover threshold (i.e., the 20% canopy cover rule). The proponent will be awarded for any eligible increase in new and additional sequestration, without the need for the final canopy cover to exceed 20%.
- In addition to removing vegetation suppressors, the proponent may actively support regeneration through activities such as weeding, conducting cool burns, seeding or planting tube-stock of woody vegetation that is native to the area, adding tree guards to protect saplings, and other activities that protect native vegetation.
 - The application of synthetic fertiliser is prohibited, due to concerns regarding emissions intensity and eutrophication risk.

Departures from the HIR method, specific to carbon quantification, include:

- FullCAM operates by modelling the growth curve of regenerating vegetation. Many parameters are involved in controlling the features of the curve, though it is primarily based on a maximum biomass raster developed by the CSIRO. FullCAM models the growth curve all the way to the natural ecological benchmark of the ecological community at a geographical point.
 - Therefore, if the project is using the naturally capped framework (i.e., the final canopy cover, then FullCAM modelling can run for the full course of the project as normal. The model is calibrated for the growth curve of the maximum biomass of that location.
 - However, if the project is using the actively capped framework, then FullCAM modelling should run as normal (i.e., following the growth curve) until the point in time that the CEA reaches the desired proponent-set density. After this point, the proponent manages the regrowth to maintain this density. From this point on, the sequestration measured should only account for the growth of the remaining trees. Therefore, a discount must be applied to the FullCAM growth curve to account for the stabilisation of the stem density, while also accounting for the continued sequestration as the remaining trees mature.
 - One option to account for this is setting the difference in sequestration rates between the unchanged FullCAM growth curve and discounted actively capped growth curve to equal the following discount formula at the end of the project (25 years). The discount level is then linearly decreased going back in time from the 25 years until it reaches 0 at the point in time where the proponent-set density is first achieved. The proposed discount formula is:

$$\text{Maximum discount applied at final year of project} = 1 - \frac{(M - S)}{M}$$

Where:

M is the maximum canopy cover reached at the ecological equilibrium for the vegetation community within the CEA, as a percentage. S is the canopy cover at the proponent-set density, at which the vegetation in the CEA is maintained, as a percentage.

- Assumptions that would need to be addressed include:
 - M - canopy cover at the maximum biomass (without active capping);
 - S - canopy cover with active capping (the proponent-set density);
 - years that the project runs for, also known as the crediting period (typically 25 years); and
 - the years between the project starting and the canopy cover reaching the proponent-set density.
- The above represents just one proposed method of discounting the growth curve to account for the actively capped scenario. Following a policy review, other methods may be deemed more appropriate.

Points warranting further consideration:

- The permanence period options should be set as 50 years and 100 years, allowing for a higher integrity approach, while acknowledging that land under this framework may still support reasonable livestock production. Project timelines and crediting periods (i.e., 25 years) would not need to change.
- The baseline period should be extended from 10 years to 15 years, to account for climatic variability and higher integrity. This is in line with current trends within the department now responsible for method development, DCCEEW.
- There is the possibility to extend the foundations of this framework to final canopy covers that exceed 20% (essentially the basis of the HIR method). This would represent one framework that measures the new and additional carbon sequestration from regenerating to either sparse cover (5-20% canopy cover) or forest cover (>20% canopy cover) without the need for multiple frameworks that cater to each. The resulting framework would streamline the process. It would reassemble the HIR method, but without the inclusion of a 20% canopy cover threshold.
 - Alternatively, different sub-frameworks (i.e., sparse woody – projects with a final canopy cover goal of 5-20% (a. naturally capped, b. actively capped) and forest woody – projects with a final canopy cover goal of >20% (c. naturally capped, d. actively capped)) could exist under the one framework (i.e., the Regenerating

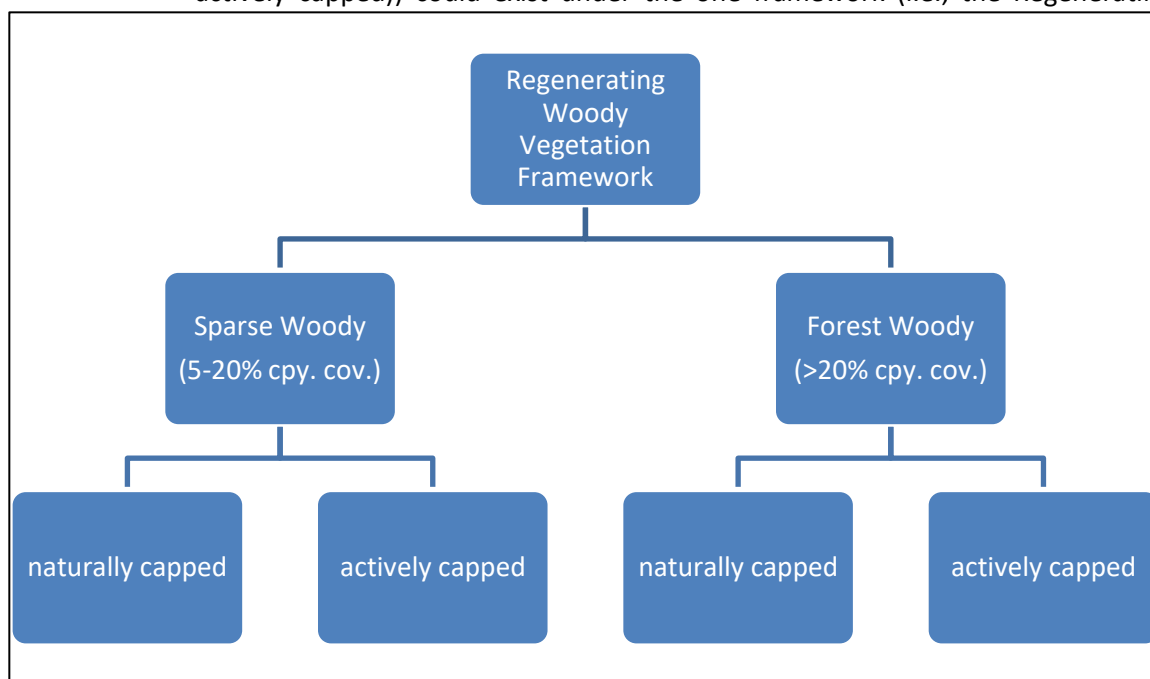


Figure 1. Options for how the Regenerating Woody Vegetation Framework may operate with sparse and forest areas, and naturally or actively capped.

