Farmlands to Reef Regeneration Fund Project

Blue Carbon Financial Feasibility Assessment

The Nature Conservancy Australia

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Introduction

Kilter Rural and The Nature Conservancy (TNC) partnered with the Great Barrier Reef Foundation (GBRF) to undertake a feasibility study into a long-term, landscape scale, impact investment fund that seeks to deliver positive environment and biodiversity outcomes for the Great Barrier Reef (GBR) and its catchments.

The Farmland to Reef Regeneration Fund (FRRF) was proposed as a mechanism to channel private investment capital into an integrated approach to farmland, water, and ecosystem regeneration to address the interdependent stresses to land and marine environments in the GBR catchments. By purchasing land and transitioning agricultural operations into BMP and regenerative practices while conserving key biodiversity assets. It was envisaged to deliver a profitable agricultural operation; improvements to the condition of the GBR through improved water quality; protection and regeneration of terrestrial and aquatic biodiversity assets; and to contribute substantially to climate change mitigation and adaptation.

Using a case study methodology, financial and environmental modelling were undertaken to assess the feasibility of the FRRF model, focusing on sugarcane and grazing agricultural systems in the Burdekin and Fitzroy basins. These areas and sectors were selected based on a range of factors that identified them as the most potentially profitable areas with the greatest potential environmental impact. However, this modelling showed that the FRRF, as originally envisaged, would be unlikely to provide an adequate financial return, primarily due to the historically high land values in the region coupled with the still low market price for carbon credits.

Nonetheless, the analysis and modelling developed for this project was deemed to be of considerable value and it was decided to extend the scope of the original project. This final phase undertakes preliminary analysis of the potential for converting sugarcane and grazing properties in the Burdekin and Fitzroy catchments into blue carbon projects.

The Tidal Restoration of Blue Carbon Ecosystems method, approved by the Clean Energy Regulator in 2022, aims to sequester carbon through reintroducing tidal flows and re-wetting previously drained coastal wetland ecosystems. Over many years, the coastline of the GBR catchments has been extensively modified and their original wetland systems drained. While such areas in many cases still represent productive agricultural landscapes, many properties are facing growing risks from factors like sea level rise, flood events and storm surges because of climate change.

Over time, the productivity and hence values of these modified coastal lands are likely to decline and may further contribute to excess runoff entering GBR lagoons[1]. Transitioning such lands back to coastal wetland systems in a controlled fashion would moderate the need for, often sub-optimal, short-term management responses to climatic events. Blue carbon could provide landholders with a source of revenue to offset the drop in productivity and at least a buffer to capital values. The broader economic analysis of implementing blue carbon is still in early stages, and it is yet to be determined if this is a financially viable option for landholders[2]over the longer term. Our analysis documented in this report provides another piece to this puzzle, albeit in the form of a current snapshot.

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[1] Williams, A., 2016. *Climate change impacts on coastal agriculture. CoastAdapt Impact Sheet 11*, National Climate Change Adaptation Research Facility, Gold Coast.

[2] Hagger, V., Waltham, N.J. and Lovelock, C.E., 2022. Opportunities for coastal wetland restoration for blue carbon with co-benefits for biodiversity, coastal fisheries, and water quality. *Ecosystem Services*, *55*, p.101423.

Blue Carbon Financial Model Case Studies

Overview

Kilter has developed a simplified cane and grazing financial model to facilitate the analysis of existing farmland in the Burdekin and Fitzroy regions for conversion into a blue carbon project. This model incorporates learnings from the financial modelling carries out in previous phases, but workings are simplified to provide a high-level evaluation of investment potential, given the relatively untested nature of a blue carbon project.

A blue carbon project enables Australian Carbon Credit Units (ACCUs) to be generated through the removal or modification of tidal restriction mechanisms and the subsequent introduction of tidal flows to a land area. Farmland committed to this cause will result in its land bank being inundated with sea water. This would redefine its coastal line and, unless an exceptionally large property, result in its farming operations not resuming thereafter. This will clearly have a material impact on land valuations and makes allocating land to a blue carbon project a challenging proposition for existing landowners without adequate compensation.

As for any valuation problem, to be feasible, the present value of the net cashflows from a blue carbon project needs to match up to at least the current land value, or its alternative highest and best use, for generating other operating income. Hence, a discounted cash flow (DCF) or a net present value (NPV) method is used for this analysis.

