



# Final report

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## Australian Beef and Sheep Sustainability Framework – Vegetation mapping, reporting, and support

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## Abstract

The overarching objectives of this project were to build on the balance of tree and grass cover (BoTGC) Platform, and to bring together the primary data analysis processes and reporting systems required for reporting on the BoTGC and related biophysical metrics under the Australian Beef Sustainability Framework (ABSF), and the Sheep Sustainability Framework (SSF) and put in place on-going analysis, reporting, and support for 3 years.

The BoTGC Platform was built using the latest benchmarks in big data platforms including: Google BigQuery, Google Data Studio and Leaflet. The data used for the reporting included: 30 years of satellite national data products identifying annual trends in woody vegetation and seasonal trends in ground, land use and agricultural census data, local, regional and national reporting units and cadastral land parcel data. Importantly, the platform only uses publicly available data and no individual farm level data is available through the platform. The reporting and mapping platform is available at the following industry website:

<https://www.sustainableaustralianbeef.com.au/resources/botgc-dashboard/>

The specific industry reports and results can be found in each of the [Australian Beef Sustainability Framework](#) and [Sheep Sustainability Framework](#) website, dashboards and annual reports. For this report the general functionality of the platform is described, in addition to examples of how the platform can be used and general trends of key metrics. In the last 3 reporting years 2019-2021 the net national extent of primary forest has increased slightly from 51.75Mha to 52.23Mha. This is largely due to increases in canopy density (woody thickening) resulting in a shift from woodland to forest resulting in a similar localised reduction in the woodland. Nationally, annual losses in primary forest and woodland (woody vegetation over the same period varied from 0.493Mha to 0.5594Mha. These losses can be attributed to the local impacts of fire, drought and land conversions. The area of secondary (regrowth) forest and woodland increased by around 1.1Mha during the same period.

The ABSF BoTGC reporting process and dashboard provides an international benchmark for transparent reporting for the red meat industries. It not only provides seamless national scale mapping and reporting using the best available national data, but also the ability for stakeholders to generate custom reports at regional and local scales based on land use, states, catchments, natural resource management regions, biogeographic regions, local government and post code areas. Users can also access consistent farm-level data through the [Australian Feedbase Monitor](#). The integrated capabilities provide seamless and consistent data from farm to national scales. In the last year around 43,000 user queries were made to the platform, with around 3-10 users per day generating reports or maps.

While the national data inputs to the ground cover reporting components of the ABSF are secure and robust, the forest cover change data inputs are far less certain. [The national forest and sparse woody vegetation data](#) managed by the Australian Governments Department of Climate Change, Energy, the Environment and Water (DCCEEW) has underpinned the industry reporting in relation to tree cover change. Unfortunately, DCCEEW failed to deliver the latest 2024 (2022 image year) forest cover change updates for incorporation into the platform.

The need for consistent, high-quality time-series remote sensing products is rapidly increasing to support customer, producer, supply chain, finance and industry expectations. Given these uncertainties, it is a matter of urgency for the ABSF and other agricultural commodities in Australia to confirm government's role in supporting these needs, specifically relating to vegetation monitoring.

## Executive summary

### Background

The first ABSF BoTGC report in 2019 set a new international benchmark for transparent agricultural industry reporting. Following a rigorous process to develop appropriate indicators (through an Expert Working Group), Cibo Labs was engaged to develop a data analytic framework to enable measurement and reporting. This involved:

- Integrating 30 years of satellite data products identifying annual trends in woody vegetation and seasonal trends in ground cover.
- Creation of a national rural properties database of covering an area of 5.5 million sqkm (70% of Australia) and over 550,000 individual properties on land use categories where grazing may occur.
- Analysing trends in woody vegetation and ground cover for each individual property.
- Aggregating and reporting on the BoTGC indicators nationally and for Australia’s NRM Region

### Objectives

The overarching objectives of this project were to build on the balance of tree and grass cover (BoTGC) Platform, and to bring together the primary data analysis processes and reporting systems required for reporting on the BoTGC and related biophysical metrics under the Australian Beef Sustainability Framework (ABSF), and the Sheep Sustainability Framework (SSF) and put in place on-going analysis, reporting, and support for 3 years.

### Methodology

The BoTGC Platform was built using the latest benchmarks in big data platforms including: Google BigQuery, Google Data Studio and Leaflet. Importantly all the component technologies identified above provide “off-the-shelf” capabilities to minimise on-going maintenance and development costs, and the ability to be embedded in any industry standard website, again reducing on-going costs.