Woody Vegetation framework).

- Within this model, each sub-framework could have an applicable set of rules specific to that sub-framework, while the overarching principles remain the same. For example, the permanence period options for the sparse woody projects could

be 50 years and 100 years, whereas the permanence period options for the forest woody could be 25 years and 100 years.

- A diagrammatic representation of this subdivision is presented in Figure 1.
- Consideration should be given as to the appropriateness and capability of FullCAM to accurately model the new and additional biomass for sparse woody communities.
- FullCAM calculations when used within the actively capped context may be overly conservative, because the calculations are not calibrated to reflect tree growth with low competition. Different allometric functions may be needed to account for this variation. Research to address this potential issue is recommended.
- Consideration should be given to the eligible suppression activities in addition to the eligible management strategies that support regrowth.
- Once fully developed, LiDAR or ground-truthed measure-model approaches (as per the 'hybrid' approach of the IFLM) may be more suitable for quantifying the sequestration under this framework than a FullCAM only approach.

6.3 Potential Policy Issues

The introduction of a new carbon sequestration framework carries inherent potential for policy issues and implications, given the complex interplay between environmental goals, economic considerations, and regulatory frameworks. Any novel approach aimed at incentivizing carbon sequestration or offsetting/insetting activities demands a careful examination of its alignment with existing policies, potential impacts on various stakeholders, and the effectiveness of regulatory mechanisms. Policy issues may arise in areas such as land use, economic incentives, and equity, highlighting the need for a comprehensive evaluation of the framework's implications to ensure its integration into broader policy agendas without unintended consequences. Understanding and addressing these potential policy challenges is crucial for the successful implementation and long-term sustainability of any new carbon sequestration initiative.

As a minimum, potential policy issues may include:

- The public perception of a carbon sequestration method that awards proponents for regenerating vegetation despite these being limited (if actively capped) from reaching forest potential may be seen as inconsistent with broader environmental goals. This would need to be addressed by emphasising the benefit in moderate reforestation in grazing land, as a means of delivering increased carbon in landscapes without conflicting with grazing management.
- Issues around integrity, specifically pertaining to newness and additionality (i.e., asking the question: would the landholder support the growth of more trees under a business-as-usual scenario?). There are difficulties in asking proponents to prove that they would not otherwise undertake regeneration efforts.
- Issues around integrity, specifically pertaining to proof that suppression activities are truly suppressing woody regeneration across the entirety of the intended CEAs. Additionally, there is a need for further evidence that the removal of these suppressors, and further management of the trees, will result in woody regeneration that is in line with modelled growth curves.

- The need to understand the maximum canopy cover reached at the ecological equilibrium for a vegetation community within a CEA under the actively capped framework. The CSIRO has developed a maximum biomass raster, but this has not been transformed into a corresponding canopy cover model for vegetation communities across Australia.
- The costs for implementing a project such as this may be comparable to ACCU Scheme projects (such as the now retired HIR method), but with significantly lower returns. While removing the 20% canopy over threshold removes a barrier-to-entry for some producers, the lower return on investment may provide a barrier-to-entry for others. More cost-effective ways of registering, implementing, verifying, and auditing projects such as this are essential.
 - In particular, significant costs are associated with the work needed to create and verify landscape ecology metrics and models of the project area and CEAs, involving field-work, remote sensing (potentially including LiDAR), and advanced GIS capabilities.

6.4 Hypothetical Case Study

Actively Capped

A hypothetical case study has been developed to provide a worked example, demonstrating what a realistic scenario using the Regenerating Sparse Woody framework (actively capped) may look like.

Situated in central Far North Queensland, a 17,000-hectare paddock within a larger cattle station serves as a hypothetical case study for the application of the framework. During the baseline period (i.e., fifteen years prior to the project's registration), the case study paddock maintained an average canopy cover of near 0%. Any woody vegetation was heavily suppressed by overgrazing. The key woody species (as seed banks in the soil, and local to the area) included acacia, eucalypts, and melaleuca.

At the project's initiation, baseline canopy cover was measured through extensive field work and CEAs were mapped. This required numerous survey points across the project area to spatially discern vegetation cover across the paddock. Over the next 25 years, the project was assumed to achieve regeneration through the control of suppression activities together with some active management to protect saplings from cattle. Once the paddock achieved a pre-selected canopy cover of 15%, the proponent began the management activities (mostly thinning and light to moderate cattle grazing) to maintain that density.

The vegetation communities in that paddock had an ecological benchmark potential of 60-80% canopy cover, but were managed to remain at 15%, as desired.

Suppressors, namely unrestricted heavy cattle grazing, were proposed to be managed through 'water and wires' – a combination of exclusion fencing, rotational grazing, and additional water points to distribute grazing pressure more evenly. Initially, cattle were proposed to be temporarily removed during the monsoon season to allow the paddock to recover and regenerate. Once a

substantial number of saplings outgrow their vulnerable juvenile stage, cattle may be gradually reintroduced, marking the commencement of a dual-use approach, balancing primary production (grazing) with carbon farming. Economic returns were proposed to fund the project and compensated for a gradual reduction in cattle numbers to achieve a consistently healthy stocking density.

Improved land management practices included:

- regular paddock spelling,
- controlled cattle browsing (managing the timing and extent of grazing)
- improving stocking densities to match the land’s carrying capacity, and
- targeted weeding and seeding.

The combination of controlled suppressors and active restorative management contributed to the gradual regeneration of the once cleared land to a 15% canopy cover. Annual progress was measured on site and modelled using FullCAM with credits awarded for sequestration that surpassed baseline levels. The annual monitoring of progress was also to ensure that once the vegetation reached the proponent selected density the appropriate discounts could be applied.