In this report analysis is run to compare future cashflows, that is income from the sale of ACCUs coupled with the expected costs to run the project, with the valuation of the land. If the net present value is higher than the current valuation, then the blue carbon project has the potential to be attractive to the landowner. This is then tested against several scenarios as per below.

- Current land value;
- Possible declining land values due to rising sea levels;
- Sensitivity analysis on different carbon prices;
- Including additional biodiversity and/or reef credits income that can be hypothetically be generated.

The properties and the generation of ACCUs modelled are derived from Firescapes Science and Seascape Life (FSSL) analysis on the Burdekin and Fitzroy region dated August 2023.

Limitations

- For practical GIS processing purposes, FSSL has narrowed interest areas to eight smaller areas (seven in the Burdekin and one in the Fitzroy). However, full datasets and base maps were only available for six of the eight interest areas. Hence, only these areas are compared here.
- It is noted that the interest areas identified do not correspond with individual property borders but, except for the 'SW' interest area which is significantly larger, the size of the interest areas are deemed to correspond to a minimum critical mass, or level of aggregation, needed to register a blue carbon project within reasonable cost boundaries.
- The assessment is focused foremost on financial factors and does not address some of the potentially complex issues related to blue carbon projects such as governance, planning and

legal topics, alternative adaptation and risk management activities, community engagement or cultural/political risks that may be relevant for this type of activity.

- The method assumes that the existing landowner would be the owner of all generated carbon credits, even if submerged lands may revert to crown ownership. There is still some uncertainty around this [3] but it should not prevent the contracting of carbon rights.
- The assessment does not include potential increases in BAU insurance costs related to climate-related impacts such as increased magnitude and frequency of climatic events and sea level rise. Such costs could be significant as climate impacts in coastal areas become more pronounced[4].
- The assessment does not incorporate other potential climate change impacts such as rainfall patterns, cloud cover, temperature increases or the changes these may bring to farming productivity and profitability[5].

[3] Bell-James, J. and Lovelock, C.E., 2019. Legal barriers and enablers for reintroducing tides: An Australian case study in reconverting ponded pasture for climate change mitigation. *Land use policy*, *88*, p.104192.
[4] Fuerst, F. and Warren-Myers, G., 2021. Pricing climate risk: Are flooding and sea level rise risk capitalised in Australian residential property?. *Climate Risk Management*, *34*, p.100361.
[5] Hughes, N., Lu, M., Soh, W.Y. and Lawson, K., 2022. Modelling the effects of climate change on the profitability of Australian farms. *Climatic Change*, *172*(1-2), p.12.

Table 1 below shows a summary of key findings of the case studies undertaken in this report.

Table 1 Summary findings of the case studies

Project	B1a	B1c	B2	B3	B4	SW
Location	Burdekin	Burdekin	Burdekin	Burdekin	Burdekin	Fitzroy
Study Area (ha)	3,136	1,616	2,033	860	2,753	27,560
Project Area (ha)	2,806	1,462	1,764	629	2,492	18,043
Net Abatement (ACCUs)	1,144,190	611,671	480,235	518,317	1,401,268	13,265,184
ACCUs per ha/year	4.1	4.2	2.7	8.2	5.6	7.4
Land Value ($/ha)	$14,407	$14,728	$14,900	$13,225	$11,819	$2,553
BAU deteriorated Land Value after sea level rise ($/ha)	$6,514	$11,325	$10,276	$1,942	$1,722	$778
NPV @ 8% ACCU price@ $100 ($/Ha)	$3,527	$4,400	$1,578	$4,876	$4,508	$3,019
NPV @ 8% ACCU price @ $300 ($/Ha)	$12,043	$14,757	$6,247	$16,466	$14,923	$9,782
Land value against NPV (ACCU@$100)	**-76%**	**-70%**	**-89%**	**-63%**	**-62%**	**18%**
BAU deteriorated Land Value after sea level rise against NPV (ACCU@$100)	**-46%**	**-61%**	**-85%**	**151%**	**162%**	**288%**
Land Value against NPV (ACCU@$300)	**-16%**	**0%**	**-58%**	**25%**	**26%**	**283%**
Land value against NPV (ACCU@$300; with Reef Credits	**-12%**	**6%**	**-52%**	**25%**	**27%**	**285%**
Land value against NPV (ACCU@$300); with Biodiversity Credits	**16%**	**33%**	**-38%**	**92%**	**81%**	**479%**
Reef Credits	4,444	3,402	4,677	14	359	3,017
DIN (kg)	4,041	3,266	4,493	0	244	163
Sediment (tonnes)	217	73	99	8	62	1,535
Biodiversity/Year	5,721	3,058	2,401	2,592	7,006	66,326

