Summary Results of Analysis of the Integrity Risk and Performance of Human-induced Regeneration (HIR) Projects using CEA data

Andrew Macintosh, Don Butler, Megan C. Evans, Marie Waschka and Dean Ansell

21 June 2023 (revised 18 July 2023)

1.   Introduction

Human-induced regeneration (HIR) projects are the most popular project type under Australia's carbon offset scheme (now known as the Australian carbon credit unit (ACCU) scheme). To date, HIR projects have generated almost 30% of the credits issued under the scheme; some 37 million ACCUs. The projects cover more than 31 million hectares, an area almost the size of Japan. They are amongst the world's largest offset type by project area.

The projects are supposed to involve the human-induced regeneration of an **even-aged native forest across the entirety of the areas that are credited (known as 'carbon estimation areas' or CEAs)**. The projects do not involve the planting or direct seeding of trees and shrubs. Most HIR projects are purporting to regenerate native forests by reducing grazing pressure from livestock and/or feral animals in arid and semi-arid rangeland areas (<350 mm average annual rainfall) that have never been comprehensively cleared.

The authors of this paper have raised concerns about the integrity of HIR projects publicly and privately since 2020. Our primary concern has been that, because:

- most of the projects are located in areas have never been cleared; and

- grazing typically does not materially reduce tree and shrub cover in rangeland areas,

it is unlikely that the projects will be able to regenerate even-age native forests across the CEAs.

In broad terms, to the extent projects are located in uncleared areas, they are likely to be credited for sequestration that has not occurred and is unlikely to occur in the future and, to the extent that sequestration does occur, it is likely to have occurred anyway. This is because of three issues.

- The credited areas (CEAs) are unlikely to support significant additional trees and shrubs because uncleared, extensively grazed native vegetation is likely to be at or near its carrying capacity for biomass in woody vegetation. One of the fundamental principles of ecology and forest science is that there is a limit on the amount of vegetation that any parcel of land will support, which is a function of its site resources (water, nutrients, light etc.). In most uncleared rangeland areas, the key resource is rainfall, which varies over decadal time-scales, bringing with it changes in the biomass of vegetation. Woody cover in many grazed rangeland areas increased through the twentieth century, particularly through a run of La Ninas from the 1950s. Those increases show that grazing, without clearing, does not widely remove or suppress native forests. Grazing can strongly affect ground layer structure and function, especially where stock congregate, but alone it typically does not exert a significant influence on woody cover. Due to this, there is likely to be limited capacity to add permanent native forest through grazing control in uncleared areas. In some cases, reducing grazing pressure can increase tree and shrub cover but, generally, any increases in woody cover that are induced by grazing control are likely relatively small and often short-lived. Drought events can remove biomass accumulated during wet times.

- To the extent there is widespread regeneration, it is likely to be attributable to fluctuations in rainfall rather than the project activities. As discussed, tree and shrub cover in uncleared rangeland areas fluctuates over time with rainfall. The method does not control for the impacts of rainfall on regeneration, creating a significant risk that projects will be credited for changes in tree and shrub cover that are attributable to natural variations in rainfall rather than the project activities.

- Projects are likely to be over-credited because sequestration in HIR projects is not directly measured, it is modelled, and the model that is used assumes that the credited sites are largely devoid of mature trees and shrubs when the projects start.

The Clean Energy Regulator and others have sought to dismiss the concerns we have raised on the grounds our analysis has not been based on the CEA data.[1]

On 6 June 2023, the Clean Energy Regulator published the CEA data for 223 HIR projects.[2] Using these data, we analysed the integrity risk and performance of 192 of these projects using three metrics:

- extent of the CEAs mapped as previously been comprehensively cleared;

- change in forest and sparse woody cover in the CEAs since the projects were registered; and

- change in forest and sparse woody cover in the CEAs since the projects were registered relative to the change in forest and sparse woody cover in 3km buffer zones (or comparison areas) around the project boundaries, excluding areas included in other projects.