Approximately 240,000 ACCUs (representing 320,000 t CO₂-e) were accrued over the course of the project (i.e., 25 years), following the modelled sequestration curve presented below (Figure 2; note that real-world sequestration curves will include fluctuations to account for natural variability and disturbance events. Discounts are applied to account for this.) Necessary discounts were applied to account for the risk of reversal, the 25-year permanence period, and potential model errors, ensuring the conservativeness of the credited sequestration. Discounts were also applied to account for project-related emissions (e.g., land degradation in other areas of the property resulting from rotational grazing, fuel used during fencing, etc.). Throughout the 25-year project, the vegetation transitioned from a baseline starting point of near 0% canopy cover to a sustained 15% canopy cover, exemplifying the success of the Regenerating Sparse Woody framework (actively capped) in achieving substantial and lasting carbon sequestration. Co-benefits included improved ecosystem resilience and ecosystem services, improved soil health and water retention, decreased erosion, increased biodiversity, improved cattle health, and significant economic returns that more than funded the implementation of the project.

Table 2. Hypothetical Case Study Summary: Restoring Degraded Forests Framework (Actively Capped)

Framework	Regenerating Sparse Woody framework, Actively Capped
Location	Central far north Queensland
Rainfall (annual long term average)	700 mm
Dominant woody vegetation	Acacia (wattle) woodland
Total carbon estimation area	17,000 ha
Baseline canopy cover (average)	0%
Baseline land use	Grazing

Estimated attainable canopy cover, based on known ecological benchmarks	70%
Suppression activities	Unrestricted heavy grazing; overstocking; poor fire management
Suppression management activities	Additional exclusion fencing; additional water points; rotational grazing and paddock spelling; cool burns; cattle browsing grasses (reducing fuel loads); reduced stocking density (later)
Regeneration management activities	Tree guards around saplings in high-risk areas; targeted weeding; targeted seeding of native woody vegetation in patchy areas;
Final canopy cover (at 25 years)	15%
Change in canopy cover (over 25 years)	+15%
Quantification method	May be possible using FullCAM with calibration and testing
Total new and additional sequestration (t CO ₂ -e) over 25 years	320,000
Total ACCUs (25 years, with 25% discount)	240,000
Gross revenue (assuming \$40/ACCU)	\$9,600,000

Disclaimer: the figures used in this case study are for illustrative purposes only. Further research is required to develop and test the tools, assumptions, and rules for development of a method.

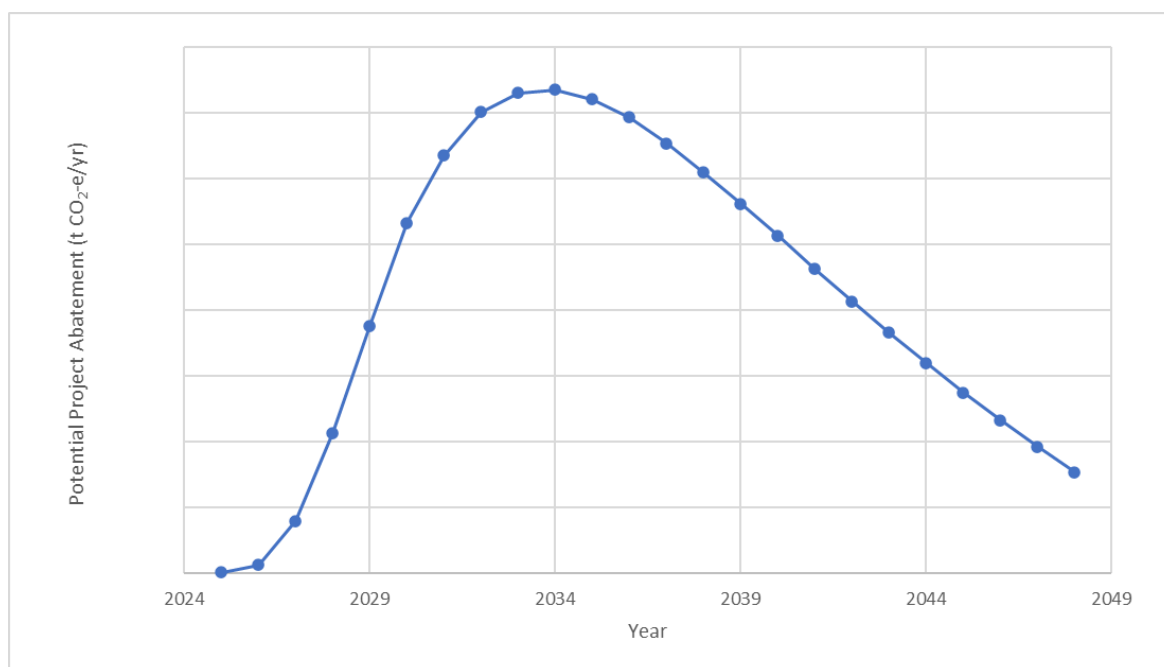


Figure 2. Shape of sequestration curve: Regenerating Sparse Woody framework (Actively Capped).

Naturally Capped

A hypothetical case study has been developed to provide a worked example, demonstrating what a realistic scenario using the Regenerating Sparse Woody framework (naturally capped) may look like.

Situated at the Western coast of WA, with the property extending significantly inland, a 17,000 hectare paddock within a larger cattle station serves as a hypothetical case study for the application of the framework. During the baseline period (i.e., fifteen years prior to the project's registration), the case study paddock maintained an average canopy cover of near 0%. Any woody vegetation was heavily suppressed by overgrazing. The key woody species (as seed banks in the soil, and local to the area) included acacia (shrub-like wattle).

At the project's initiation, baseline canopy cover was measured through extensive field work and CEAs were mapped. This required numerous survey points across the project area to spatially discern vegetation cover across the paddock. Over the next 25 years, the project was assumed to achieve regeneration through the control of suppression activities together with some active management to protect saplings from cattle. Once the paddock achieved a it's maximum ecological benchmark of 15% canopy cover, it was left to sustain this limit naturally. The landscape was not capable of supporting a density higher than this.

The vegetation communities in that paddock had an ecological benchmark potential of 15% canopy cover; no thinning was required, and careful management of suppressors was maintained.