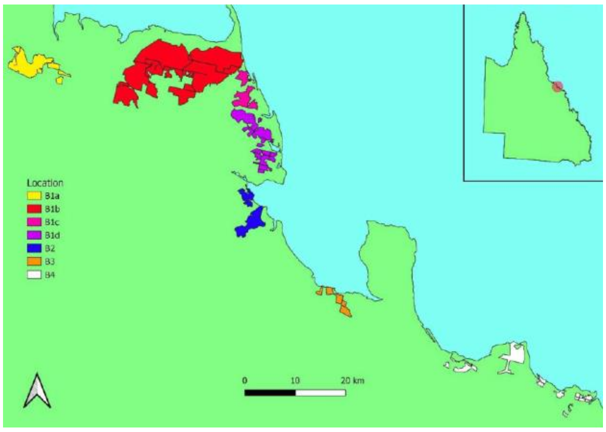
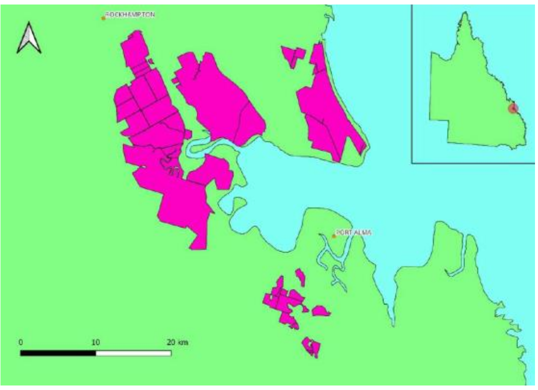
Key findings here include:

- Land valuation is key in determining whether a blue carbon project will be undertaken by landholders. A lower land valuation will result in a project being more likely to meet return hurdles for landholders. Out of the six case studies, only the "SW" interest area in Fitzroy, indicates some potential to be considered for a blue carbon project today – driven by much lower relative land pricing.
- BAU farm productivity, and hence farmland values, are likely to deteriorate over time and in line with rising sea levels. This may give rise to more landholders taking up a blue carbon project for income.
- A higher carbon pricing will result in higher returns derived from the blue carbon project. This increases the likelihood of take-up by landholders.
- The ability to add other income sources to the project, such as reef credits and/or biodiversity credits will further increase the likelihood of take-up. However, at $50/unit, reef credit income is not currently sufficient in getting a project across the line. The market for biodiversity credits holds hope for the future but is still largely unproven.

Project Area

Our analysis from previous project phases on taking an integrated approach to farmland, water, and ecosystem regeneration that will deliver both profits and improve the condition of the Great Barrier Reef (GBR) helped narrow the geographical scope to the Burdekin and the Fitzroy catchments in Queensland. To qualify for a blue carbon project, (legally) manmade tidal restrictions such as gates and bund walls need to be removed and tidal flow to be introduced to the land area. TNC engaged Firescapes Science and Seascape Life (FSSL) to analyse the potential of establishing blue carbon projects in these catchments. FSSL has refined its study area to cover 30,504 hectares in the Burdekin region and 27,560 hectares in the Fitzroy region, with a focus on freehold land used for sugar production and grazing area that is expected to be inundated by seawater within the next 100 years.

Table 2: Maps of areas studies in the Burdekin and Fitzroy region

For practical GIS processing purposes, FSSL narrowed the interest areas to eight smaller areas (seven in the Burdekin and one in the Fitzroy). However, complete datasets and base maps were only available for six of the eight interest areas. Hence, only these areas are compared in this paper. The table below shows the key area breakdown of the six areas undertaken.