We also compared the performance of the projects to ACCU issuances over the relevant time periods (i.e. from project registration until 2021).

The analysis was undertaken using the National Forest and Sparse Woody (NFSW) dataset (Version 6.0 - 2021 Release) and the Carbon Integrity Explorer.[3] The NFSW dataset is used to estimate land sector emissions and removals in Australia's UNFCCC National Inventory Report (NIR). The data are an annual time series in which 25m x 25m grid cells are classified as either non-woody, sparse woody (sub-forest woody cover where crown cover is between 5-19%) or forest (woody vegetation ≥2 m tall with crown cover >20%). Changes in forest and sparse woody cover that are not detected in the NFSW dataset are not accounted for in Australia's NIR and do not count towards Australia's climate change mitigation targets. The 192 projects were selected because they were the only projects with 3 or more data points (years of data) in the 2021 NFSW dataset. The main results are as follows.

---

[1] Chubb, I (2023) Carbon Farming: let's get real and let's get on with it. Department of Climate Change, Energy, the Environment and Water, Canberra. Available at: https://www.dcceew.gov.au/climate-change/emissions-reduction/independent-review-accus (20 June 2023); Emissions Reduction Assurance Committee (ERAC) (2022) Emissions reduction fund: method claims not substantiated. Clean Energy Regulator, Canberra. Available at: https://www.cleanenergyregulator.gov.au/ERAC/Pages/News%20and%20updates/NewsItem.aspx?ListId=19b4efbb-6f5d-4637-94c4-121c1f96fcfe&ItemId=1114 (18 July 2023).

[2] Clean Energy Regulator (2023) 'Emissions Reduction Fund project register', available at: https://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (20 June 2023); Clean Energy Regulator (2023) 'Media Release: Carbon Estimation Areas released as part of ACCU Review implementation", available at: https://www.cleanenergyregulator.gov.au/About/Pages/News%20and%20updates/NewsItem.aspx?ListId=19b4efbb-6f5d-4637-94c4-121c1f96fcfe&ItemId=1222 (20 June 2023).

[3] Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).
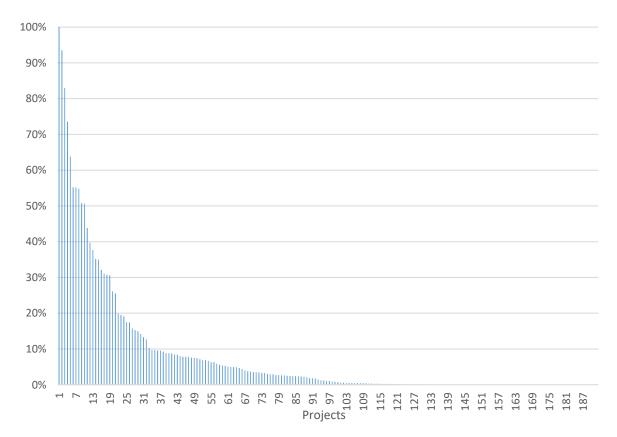
2. Percentage of CEAs mapped as previously comprehensively cleared

The results confirm that the vast majority of the land areas included in CEAs are not mapped as having previously been comprehensively cleared. As shown in Table 1 and Figure 1, for 83% of the projects in the sample, less than 10% of their CEA area is mapped as having been previously comprehensively cleared. 54% of projects have less than 2% of their CEA area mapped as having been previously comprehensively cleared. The median of the areas cleared in the CEAs of the projects is a mere 1.1%.

Table 1. Proportion of CEAs mapped as previously comprehensively cleared

Proportion mapped as comprehensively cleared	≥50%	≥25%	≥10%	≥5%	≥2%	<2%
Number of projects	10	21	33	62	89	103
% projects	5%	11%	17%	32%	46%	54%

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).