The data used for the reporting included the following:

- 30 years of satellite national data products identifying annual trends in woody vegetation and seasonal trends in ground;
- [The ABARES Landuse data](#)
- The Australian Bureau of Statistics (ABS) [2020-21 Agricultural Census data](#)
- [Spatial reporting region data](#) including: national, state, NRM Regions, local government areas, biogeographic regions (IBRA), post codes, river catchments and basins, and regional forest agreement areas.
- [Cadastral land parcel data](#) property data. Importantly individual parcel or farm-level data is NOT accessible through the platform, and only aggregated data are available according to spatial reporting regions listed above.

## Results/key findings

The specific industry reports and results can be found in each of the [Australian Beef Sustainability Framework](#) and [Sheep Sustainability Framework](#) website, dashboards and annual reports. For the purpose of this report the general functionality of the platform is described, in addition to examples of how the platform can be used and general trends of key metrics.

The reporting and mapping platform is available at the following industry website:  
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In the last 3 reporting years 2019-2021 the net national extent of primary forest has increased slightly from 51.75Mha to 52.23Mha. This is largely due to increases in canopy density (woody thickening) resulting in a shift from woodland to forest resulting in a similar localised reduction in the woodland. Nationally, annual losses in primary forest and woodland (woody vegetation over the same period varied from 0.493Mha to 0.5594Mha. These losses can be attributed to the local impacts of fire, drought and land conversions. The area of secondary (regrowth) forest and woodland increased by around 1.1Mha during the same period.

At the national level since 1990 there have been 5 seasons where around 60 percent of the continent achieved 50 percent ground cover. Given the enormous variable in the Australian landscape, regional reporting of ground cover targets provides a more robust measure. In 2023, 57 percent (31) of the 54 NRM regions achieved regionally appropriate healthy groundcover thresholds for the late dry season (September as per available imagery). For rangeland regions in semi-arid parts of Australia, the threshold is 50% groundcover. This increases to 70% for coastal and tropical regions and 80% for high rainfall regions.

## Benefits to industry

The ABSF BoTGC reporting process and dashboard provides an international benchmark for transparent reporting for the red meat industries. It not only provides seamless national scale mapping and reporting using the best available national data, but also the ability for stakeholders to generate custom reports at regional and local scales based on land use, states, catchments, natural resource management regions, biogeographic regions, local government and post code areas. Users can also access consistent farm-level data through the [Australian Feedbase Monitor](#). The integrated capabilities provide seamless and consistent data from farm to national scales. In the last year around 43,000 user queries were made to the platform, with around 3-10 users per day generating reports or maps

The platform takes advantage of big data systems that enable the underlying data and statistics to be processed and stored at individual cadastral land parcel level in a secure environment and to aggregate that data “on-the-fly” for industry reporting. This allows Cibo Labs to support other farm-level reporting initiatives including the MLA – Environmental Credentials for Grassfed Beef IT Platform (ECGBITP); the Australian Feedbase Monitor (AFM) Farm Reports, and the rapidly approaching European Union Deforestation Free Beef Regulations (EUDR).

## Future research and recommendations

The BoTGC Platform currently utilises, key national ground cover datasets based on Landsat satellite imagery maintained by the Terrestrial Ecosystem Research Network (TERN), the Joint Remote Sensing Research Program (JRSRP), and the Forest and Sparse Woody Vegetation mapping program managed by DCCEEW to underpin Australia’s National Greenhouse Gas Inventory obligations.

While the data inputs to the ground cover reporting components of the ABSF are secure and robust, the forest cover change data inputs are far less certain. DCCEEW have failed to deliver the latest 2024 (2022image year) forest cover change updates.

The need for consistent, high-quality time-series remote sensing products is rapidly increasing to support customer, producer, supply chain, finance and industry expectations. Given these uncertainties, it is a matter of urgency for the ABSF and other agricultural commodities in Australia to confirm government's role in supporting these needs, specifically relating to vegetation monitoring.

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## 1. Background

The first ABSF BoTGC report in 2019 set a new international benchmark for agricultural industry reporting. Following a rigorous process to develop appropriate indicators (through an Expert Working Group), Cibo Labs was engaged to develop a data analytic framework to enable measurement and reporting. This involved:

- Integrating 30 years of satellite data products identifying annual trends in woody vegetation and seasonal trends in ground cover.
- Creation of a national rural properties database of covering an area of 5.5 million sqkm (70% of Australia) and over 550,000 individual properties on land use categories where grazing may occur.
- Analysing trends in woody vegetation and ground cover for each individual property.
- Aggregating and reporting on the BoTGC indicators nationally and for Australia’s NRM Regions

Due to the resource and time constraints for the 2019 ABSF Update Report, the BoTGC indicators could only be reported using “static” maps, tables and graphs. To streamline the data analysis processes required for reporting the BoTGC under the ABSF, and to provide an on-going reporting capability, the BoTGC platform and database was developed to:

- Allow individual users to interact with the data (while maintaining the privacy of individual property records) by visualising the satellite mapping and generating dynamic reports (on-the-fly)
- Support ongoing ABSF reporting and create another building block for data insights to support the red meat industry and broader agricultural sector.