Table 3: Summary area breakdown and net carbon abatement potential by interest/project area

Project	B1a	B1c	B2	B3	B4	SW
Total Area	**3,131**	**1,612**	**2,040**	**736**	**2,753**	**33,767**
Study Area	*3,136*	*1,616*	*2,033*	*860*	*2,753*	*27,560*
Net Abatement (ACCUs)	1,144,190	611,671	480,235	518,317	1,401,268	13,265,184
ACCUs per Ha/year	4.1	4.2	2.7	8.2	5.6	7.4
Sugarcane Land	14%	23%	25%	-	1%	-
Cropping Land	4%	-	-	-	1%	3%
Grazing Land	45%	36%	33%	76%	52%	67%
Other land area*	37%	41%	42%	24%	46%	30%

**Other land area includes forest, mangroves, wetland, saltmarsh, flooded agricultural land, saline water bodies, drainage channel/ditches, seagrass, ponds and other constructed water bodies*

Current land valuation

Current land values are assessed based on their uses. The key farmland areas are valued at market assessable values with other land areas such as forestry and wetlands (non-income generating) assumed to be at 50% of pasture/grazing land values. The model assumed a $27K/ha price for sugarcane and a $15K/ha price for grazing land in the Burdekin. In the Fitzroy region, grazing land is priced at $3K/ha.

There are large variations in individual property prices and the amount of recent sales volume is limited. Actual pricing can also be detracted with the inclusion of infrastructure such as homes and equipment in the total sales value. Nevertheless, sugarcane area in the Burdekin is currently priced at around $25K - $28K/ha, and an irrigated pasture area in the Burdekin was recently sold at around $13K/ha.

Grazing land in Fitzroy River is priced around the $2K-$3K/ha mark. Previous work suggests that grazing land can be priced based on their carrying capacity. Previous pricing put the Fitzroy region at $15K-$20K per LSU. At a median rainfall of 770mm in this area, and assuming a carrying capacity of 13 SDH/100mm (stock day holding per 100mm rainfall), the carrying capacity is estimated at 3.65 LSU per hectare. At the lower band of $15K/LSU, this puts the land price at around $4K/ha.

However, the Eastern States Young Cattle Indicator (ESYCI), a measurement of the price of cattle in the Australian eastern states based on an average seven-day rolling price expressed in kilogram of carcass (or dressed) weight ($/kg cwt), has fallen from $10.40/kg cwt in October 2022 to $3.60/kg cwt in October 2023. With that, a price of $3K/ha is assumed in the calculation of grazing land in the Fitzroy region.

Table 4: Recent estimated land sales price in the Burdekin and Fitzroy catchment

Location	Catchment	Basin	Km from coast	Enterprise	Property Area (Ha)	Estimated Price	Est. Value ($/ha)
Ayr	Burdekin	Burdekin	2	Sugarcane	211.89	$6.00M	$28,317
Osborne	Burdekin	Burdekin	22	Sugarcane	123.29	$3.40M	$27,577
Horseshoe Lagoon	Burdekin	Burdekin	22	Grazing	60.30	$0.83M	$13,765
Home Hill	Burdekin	Burdekin	17	Sugarcane	147.00	$4.10M	$27,891
Osborne	Burdekin	Burdekin	22	Sugarcane	123.00	$3.10M	$25,203
Ayr	Burdekin	Burdekin	2	Sugarcane	18.00	$0.24M	$13,056
Ayr	Burdekin	Burdekin	2	Sugarcane	49.00	$1.25M	$25,510
Mountain hut	Fitzroy River	Fitzroy	40	Grazing	3,508.00	$6.95M	$1,981
Diglum	Boyne river	Fitzroy	30	Grazing	1,262.00	$1.30M	$1,030
Oakey Creek	Fitzroy River	Fitzroy	25	Grazing	506.00	$0.95M	$1,877
Raglan	Fitzroy River	Fitzroy	30	Grazing	505.86	$1.23M	$2,432
The caves	Fitzroy River	Fitzroy	25	Grazing	1,005.00	$1.25M	$1,244

Table 5 Estimated Land Valuation

Project	B1a	B1c	B2	B3	B4	SW
Location	Burdekin	Burdekin	Burdekin	Burdekin	Burdekin	Fitzroy
Land Value ($/Ha)	$14,407	$14,728	$14,900	$13,225	$11,819	$2,553

Cost assumptions for a blue carbon project

Finding actual blue carbon project costing is difficult at this stage and all costs in the model are based on desktop analysis using several pilots and case studies where TNC is currently involved. Amongst the costs included in this model are:

- Aggregators service costs to support participation in the ACCU scheme. This is the most significant cost and 20% of ACCUs generated is assumed to be attributed to the aggregator/project developer. Given the nascency of the blue carbon market and the fact that very few carbon developers can handle blue carbon currently, 25%-30% is more realistic in the shorter term – depending also on other terms such as division of project risk.
- Tidal removal costs of $100K per project are assumed based on five tidal gates per site and $20K/tidal barrier removal. Note that a detailed site survey of tidal gates and other factors would need to be carried out to get a more precise estimate.