Figure 1. Proportion of CEAs mapped as previously comprehensively cleared

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).

3.   Trends in tree cover in the CEAs

Given that most of the CEAs have never been comprehensively cleared, we would expect that the projects are unlikely to have materially increased 'tree cover' (defined here as areas with either forest or sparse woody cover). The data support this.

Table 2 shows the number of projects whose tree cover has decreased, barely changed (up or down) and increased. Only 19% of projects (n=36) experienced any material increase in tree cover, which was defined as a modest quarter of a percent increase per year in forest or woody cover across the CEA. 81% of projects (n=156) experienced negligible or negative tree cover change, yet they received 20.1 million ACCUs over the period to 2021.

Table 2. Proportion of projects whose tree cover decreased, barely changed or increased, from project registration until 2021, and ACCU issuances to 30 June 2021

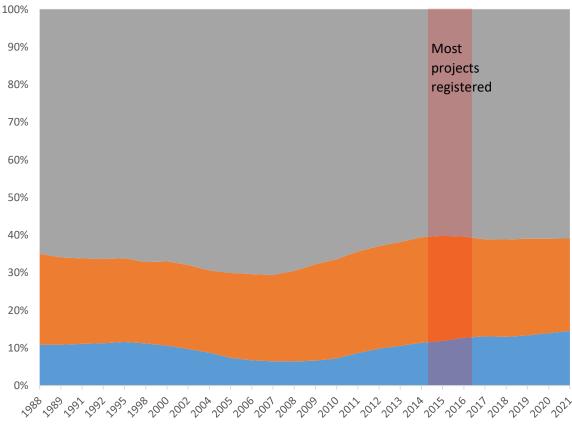|	Decreased	Negligible	Increased	Total
Projects (no.)	81	75	36	192
% projects	42%	39%	19%	
ACCUs	11,204,341	8,923,300	4,643,315	24,770,956

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023); Clean Energy Regulator (2023) 'Emissions Reduction Fund project register', available at: https://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (20 June 2023).

Figure 2 below shows the proportion of the area in the project CEAs (n=189) that had forest, sparse woody and non-woody cover over the period 1988-2021.[4] Most of the projects were registered in 2015 and 2016 (shown with a red bar). Tree cover has declined slightly in the CEAs since that time (-0.5%): forest cover has increased slightly (by 1.6%), while sparse woody cover has declined marginally (by 2.1%).

---

[4] Three projects were excluded from the time series and comparative analysis because they are completely surrounded by other HIR projects, meaning it was not possible to create a valid comparison area.

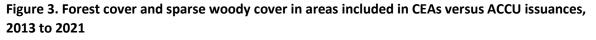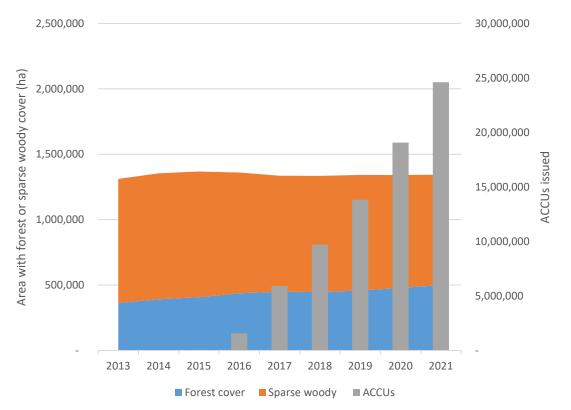**Figure 2. Proportion of area included in CEAs, by forest, sparse woody and non-woody cover, 1988 to 2021**

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).

Projects are supposed to be **regenerating even-age native forests across the entire area included in the CEAs (3.4 million hectares)**. Most of the projects have been credited for 7-10 years of growth by 2021, which is why almost 25 million ACCUs were issued to these projects between 2014-2021 (they have received 34 million to 9 June 2023). However, forest cover has **barely increased**, and overall tree cover **has declined**. This disparity is shown in the Figure 3.