Suppressors, namely unrestricted heavy cattle grazing, were proposed to be managed through 'water and wires' – a combination of exclusion fencing, rotational grazing, and additional water points to distribute grazing pressure more evenly. Once a substantial number of saplings outgrow their vulnerable juvenile stage, cattle may be gradually reintroduced, marking the commencement of a dual-use approach, balancing primary production (grazing) with carbon farming. Economic returns were projected to fund the project and compensated for a gradual reduction in cattle numbers to achieve a consistently healthy stocking density.

Improved land management practices included:

- regular paddock spelling,
- controlled cattle browsing (managing the timing and extent of grazing)
- improving stocking densities to match the land's carrying capacity, and
- targeted weeding and seeding.

The combination of controlled suppressors and active restorative management contributed to the gradual regeneration of the once cleared land to a 15% canopy cover. Annual progress was measured on site and modelled using FullCAM with credits awarded for sequestration that surpassed baseline levels. The annual monitoring of progress was also to ensure that once the vegetation reached the proponent selected density the appropriate discounts could be applied.

Approximately 75,000 ACCUs (representing 100,000 t CO₂-e) were accrued over the course of the project (i.e., 25 years), following the modelled sequestration curve presented below (Figure 3; note that real-world sequestration curves will include fluctuations to account for natural variability and

disturbance events. Discounts are applied to account for this.) Necessary discounts were applied to account for the risk of reversal, the 25-year permanence period, and potential model errors, ensuring the conservativeness of the credited sequestration. Discounts were also applied to account for project-related emissions (e.g., land degradation in other areas of the property resulting from rotational grazing, fuel used during fencing, etc.). Throughout the 25-year project, the vegetation transitioned from a baseline starting point of near 0% canopy cover to a sustained 15% canopy cover (the natural maximum), exemplifying the success of the Regenerating Sparse Woody framework (naturally capped) in achieving substantial and lasting carbon sequestration. Co-benefits included improved ecosystem resilience and ecosystem services, improved soil health and water retention, decreased erosion, increased biodiversity, improved cattle health, and significant economic returns that more than funded the implementation of the project.

Table 3 Hypothetical Case Study Summary: Restoring Degraded Forests Framework (Naturally Capped)

Framework	Regenerating Sparse Woody framework, Naturally Capped
Location	Western Pilbara
Rainfall (annual long term average)	300 mm
Dominant woody vegetation	Acacia (wattle) woodland, with hummock grasslands
Total carbon estimation area	17,000 ha
Baseline canopy cover (average)	0%
Baseline land use	Grazing
Estimated attainable canopy cover, based on known ecological benchmarks	15%
Suppression activities	Unrestricted heavy grazing; overstocking; poor fire management
Suppression management activities	Additional exclusion fencing; additional water points; rotational grazing and paddock spelling; cool burns; cattle browsing grasses (reducing fuel loads); reduced stocking density (later)
Regeneration management activities	targeted weed control; targeted seeding of native woody vegetation in patchy areas;
Final canopy cover (at 25 years)	15%
Change in canopy cover (over 25 years)	+15%
Quantification method	May be possible using FullCAM with calibration and testing
Total new and additional sequestration (t CO ₂ -e) over 25 years	100,000
Total ACCUs (25 years, with 25% discount)	75,000
Gross revenue (assuming \$40/ACCU)	\$3,000,000

Disclaimer: the figures used in this case study are for illustrative purposes only. Further research is required to develop and test the tools, assumptions, and rules for development of a method.

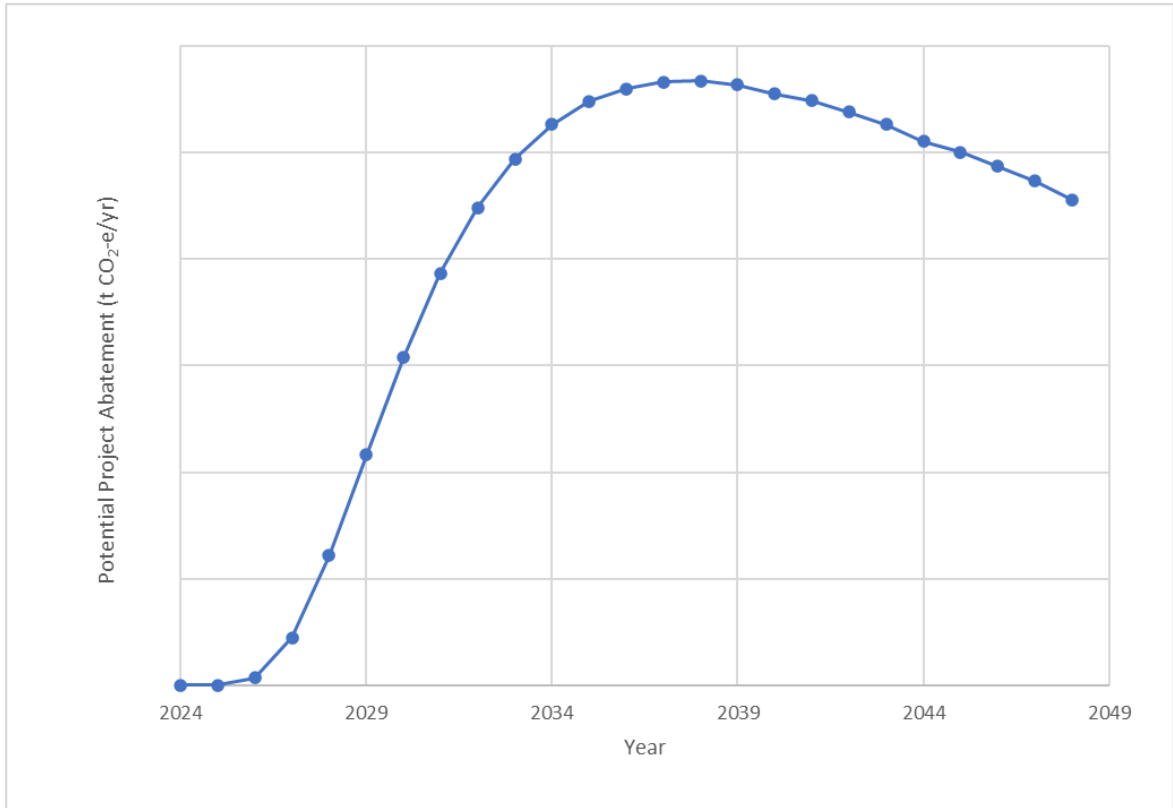


Figure 3. Shape of sequestration curve: Regenerating Sparse Woody framework (Naturally Capped).