- Further drainage works may be needed to redirect tidal flow to avoid flooding other uncommitted neighbouring sites. The cost here is assumed at $3,500 per ha but only 5% of farming sites are assumed to require this work at this stage.
- Auditing and monitoring costs will be needed every five years to verify the blue carbon gain from the project. This is assumed at $20K per site.
- In addition to the auditing and monitoring costs, annual maintenance costs are assumed at $10/ha for the Fitzroy region and $20/ha for the Burdekin region. These costs include mosquito and feral animal management.
- Overgrown mangroves and vegetation may potentially represent a fire hazard and some thinning is envisaged every three years. These costs are assumed at $5/ha for the Fitzroy region and $10/ha for the Burdekin region.
- Finally, annual insurance costs may be needed to avoid liabilities to other third parties for flooding and general land insurance costs. These are assumed to be about 0.05% of the land valuation per year. We note that the liability attached to the potential unintentional flooding of neighbouring properties may constitute a substantial risk that is currently challenging to quantify and price accurately – hence this estimate is hypothetical.

Main income stream from selling blue carbon credits

The model is assumed to run for 100 years with future cash flows discounted to present value at 8% as the base case. A higher discount rate may be required given the rise in the risk-free rate over the past year. Nevertheless, an 8% discount rate is considered reasonable with Queensland farmland having grown at 8.3% p.a. over the last 10 years[6].

The main income source for a blue carbon project comes from selling the ACCUs generated. The model assumed ACCUs would be sold every five years at the specific carbon price. For this, a 100-year permanence period is assumed to be undertaken, with more than 80% of the impacted area assumed to be part of the project area. Hence only a 5% risk reversal buffer is applied to the sequestered abatement rate. Note that the ERF currently only allows for a 25-year crediting period even though two-thirds of total carbon is estimated to be sequestered after the end of 25 years. This suggests that a significant proportion of the benefits provided by blue carbon ecosystems flows to the public good rather than to the private landholder. This should, at least in theory, provide an incentive for public finance to participate in various types of blended finance structures to encourage such investment. This public investment willingness should be further enhanced if also taking into account the substantial suite of 'co-benefits' that may be related to blue carbon ecosystem restoration (e.g. habitat formation; fishery output; flood protection and other climate resilience) An alternative, sub-optimal, scenario may be that the 25-year crediting period simply gets extended to better match the carbon sequestration rate eventually.

[6] Australian Farmland Values 2023, Rural Bank

Table 6 Estimated net abatement rate sequestered from each blue carbon site and respective NPV

Net Abatement	B1a	B1c	B2	B3	B4	SW
Total	1,144,190	611,671	480,235	518,317	1,401,268	13,265,184
2030	4,622	16,976	-52,122	-5,897	28,234	120,263
2050	607,684	352,503	344,953	195,458	567,259	4,632,433
2075	280,952	152,449	104,547	172,220	460,892	4,267,230
2125	250,932	89,743	82,857	156,536	344,883	4,245,258
ACCUs per Ha/year	4.1	4.2	2.7	8.2	5.6	7.4
NPV of cashflow @ ACCU $100	$3,514	$4,384	$1,571	$4,859	$4,492	$3,009

The ACCU spot price reached a high of $57 in early 2022 and has been volatile since, dropping below $25 earlier this year. Currently, the ACCU spot price is hovering around $30. Research from S&P Global[7] forecasts that the EU ETS price, which is currently at about €78/tCO_2e will likely exceed €100/tCO_2e from 2025 onward.

EY Net Zero Centre report[8] is projecting that the volume of carbon credits required globally to increase at least twentyfold by 2035. This increase in demand for credit volumes could result in US$80-150/$tCO_2$-e by 2035. As the blue carbon credits will only be realised in the fifth year of the model, the projected price assumed in the model is $100. We also note that blue carbon credits are currently rare and considered novel by certain potential buyers. With this, we think it would be possible to forward sell blue ACCUs at about $100 today, but not much more.