Figure 3. Forest cover and sparse woody cover in areas included in CEAs versus ACCU issuances, 2013 to 2021

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023); Clean Energy Regulator (2023) 'Emissions Reduction Fund project register', available at: https://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (20 June 2023).

If the projects were performing as expected, and in accordance with how they are being credited, there would be a pronounced increase in sparse woody cover several years after the project activities commence, followed not long after by an equally large increase in forest cover. Very few projects show this response.

The Arbon-Tooligie Human Induced Regeneration project (EOP100275) is an example where this type of response is evident, at least to 2021. This is the only project in the sample that is located in South Australia. It was the first HIR project registered, in December 2013. It is comparatively small, with a project area of 7,863 ha and a CEA area of 3,395 ha. It is located on the Eyre Peninsula, south of a small town called Lock.

Figure 4(a) shows the project area for the Arbon-Tooligie Human Induced Regeneration project, without its CEAs. Figure 4(b) shows the project with the CEAs in light purple.

Figure 4. Arbon-Tooligie Human Induced Regeneration project (EOP100275)

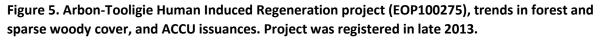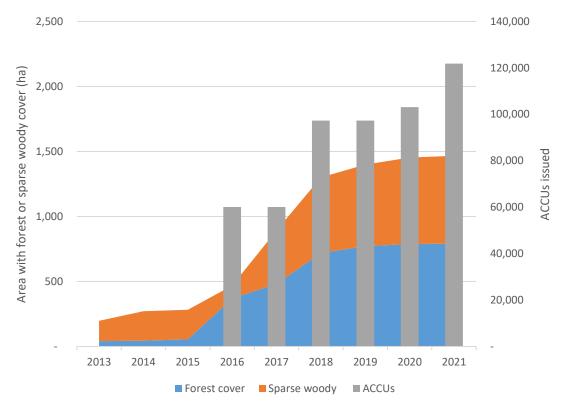| (a) Project area (without CEAs)	(a) Project area (with CEAs)

Source: Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023). Note, the dark purple polygons show the boundary of the project area, the white dashed line shows the outline of the 3km buffer zone (comparison area), and the light purple coloured areas are the CEAs.

As is evident from the image, the project is located in an intensive agricultural area, where a substantial proportion of the native vegetation has previously been comprehensively cleared. The data suggest that approximately 50% of the area included in the project's CEAs has been comprehensively cleared, placing it amongst the most cleared in the sample of projects. The cleared areas are where HIR CEAs should be located. Figure 5 shows the trends in forest and sparse cover in the CEAs of the Arbon-Tooligie project and the cumulative ACCU issuances over the period 2013 to 2021. Consistent with expectations, there has been a material increase in tree cover (37%) since the project started. Very few other projects show this expected trajectory.

Figure 5. Arbon-Tooligie Human Induced Regeneration project (EOP100275), trends in forest and sparse woody cover, and ACCU issuances. Project was registered in late 2013.

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023); Clean Energy Regulator (2023) 'Emissions Reduction Fund project register', available at: https://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (20 June 2023).

4.   Change in tree cover relative to change in 3km buffer zones (comparison areas)

As noted above, our primary concern has been that, because of where the projects are located and what the proponents are purporting to do (largely grazing control), any permanent changes in forest carbon stocks, historically and into the future, will largely be attributable to rainfall fluctuations rather than the project activities. Again, the data support this.
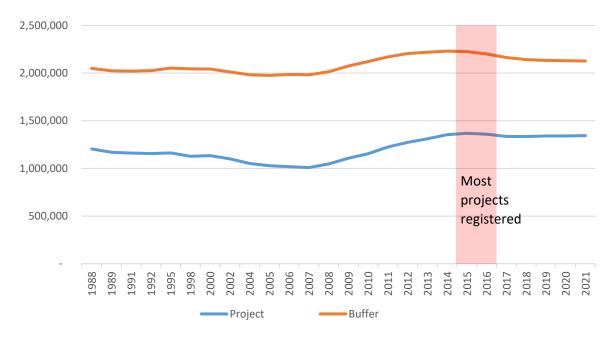
The projects have had an effect on woody cover, in a statistical sense, but it is very small, equivalent to less than half a percent per year of forest extent changes outside the project. This level is particularly underwhelming when compared to how the projects are being credited. The graphs below show this.