7 Forthcoming ACCU Scheme Opportunities and Limitations

7.1 Integrated Farm and Land Management (IFLM) Method

The Department of Climate Change, Energy, the Environment, and Water (DCCEEW) is in the process of formulating an Integrated Farm and Land Management (IFLM) method. The proposed IFLM method aims to amalgamate various soil and vegetation sequestration methods into a unified approach to streamline several ACCU Scheme methods (with modifications) in combination with the development of new methods and associated activities.

According to DCCEEW in the draft Proposed Integrated Farm and Land Management Method issues paper (2023c), the proposed IFLM method would combine activities from the following existing methods into one method:

- Human-induced regeneration (HIR) method
- Native forest from managed regrowth (NFMR) method
- Reforestation and Afforestation method
- Environmental and mallee plantings method
- Soil 2021 method

The inclusion of other methods may be considered for future iterations of the method.

Through amalgamating existing method activities and combining these with new activities, the proposed eligible IFLM activities would include:

- Human-induced regeneration of a permanent even aged native forest
- Managed regrowth of native forest
- Planting or seeding to establish permanent forest
- Soil management activities that increase soil carbon
- Infill planting of native vegetation, to assist regeneration (new)
- Sequestration of soil carbon from vegetation activities (new)

The draft IFLM Issues paper (DCCEEW, 2023c) notes that the proposed IFLM method could include multiple eligible project activities across one or more adjoining properties. Project proponents undertaking an IFLM project will be able to receive ACCUs for both the sequestration of carbon in vegetation and in soil within a project's carbon estimation area (CEA). This flexibility and variety represents a foundational shift in the ACCU Scheme opportunities presented to land managers.

Additionally, the method is slated to introduce a novel strategy for estimating sequestration in woody biomass (referred to as the 'hybrid approach'). Regarding sequestration quantification and measurement, the proposed method will provide three measurement options:

- FullCAM (this option will continue)
- Measurement only (for soil carbon)
- Hybrid approach (new)

Typically, sequestration estimation in woody biomass was conducted through FullCAM measurements, enhanced by ground-truthing. The hybrid approach will allow proponents to use a

geospatial model of their choosing to estimate sequestration in woody biomass. The model must be validated and ground-truthed. It is likely that there will be no minimum model accuracy threshold (unlike current methods). Instead, project crediting will be discounted according to model performance (i.e., the level of inaccuracy in the model). This model-agnostic approach therefore aims to incentive innovative model development and would negate the need for FullCAM. Accordingly, it is likely that model restrictions associated with FullCAM (discussed in Section 5.2) will also be negated, allowing for greater flexibility in sequestration quantification. Further, the optional use of LiDAR, together with allometric functions and ground-truthing, may be incorporated within the hybrid approach. Standards for LiDAR use are currently in development.

The IFLM method presents a significant opportunity for the incorporation of the frameworks presented in this report – either in principle or in full. Firstly, if the removal of the 20% canopy cover threshold is adopted by the IFLM method, the use of the hybrid approach could facilitate the Regenerating Sparse Woody framework. Secondly, if the IFLM method went further to include changes to existing forest carbon stocks (perhaps in relation to the proposed infill planting of native vegetation activity) then the IFLM method may also facilitate the Restoring Degraded Forests framework. The hybrid model allows for infill planting to be measured, and this may provide an avenue into quantifying sequestration from restoration. The integration of these frameworks into the IFLM method would greatly enhance the accessibility of the method.

Currently, DCCEEW are actively seeking stakeholder engagement in the development of the method. Regular technical workshops are being held with open invitations encouraging stakeholder participation. Given DCCEEW's openness to industry feedback and participation in the method's development, it is likely that DCCEEW would welcome feedback from DAF that highlighted the frameworks described in this report. This is time sensitive however, as the window for active industry stakeholder engagement is closing (see Table 4).

Table 4. Indicative Timeline of IFLM Development (DCCEEW, 2023a)

Key milestone/deliverable	Indicative Timing
Method development moved from CER to DCCEEW	March 2023
HIR method expired	September 2023
Finalise method development through a co-design approach with stakeholders	Info session #1: 5 October Technical workshops: October – December
2 additional information sessions to provide update on progress by technical working groups	November – December 2023
Legislative drafting of draft method	November 2023 – January 2024
Consultation on exposure draft method (subject to ERAC approval to release)	February – March 2024
ERAC assessment of draft method against the Offsets Integrity Standards	April 2024
Ministerial consideration to make the method (subject to ERAC approval)	May – June 2024

Other proposed aspects unique to the IFLM method are listed below:

- Enhanced conservativeness measures. For example, extending the baseline period from 10 to 15 years.
- Whole-of-property accounting (proposed for soils and regeneration activities only; not planting activities). The project area will be set to the property and will include **creditable carbon estimation areas** (CCEAs: activities occur within these zones and credits can be earned) and **non-creditable carbon estimation areas** (NCCEAs: carbon stock estimated in these zones to account for possible carbon leakage).
- Option to include soil sequestration in reforestation projects.
- No option for emissions avoidance activities; only sequestration.
- Fire management as a regeneration activity, potentially including wildfire as an eligible suppressor.
- A new public release version of FullCAM.

Aspects of the proposed IFLM method that are still in development include, but are not limited to:

- Measures to enhance conservativeness.
- Making the whole-of-property accounting work.
- Accounting for emissions from fire.
- Rules for projects transitioning from old methods.
- Addressing woody biomass removals.
- Accounting for onsite energy use emissions.
- Decisions pertaining to lime and fertiliser application.
- Fair and reasonable LiDAR protocols.
- Minimum height requirements in stand inventories.
- Approved databases for converting volume of biomass to weight of carbon.
- Approved allometric functions.

The integration of diverse activities and the introduction of new abatement estimation approaches will create new opportunities for project proponents. Implementing these opportunities and improvements while balancing method accessibility and integrity presents a complex challenge (DCCEEW, 2023c).