Table 7 Sensitivity analysis of blue carbon NPV against current land values at different carbon pricing

Carbon Price	B1a	B1c	B2	B3	B4	SW
$30/$tCO_2$e	-96%	-95%	-100%	-94%	-93%	-75%
$100/$tCO_2$e	-76%	-70%	-89%	-63%	-62%	18%
$150/$tCO_2$e	-61%	-53%	-82%	-41%	-40%	84%
$200/$tCO_2$e	-46%	-35%	-74%	-19%	-18%	150%
$300/$tCO_2$e	-16%	0%	-58%	25%	26%	283%

Table 7 shows that, at the current ACCU spot price, no project would be compensated sufficiently to go ahead with a blue carbon project. At $100, a blue carbon project may be possible in parts of the Fitzroy region where land prices are currently significantly lower.

[7] Carbon pricing, in various forms, is likely to spread in the move to net zero, August 2022, S&P Global Ratings

[8] Essential, expensive and evolving: The outlook for carbon credits and offset, 2022. An EY Net Zero Centre report

In the Burdekin region, a higher proportion of sugarcane/cropping area to total area, implies a more expensive overall land value (see Project B2 for example). Hence, a larger amount of ACCUs will need to be recovered or a much higher ACCU price is needed for the blue carbon project to be viable.

At an ACCU price of $300, properties with an expected yield of at least five ACCUs per hectare should be interested in moving ahead with a blue carbon project.

Blue carbon project uptake likely to grow with rising sea levels

The model has also taken into consideration a scenario whereby rising sea levels or higher groundwater levels in the Burdekin, may result in waterlogging the soil, increasing salinity, and therefore reducing productivity of the farmland. This will impact the production yield, especially in the sugarcane area, and can lead to reduced profitability and hence a drop in future land valuation. This demonstrates that a blue carbon project may become more attractive to undertake if such a scenario were to eventuate.

In order to undertake this analysis, current gross income from sugarcane, cropping, and grazing is analysed and then projected forward. To demonstrate a drop in productivity due to rising sea level, the annual gross margin is projected to decline by 1% per annum (based on a yield reduction). By applying a similar discount rate of 8%, farming cashflow is then discounted back to today's value to approximate a possible future land value.

Table 8 below shows the calculated current gross margin for each project site and the land valuation assuming the decline in gross margin over time. Key variables in differentiating each site's gross margins are their respective cane yield and median rainfall for estimating pasture production.

Table 8 Estimated gross margin per hectare and therefore land valuation @ 8% discount rate

Gross Margin per Ha	B1a	B1c	B2	B3	B4	SW
Sugarcane (GM/ha)	$2,077	$3,380	$2,838	$0	$760	$0
Cropping (GM/ha)	$584	$584	$584	$584	$584	$1,005
Grazing (GM/ha)	$209	$141	$72	$23	$1	$16
Land Valuation @ 8% discount rate	$6,514	$11,325	$10,276	$1,942	$1,722	$778

Estimating sugarcane income

In calculating the current sugarcane income, average cane yield and CCS (commercial cane sugar – recoverable sugar content from cane crushed) from Wilmar 2020 Burdekin region productivity statistic report were used. However, B4 is located nearer to the Proserpine region than that of the Lower Burdekin. Hence ABARES statistical data of the Top 10 area for 2020 cane yield is utilised instead. Income is derived by taking the sugar yield and multiplying it with the sugar price after deducting harvesting costs of $9.50 per tonne and levy of $1.00 per tonne.

The sugar price used in our modelling is $558/tonne which is based on the average price over the last three years. This lower price projection is deemed appropriate for a longer-term forecast, while the current sugar price has appreciated to above A$900/tonne possibly attributed to rising oil prices, reduction of supply due to production shortfall in India, and the depreciating Australian dollar.

Recent high production in Brazil may slow down the increases in sugar prices. Nevertheless, the sugar market is considered quite bullish with the expectation that sugar prices will remain at elevated levels in the short to medium term.

Kilter has estimated an average sugarcane cost at $2,258/ha based by applying an average rate of $3,960/ha costs on planting (20% of the area), $2,260/ha costs on ratoon (60% of the area) and $550/ha costs on fallow (20% of the area).