Figure 7 shows trends in tree cover in the CEAs and the buffer zones (in hectares). Figure 8 shows the same as changes in percentage cover over the period 1988 to 2021. Figures 9 and 10 show the changes in percentage of forest and sparse woody cover respectively.
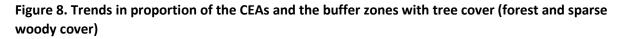
Figures 7-11 all show there is a strong correlation between the trends in cover in the project CEAs and in their corresponding buffer zones, where the project activities are not being undertaken.
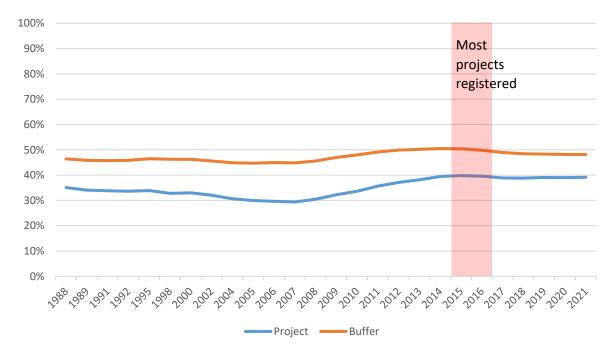
Figure 7. Trends in tree cover (forest and sparse woody cover) in the CEAs and the buffer zones, hectares

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).

Figure 8. Trends in proportion of the CEAs and the buffer zones with tree cover (forest and sparse woody cover)

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).

Figure 9. Trends in proportion of the CEAs and the buffer zones with forest cover

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).
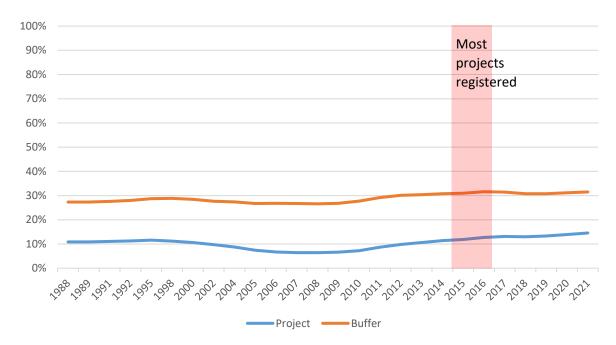
Figure 10. Trends in proportion of the CEAs and the buffer zones with sparse woody cover

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).
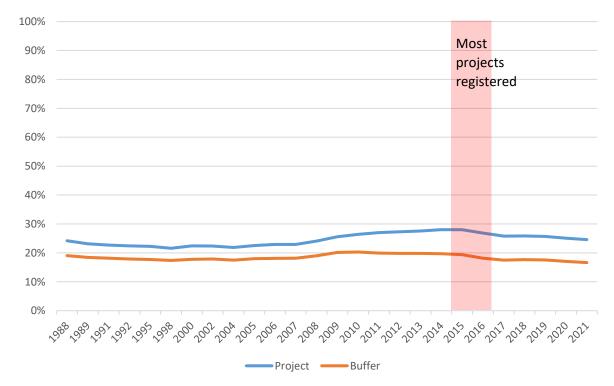
Figure 11. Annual observations of forest cover change inside current project CEAs prior to project registration (left panel) and after registration (right). Dashed lines indicate 1:1.