Limitations

It is difficult to anticipate the limitations of a method that is not yet defined with much certainty. As it stands, the limitations of the proposed IFLM method may include:

- Increased burden on participants associated with whole-of-property accounting (e.g., the compulsory sampling of the entire property instead of a proponent-defined project area).
- Increased burden on participants associated with the extension of the baseline period (e.g., retrospective assessment over a longer period, and the increased burden-of-proof to provide evidence of suppression over this time).

- Potentially prohibitive costs associated with largescale LiDAR application if this is required regularly.
- Ambiguity resulting from the method's attempt to streamline several methods into one (including modifications of existing methods and the addition of new activities) could cause confusion and hesitancy among potential proponents.
- Without the incorporation of the frameworks presented in this report, the barriers-to-entry addressed in Section 2 (i.e., restrictively narrow definitions about what can be credited as sequestration) will remain, severely limiting the potential land area available to the method.

7.2 Proponent-led Method Development Process

The ACCU Review (DCCEEW, 2023b) recommended a shift from the current government-led method development process to a proponent-led approach. This change aims to encourage innovation and wider adoption of carbon abatement methods by allowing proponents flexibility in proposing and developing methods. The Emissions Reduction Assurance Committee (ERAC) is proposed to be replaced by a new Carbon Abatement Integrity Committee (CAIC), an independent expert body responsible for ensuring method integrity under the proponent-led development process. The revised process permits method developers, including industry stakeholders and experts, to submit method proposals to the Integrity Committee, fostering a collaborative approach between stakeholders during the development of a new method. The Integrity Committee will work with method developers and the department to continuously enhance the proponent-led approach and update guidelines. This new process prioritizes transparency and accessibility, with the Integrity Committee triaging proposals and prioritizing methods for Ministerial consideration. Method developers will take the lead in developing new methods, providing flexibility and fit-for-purpose solutions, as proposed by the ACCU Review.

Figure 4 demonstrates the proposed flow of the proponent-led method development process. The process begins with an expression of interest (EOI) lodged by the proponent. The EOI must comply with the *Carbon Credits (Carbon Farming Initiative) Act 2011* (the 'CFI Act') objectives, aligning with the offsets integrity standards, ACCU Scheme principles, and scheme participation requirements. Once lodged the Carbon Abatement Integrity Committee (CAIC) drive the triage and approval processes. Pending a successful ministerial approval, the Clean Energy Regulator (CER) adopts the method and makes it available to potential proponents for registration.

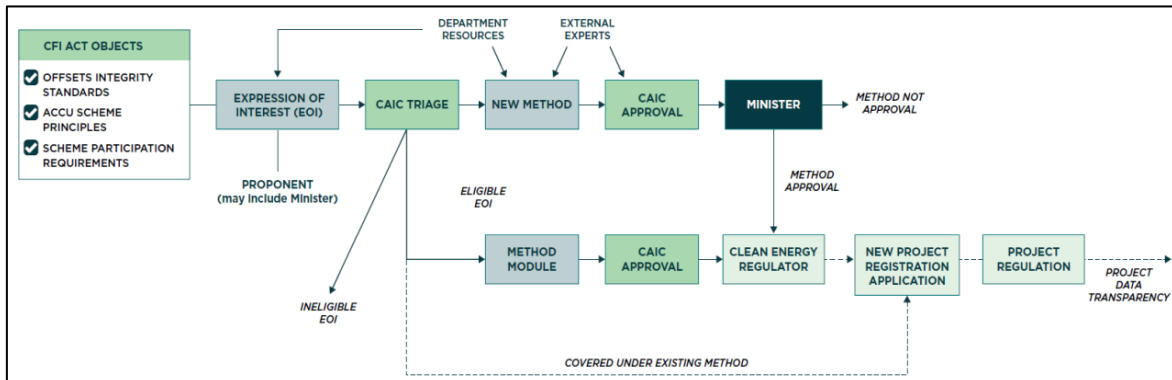


Figure 4. Proponent-led process for method development and modification, as proposed by the ACCU Review (Chubb *et al.*, 2022).

The creation of a proponent-led method development process was triggered by recommendation 5 of the ACCU Review. According to the ACCU Review: to enhance emissions reduction efforts, a shift towards a modular, proponent-led approach in method development is crucial. The current process hinders timely and effective emissions reductions, prompting the need for a more flexible and transparent model. The proposed proponent-led approach encourages innovation and adaptability in carbon abatement strategies, fostering a diverse portfolio of methods for scalable emissions reduction. This model aligns with international practices and emphasizes the importance of clear, independently peer-reviewed evidence to support method development. The objective is to create a transparent, accessible, and scientifically sound framework that incentivizes a variety of emissions reduction options.

The specifics of this recommendation are summarised below:

ACCU Review Recommendation 5: proponent-led method development process (Chubb *et al.*, 2022)

- Establish a transparent proponent-led process for developing and modifying methods as soon as practicable, with the CAIC assuring the integrity of methods and the Department providing support for participants who otherwise may not be able to participate:
 - Replace current priority setting process with an open EOI process, with the CAIC involved in setting priorities for method endorsement and approval. The Minister may nominate priorities but is not required to do so.
 - The Minister is not obliged to approve any method.
 - The Minister may only make or vary methods which have been endorsed by the CAIC.
 - Before making or varying a method, the Minister must be satisfied that it complies with the Offsets Integrity Standards (OIS) and ACCU Scheme Principles.
 - The CAIC must only endorse a method if it is satisfied that it complies with the OIS.

- The Minister and the CAIC must publish reasons for recommendations and for decisions.
- The Department should support method development, including supporting community and NGO participation. Support could include allocation of staff resources, grants and other mechanisms.
- The proposed process should apply to methods currently in development.
- Until the CAIC is established, the Department should develop a framework for proponents to follow when proposing and developing methods and modifications.

A framework for proponent-led method development is currently being developed. As such, there is currently no option to participate in the proponent-led development process. Once this framework is established, it may provide a significant opportunity to advance the objectives of the frameworks discussed in this report. An interim framework for this process will likely become available during 2024. Until the EOI process has been developed, the proponent-led method development process will not be applicable to the potential development and implementation of the Restoring Degraded Forests and Regenerating Sparse Woody frameworks.