Table 9 Estimating sugarcane gross margin

Project	B1a	B1c	B2	B3	B4	SW
Location	Giru	Airdmillan	Inkerman	No Sugar	Proserpine	No Sugar
Average Cane Yield	116	133	111		74	
Average CCS	13.4	14.4	15.1		14.1	
Income after harvesting costs	$4,335	$5,638	$5,096		$3,018	
Gross Margin per Ha	**$2,077**	**$3,380**	**$2,838**	-	**$760**	-

Estimating cropping income

For cropping income, gross margins in the Burdekin and Central Highlands are obtained from the Queensland AgMargins reports[9]. Data for irrigated and dryland navy beans and soybeans are aggregated over the last three seasons which averages to $584/ha in the Burdekin. The gross margin in the Fitzroy region is estimated at $1,005/ha. This is based on the 3-year average gross margin for aggregated irrigated and dryland crops in the Central Highlands, including wheat, barley, soybeans, lentils, mung beans, fava beans, and chickpeas.

Estimating grazing income

Land carrying capacity is important in determining gross margin. Carrying capacity across the catchment is estimated at 13 SDH/100mm based on averaging coastal flats and marine plains land condition of C.

Table 10 below shows how each site's gross margin is derived.

For example, in SW, the median rainfall is 770mm. Applying this to the carrying capacity rate of 13 SDH/100mm, there are 100 days of pasture grown on average rainfall. This implies that each large stock unit (LSU) will need 3.65 hectares for feed. Taking an average EYCI rate of $5.80/kg cwt, income of $857/LSU is derived. An average cost of $60/head is estimated. This estimate includes animal health tags, insurance, labour, and administrative costs. The calculated gross margin per hectare is therefore estimated at $16/ha.

[9] https://agmargins.net.au/Reports/Index

Table 10 Estimating grazing gross income

Project	B1a	B1c	B2	B3	B4	SW
Location	Burdekin	Burdekin	Burdekin	Burdekin	Burdekin	Fitzroy
Annual Median Rainfall (mm)	1,160	1,009	869	780	745	770
Carrying Capacity (SDH/100mm)	13	13	13	13	13	13
LSU per Ha	2.4	2.8	3.2	3.6	3.8	3.7
Income per Ha @ $857/LSU	$354	$308	$265	$238	$227	$235
Cost assuming $60/head costs	-$145	-$167	-$194	-$216	-$226	-$219
Gross Margin per Ha	**$209**	**$141**	**$72**	**$23**	**$1**	**$16**

Table 11 illustrates the way blue carbon projects, naturally, become more attractive in line with falling land values that stem from rising sea levels and lower farm productivity facing the landholder. Even at ACCU prices of $100, several more project areas would likely see blue carbon as an attractive option in the face of lower productivity in a BAU scenario with sea levels rising. Certain sites (for example B2) with higher production yield and much lower potential for carbon credit generation, are unlikely to be suitable for blue carbon projects within a foreseeable future. Other sites could see a substantial uplift through blue carbon when compared to business as usual.

Table 11 Sensitivity analysis of blue carbon NPV against estimated future deteriorated values at different carbon pricing

Carbon Price	B1a	B1c	B2	B3	B4	SW
$30/tCO$_2$e	-92%	-93%	-101%	-59%	-51%	-18%
$100/tCO$_2$e	-46%	-61%	-85%	150%	161%	287%
$150/tCO$_2$e	-13%	-38%	-73%	300%	312%	505%
$200/tCO$_2$e	19%	-15%	-62%	449%	464%	722%
$300/tCO$_2$e	85%	30%	-39%	748%	767%	1158%

Other possible income sources with a blue carbon project

The model also considers the possibility of other possible income generated while undertaking a blue carbon project. If ecosystem service income "stacking" is allowed, a result of ceasing farming activities could lead to savings in nutrient and sediment runoff, thereby potentially generating revenue from reef credits.

One reef credit equates to preventing 1kg of nitrogen or 538 kg of sediment from entering the Great Barrier Reef. The Queensland government has in the past purchased at least 18,000 reef credits estimated to be valued at $45/unit and has recently committed to spending another $10 million on reef credits over the next three years. So far, the market for reef credits has seen slow progress with little liquidity and uptake; but in the model we assume a price of $50/unit.

From an environmental perspective, grazing systems offer far greater impact than sugarcane for biodiversity but sugarcane has greater improvements in reducing nutrient runoff. Here we assume that income from biodiversity credits to be 50% of ACCUs generated from the blue carbon project with the same price as ACCUs. It is noted that this is a highly theoretical approach as it is difficult to estimate a reasonable value for biodiversity credits since the market is still in its infancy. Nevertheless, the assumption is not unreasonable given that carbon credits often achieve a price premium based on different types of co-benefits, in some cases up to 100%.