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).
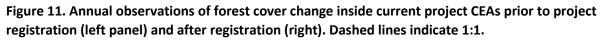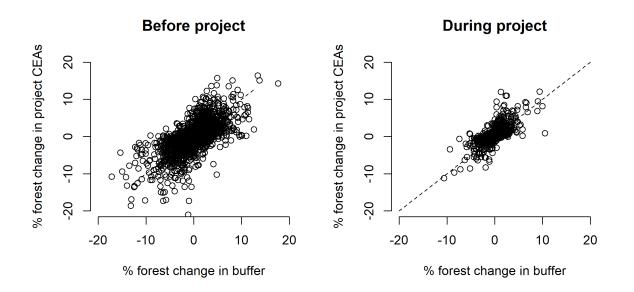
Again, these results for the entire sample contrast with those of the Arbon-Tooligie Human Induced Regeneration project (Figure 12). Tree cover in the CEAs of the Arbon-Tooligie Human Induced Regeneration project has increased from approximately 6% when the project was registered to 43% in 2021. Over the same period, tree cover in the buffer zone increased from 40% to 47%.

Figure 12. Arbon-Tooligie Human Induced Regeneration project, trends in proportion of CEA and buffer zone with tree cover (forest and sparse woody cover). Project was registered in late 2013.
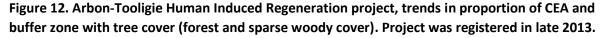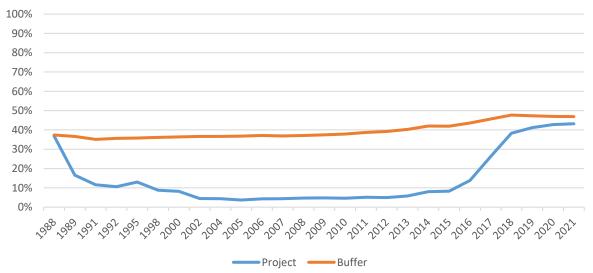

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023).

5.   Conclusion

The data confirm that:

- the vast majority of HIR projects that have been credited to date have resulted in very little (and often negative) tree cover change;

- most of the change that has occurred is likely to be attributable to seasonal variability rather than the project activities, because changes inside projects parallel changes outside them; and

- the projects are likely to have been significantly over-credited.

Table 3 below provides summary statistics for the projects, by jurisdiction.

Table 3. Summary statistics for projects (n=189), by jurisdiction

	All	**NSW**	**QLD**	**WA**	**SA**
CEA (ha)	3,435,265	1,109,228	1,412,190	910,452	3,395
Average CEA (ha)	18,176	12,057	19,890	36,418	3,395
Increase in tree cover (ha)	-18,160	5,178	-33,037	8,429	1,270
% increase in tree cover	-0.5%	0.5%	-2.3%	0.9%	37.4%
Increase in forest (ha)	54,905	15,604	15,735	22,815	750
% increase in forest	1.6%	1.4%	1.1%	2.5%	22.1%
Total ACCUs	24,600,748	13,488,384	10,431,931	558,607	121,826
ACCUs per project	130,163	146,613	146,929	22,344	121,826
ACCUs per ha of forest cover increase	448	864	663	24	162

Source: Department of Climate Change, Energy, the Environment and Water (2022) National Forest and Sparse Woody Vegetation Data (Version 6.0 - 2021 Release). Available: https://data.gov.au/dataset/ds-dga-b0d6b762-fe24-4873-91bd-ae0a8bbb452e/details (20 June 2023); Centre for Environment and Integrity (2023) Carbon Integrity Explorer. Available at: https://www.carbonintegrity.au/ (20 June 2023); Clean Energy Regulator (2023) 'Emissions Reduction Fund project register', available at: https://www.cleanenergyregulator.gov.au/ERF/project-and-contracts-registers/project-register (20 June 2023).