Limitations

It is difficult to anticipate the limitations of a process that is not yet defined with much certainty. As it stands, the limitations of the proposed proponent-led method development process may include:

- The shared responsibility between stakeholders to collaboratively develop a process may stifle development (e.g., stakeholders, such as consultancies, may be unwilling to share their intellectual property or to collaborate with competing consultancies).
- Without an authoritative body to oversee the method development, disagreements between method developers may stifle development; there is no clear leadership structure which would govern the development and the timeliness of such development.
- There is little incentive for stakeholders to release their intellectual property to the general marketplace.
- Conflict of interest issues may arise when stakeholders are developing the method from which they will financially benefit from.
- By opening the EOI opportunity to the public, there is the potential for multiple similar methods to be proposed; this is the opposite of the streamlining of methods that the IFLM aims to achieve.

7.3 Insetting method

Offsetting refers to greenhouse gas removals which are credited and able to be transferred between entities. Offsetting is principally concerned with criteria regarding additionality, permanence, credible baselines, monitoring, and independent verification.

Offsetting was designed to provide a system for verified removals (and emission reduction) from businesses, enabling these removals to be credited and transferred to other businesses to reduce their carbon account, either voluntarily or because of regulation. This system has been used to

incentivize action on climate change by purchasing credits, assisting Australia to meet its climate commitments. In relation to the agricultural sector, the offsets system provides benefits to producers who can participate in the market, including diversified income streams, positive environmental action and environmental co-benefits.

However, businesses need to demonstrate their action on climate change to support the trade of their outputs and products. Within the offsetting system, carbon credits are freely traded and there is no traceability of the abatement (carbon credit). In other words, businesses are decoupled from the carbon credits which they generate.

By contrast, insetting refers to greenhouse gas removals that occur within an entity's defined emissions boundary. Insetting is principally concerned with the criteria of on-going storage monitoring and traceability.

Insetting's core purpose is to verify sequestration on a carbon account to provide a complete assessment of emissions and removals. By definition, carbon accounts are reported retrospectively and are primarily concerned with verifying actual emissions and removals. Insetting is different from offsetting in that no tradable "Credit" is created. Rather, a verified line item is included in the carbon account where values indicating sequestration exist.

In the Australian Government's Climate Active program, emissions and sequestration (offsets) are handled independently. Strictly, for a project to demonstrate carbon neutrality and generate offsets onsite, it would need to separately register a carbon offset project (for example an ACCU Scheme project) and deliver these carbon credits so that they can be retired against a carbon neutral product. This creates a series of barriers to participation for land managers such as beef cattle producers. The barriers are:

1. This introduces two regulatory systems, each with audits and compliance costs.
2. The ACCU Scheme is a complex system that has been adopted predominantly by very large entities with unique opportunities to sequester large volumes of carbon. In contrast, carbon neutrality is attractive to supply chains with many smaller beef producers and who may have much smaller carbon sequestration activities than are required to be viable under the ACCU Scheme.
3. The ERF has strict newness criteria that rule out carbon sequestration occurring on farms as part of ongoing activities (such as from trees planted 5 years ago). These activities are contributing to negative emissions (sequestration) on the carbon balance but cannot be counted towards carbon neutrality under Climate Active. This does not reflect the true state of the carbon balance and therefore does not reflect the biological 'carbon neutrality' of the production system. It is also a conceptual barrier to participation, because participants feel they are not being credited for positive action (sequestration) despite being deducted for emissions.

Because insetting addresses these three barriers-to-entry into the carbon market, the inclusion of insetting as an optional outcome of a sequestration project aligns with the goal of developing frameworks that are more accessible to land managers. For instance, the opportunity to inset would be particularly attractive to smaller scale carbon projects that might not have the returns on

investment needed to facilitate a fully audited ACCU Scheme method. While the frameworks are designed to be agnostic to inseting or offsetting, the actual application and auditing of the framework (and therefore the project-specific expenses) may vary depending on the output chosen. For instance, offsets require more stringent auditing processes throughout the life of the project. These differences would be refined at a later stage through policy-related questions that are beyond the scope of the conceptual development of the frameworks described in this report. Despite this, the quantification and verification approaches of the frameworks (outlined in sections 5.2, 5.3, 6.2, and 6.3) are designed to be applicable to either offsetting or inseting applications of the frameworks.

While the framework for the first inseting method has been fully developed (currently limited to tree plantings), the inseting guidelines are pending approval from the Climate Active review committee before inseting can be accessed by prospective proponents. An approval of the guidelines is expected to be published in the coming months.

8 Conclusion and Recommendations

A review of core vegetative ACCU Scheme methods, together with a thorough understanding of the barriers-to-entry faced by land managers, has identified gaps in available sequestration methods that inhibit a more widespread uptake of sequestration projects. By balancing realistic production needs, high integrity standards, and accessibility, this report has outlined the conceptual development of two frameworks that bridge these gaps.

The Restoring Degraded Forests framework focuses on actively restoring degraded forests to their ecological benchmarks, recognizing the substantial carbon sequestration potential gap between a degraded state and ecological equilibrium. Through systematic processes and active management, this framework quantifies and incentivizes the additional carbon sequestration resulting from successful restoration efforts. The technical avenues explored, such as the Forest Growth Model (e.g., 3-PG), enhance the feasibility of implementation. However, potential policy issues need consideration to ensure the effectiveness and fairness of the frameworks.

The Regenerating Sparse Woody framework introduces a departure from existing methods by allowing partial regeneration without imposing a mandatory 20% canopy cover threshold. This flexibility addresses the challenges faced by landholders who cannot achieve this threshold because of production and/or landscape constraints. The framework accommodates both actively capped and naturally capped scenarios, providing options that balance accessibility with positive environmental outcomes.

The hypothetical case studies illustrated how proponents can successfully restore degraded forests or regenerate cleared land, either actively managing canopy cover at a certain density or allowing it to reach its ecological equilibrium. The quantification and verification processes, along with necessary discounts, ensure the credibility of awarded offsets or insets, serving as tangible incentives for regeneration.