Table 12 below shows the estimated dissolved inorganic nitrogen (DIN) and fine sediment (FS) from completely seizing farming on each project site. The nutrient savings here are estimated based on data from the P2R Projector (Paddock to Reef Projector) which was developed by the Queensland government.

Table 12 Reef credits and biodiversity estimates on project site

Projects	B1a	B1c	B2	B3	B4	SW
DIN and FS data obtained from			**Lower Burdekin River**		**Don River**	**Fitzroy River**
Cane DIN (kg/ha/year)	8.72	8.72	8.72	8.72	6.43	0.00
Cane Sediment (kg/ha/year)	174.54	174.54	174.54	174.54	863.28	0.00
Cropping DIN (kg/ha/year)	1.43	1.43	1.43	1.43	1.90	0.17
Cropping Sediment (kg/ha/year)	958.50	958.50	958.50	958.50	469.44	343.64
Grazing DIN (kg/ha/year)	0.00	0.00	0.00	0.00	0.00	0.00
Grazing Sediment (kg/ha/year)	13.45	13.45	13.45	13.45	17.06	53.13
Reef Credits	**4,444**	**3,402**	**4,677**	**14**	**359**	**3,017**
DIN (kg)	4,041	3,266	4,493	0	244	163
Sediment (tonnes)	217	73	99	8	62	1,535
Biodiversity/Year	**5,721**	**3,058**	**2,401**	**2,592**	**7,006**	**66,326**

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Table 13 Sensitivity analysis of blue carbon NPV against current land values with Reef Credits

Carbon Price	B1a	B1c	B2	B3	B4	SW
$30/tCO₂e	-92%	-89%	-94%	-94%	-92%	-73%
$100/tCO₂e	-71%	-64%	-83%	-63%	-62%	19%
$150/tCO₂e	-57%	-47%	-75%	-41%	-39%	86%
$200/tCO₂e	-42%	-29%	-67%	-19%	-17%	152%
$300/tCO₂e	12%	6%	-52%	25%	27%	285%

Table 14 Sensitivity analysis of blue carbon NPV against current land values with Biodiversity Credits

Carbon Price	B1a	B1c	B2	B3	B4	SW
$30/tCO₂e	-64%	-62%	-80%	-26%	-38%	121%
$100/tCO₂e	-43%	-37%	-69%	5%	-7%	214%
$150/tCO₂e	-28%	-20%	-61%	27%	15%	280%
$200/tCO₂e	-14%	-2%	-54%	49%	37%	347%
$300/tCO₂e	16%	33%	-38%	92%	81%	479%

Summary

Against a backdrop of historically high farmland values coupled with relatively low market prices for carbon credits, the investment case for establishing a blue carbon project in the Burdekin and Fitzroy regions of Queensland is currently challenging. This is true in particular for areas where farm productivity is strong and gross margins have been boosted by buoyant commodity prices. However, the analysis undertaken offers valuable perspectives: in parts of the Fitzroy region, where land values are significantly lower, the net present value of expected income streams from blue carbon projects is nearly at par with the current use as grazing land. This assumes that a seller of carbon credits could achieve at least around $100 per blue ACCU, something that we consider reasonable given that blue carbon credits are scarce and likely would fetch a 'novelty premium' at present. Many credible sources forecast a sharp increase in demand, and price growth, for carbon credits over the next decade as the world progresses further on its decarbonisation journey. When considering the potential to also earn income from biodiversity- and improved water quality outcomes, the investment case naturally strengthens even further.

One key insight from the FSSL BlueCAM analysis is that, under current ERF rules, roughly two-thirds of carbon sequestration benefits would flow to the public good over a 100-year permanence period – thus suggesting that public finance could play a key and well-justified role in helping blue carbon projects get off the ground. This perspective gets reinforced when considering a range of other co-benefits – that are increasingly proven in connection with blue carbon ecosystem restoration – of which many are currently not monetisable for private landholders.

While our BAU assumptions and calculations are necessarily somewhat theoretical at this point, one of the most important insights highlighted here is that sea level rise and other climatic impacts are highly likely to erode farmland productivity over time – and current landholders as well as relevant government authorities would do well by planning for, and in some cases frontrunning, these types of scenarios.