These frameworks offer pragmatic solutions to enhance carbon sequestration through the restoration of degraded forests and the regeneration of sparse woody landscapes. The combination of conceptual clarity, technical feasibility, and policy considerations positions these approaches as valuable tools in addressing the pressing environmental challenges associated with degraded ecosystems.

The carbon market in Australia is currently undergoing multiple critical shifts. Following the ACCU Review, the Clean Energy Regulator has overhauled the pre-existing Emission Reduction Fund, replacing it with the ACCU Scheme. This transition comes with new, stakeholder-focused ways of developing methods, led by DCCEEW. The imminent development of the Integrated Farm and Land Management (IFLM) method and the forthcoming Proponent-Led Method Development Process represent significant opportunities to launch the frameworks discussed in this report into recognised carbon market channels.

Accordingly, it is recommended that the Department presents the frameworks described in this report to DCCEEW as feedback pertaining to the development of the IFLM. DCCEEW are actively engaging industry stakeholders to participate in the IFLM development. They are seeking feedback from the industry as to what is reasonable and applicable. Given the timelines outlined by DCCEEW,

this is a time-sensitive recommendation. This report clearly outlines key barriers-to-entry and provides solutions to these barriers through conceptual frameworks, noting technical avenues and potential limitations. This information would be valuable to DCCEEW as they consider the technical aspects of the activities included under the IFLM. Therefore, this window of opportunity provides an ideal platform for the uptake and wider discussion of the ideas and concepts outlined through the frameworks presented in this report.

Secondly, it is recommended that the Department seeks to lodge (or oversee the lodgement of) an expression of interest into the Proponent-Led Method Development Process once that pathway is established. Failing the successful uptake of the frameworks into the IFLM, this pathway would represent a promising avenue to develop methods that align with the goals of the frameworks set out in this report. The details presented here would allow for comprehensive expressions of interest and agendas that would drive innovation towards accessible and high-integrity methods that align with the Restoring Degraded Forests and Regenerating Sparse Woody frameworks. Given that the Proponent-Led Method Development Process is in its infancy, the Department would have sufficient time to assess if the IFLM satisfactorily incorporates the elements of the frameworks before it decides whether the lodgement of an expression of interest is needed.

Thirdly, it is recommended that the Department seeks to actively participate in the development of methods that align with the frameworks. In particular, the Department is well placed to advocate for land managers and the production constraints they face. Through its interactions with graziers and the agricultural sector more broadly, the Department understands the need for improved accessibility into the carbon market, as well as the need to incentivise carbon sequestration so that optimal land management and environmental conservation becomes an economically viable opportunity for land managers. The details pertaining to barriers-to-entry and the science of regeneration, as presented in this paper, would inform the advocacy that the Department may undertake on behalf of the agricultural sector. Active engagement in the development of methods, especially at this critical transitional period within the ACCU Scheme, is critical to guiding a sustainable and carbon-engaged agricultural sector that seeks to increase its carbon sequestration.

The proposed frameworks for restoring degraded forests and regenerating sparse woody landscapes offer innovative approaches to carbon abatement, outlining key conceptual, technical, and policy challenges. These frameworks successfully provide more accessible pathways into the carbon market. If these frameworks become legislated options for inseting and offsetting, land manager participation in the carbon sequestration market can be expected to increase substantially, and an incentive will exist to vegetate extensive areas of Australia that would otherwise remain degraded or cleared.

References

- Australian Government. (2023a) *Carbon Credits (Carbon Farming Initiative) Act 2011*. Available at: <https://www.legislation.gov.au/Details/C2023C00399> (Accessed: 22 November 2023).
- Australian Government. (2018a) *Carbon Credits (Carbon Farming Initiative) (Human-Induced Regeneration of a Permanent Even-Aged Native Forest—1.1) Methodology Determination 2013*. Available at: <https://www.legislation.gov.au/Details/F2018C00125> (Accessed: 22 November 2023).
- Australian Government. (2018b) *Carbon Credits (Carbon Farming Initiative) (Native Forest from Managed Regrowth) Methodology Determination 2013*. Available at: <https://www.legislation.gov.au/Details/F2018C00119> (Accessed: 22 November 2023).
- Australian Government. (2018c) *Carbon Credits (Carbon Farming Initiative) (Reforestation by Environmental or Mallee Plantings—FullCAM) Methodology Determination 2014*. Available at: <https://www.legislation.gov.au/Details/F2018C00118> (Accessed: 22 November 2023).
- Australian Government. (2023b) *Carbon Credits (Carbon Farming Initiative) Rule 2015*. Available at: <https://www.legislation.gov.au/Details/F2023C00811> (Accessed: 22 November 2023).
- Chubb, I. *et al.* (2022) *Independent Review of Australian Carbon Credit Units - Final Report*. Available at: <https://www.dcceew.gov.au/sites/default/files/documents/independent-review-accu-final-report.pdf> (Accessed: 22 November 2023).
- Clean Energy Regulator. (2023) *About the ACCU Scheme*. Available at: <https://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund> (Accessed: 22 November 2023).
- DCCEEW. (2023a) 'IFLM Method Development Stakeholder Update Session'.
- DCCEEW. (2023b) *Independent Review of ACCUs - Implementation*.
- DCCEEW. (2023c) *Proposed Integrated Farm and Land Management Method - Issues Paper (DRAFT)*.
- Hughes, N. *et al.* (2022) 'Modelling the Effects of Climate Change on the Profitability of Australian Farms'. *Climatic Change*, 172(1), p. 12. DOI: 10.1007/s10584-022-03356-5.
- Trotsiuk, V., Hartig, F. and Forrester, D.I. (2020) 'R3PG—An r Package for Simulating Forest Growth Using the 3-PG Process-based Model'. *Methods in Ecology and Evolution*, 11(11), pp. 1470–1475. Available at: <https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/2041-210X.13474> (Accessed: 22 November 2023).
- Trotsiuk, V., Hartig, F. and Forrester, D.I. (2023) *The R3PG R Package*. *r-project.org*. Available at: <https://cran.r-project.org/web/packages/r3PG/vignettes/r3PG-ReferenceManual.html> (Accessed: 22 November 2023).