## 2. Objectives

The overarching objectives of this project were to build on the BoTGC Platform, and to bring together the primary data analysis processes and reporting systems required for reporting on the BoTGC and related biophysical metrics under the ABSF, and the Sheep Sustainability Framework (SSF) and put in place on-going analysis, reporting, and support for 3 years.

Specific objectives included:

1. In consultation with ABSF and SSF
  - a. Review interactive reports and mapping currently available on existing BoTGC Dashboard
  - b. Rationalise and agree on spatial and administrative reporting areas to be used for ongoing ABSF and SSF Reporting
2. Further develop the existing BoTGC Dashboard to service the reporting and mapping requirements of both the ABSF and SSF.
  - a. Common ABSF and SSF interface
  - b. Specific ABSF and SSF reporting pages, maps, tabular and graph products
  - c. interactive reports based on specific themes, regions and date ranges, and save the derived reports in tabular (spreadsheet) and graphic (image, PDF) forms.
  - d. Display the woody vegetation change data and seasonal ground cover imagery as maps, with the ability to select, display and compare individual dates
  - e. Display basemaps and reporting regions including national and state boundaries; NRM Regions, Local Government, ABARES, ABS, catchment, IBRA regions and sub regions.

3. Maintain the necessary data and systems for processing and reporting on annual woody vegetation extent, and seasonal fractional ground cover according to existing established processes
4. Complete all analyses and population of dashboard reports prior to release of annual ABSF and SSF reports.
5. Support ongoing ABSF and SSF reporting for 2022, 2023 and 2024.
6. Provide the necessary technical support for the ABSF and SSF Dashboards and required project reporting.

### 3. Methodology

The BoTGC Platform was built using the latest benchmarks in big data platforms including:

- Google BigQuery - a RESTful web service that enables interactive analysis of massive datasets working in conjunction with Google Storage. It is a serverless Platform as a Service (PaaS) that may be used complementarily with MapReduce.
- Google Data Studio - which provides powerful tools for visualising the data through an interactive dashboard that can be embedded in existing websites and services. See examples
- Leaflet - an open source JavaScript library for mobile friendly interactive maps. Cibo Labs already manages a Leaflet and GeoServer environment for hosting the satellite data products including the woody vegetation change used in the ABSF reporting

Importantly all the component technologies identified above provide “off-the-shelf” capabilities to minimise on-going maintenance and development costs, and the ability to be embedded in any industry standard website, again reducing on-going costs.

The data used for the reporting included the following:

- 30 years of satellite national data products identifying annual trends in woody vegetation and seasonal trends in ground cover were analysed according to the relevant ABSF and SSF metrics. The ground cover data were sourced from the [TERN Ecosystem Research Infrastructure Data Repository](#). The woody vegetation data were sourced from the Department of Climate Change, Energy, the Environment and Water (DCCEEW) [National Forest and Sparse Woody Vegetation Data](#)
- [The ABARES Landuse data](#) was used to identify land use categories where grazing may occur
- The Australian Bureau of Statistics (ABS) [2020-21 Agricultural Census data](#) were used to identify the primary distributions sheep and cattle for each statistical region.
- [Spatial reporting region data](#) including: national, state, NRM Regions, local government areas, biogeographic regions (IBRA), post codes, river catchments and basins, and regional forest agreement areas.
- [Cadastral land parcel data](#) was used as the primary analysis unit for summarising the time-series remote sensing data to allow data to be flexibly aggregated for reporting. Statistical summaries are stored for each of approximately 1.5 million individual cadastral land parcels on rural land within the database. Importantly, while the data are processed at the land parcel level, the secure database does not allow public access to individual property data. Only aggregated data are available according to spatial reporting regions listed above.

## 4. Results

The specific industry reports and results can be found in each of the [Australian Beef Sustainability Framework](#) and [Sheep Sustainability Framework](#) website, dashboards and annual reports. For this report the general functionality of the platform is described, in addition to examples of how the platform can be used and general trends of key metrics. In the last year around 43,000 user queries were made to the platform, with around 3-10 users per day generating reports or maps.

The reporting and mapping platform is available at the following industry website:

<https://www.sustainableaustralianbeef.com.au/resources/botgc-dashboard/>

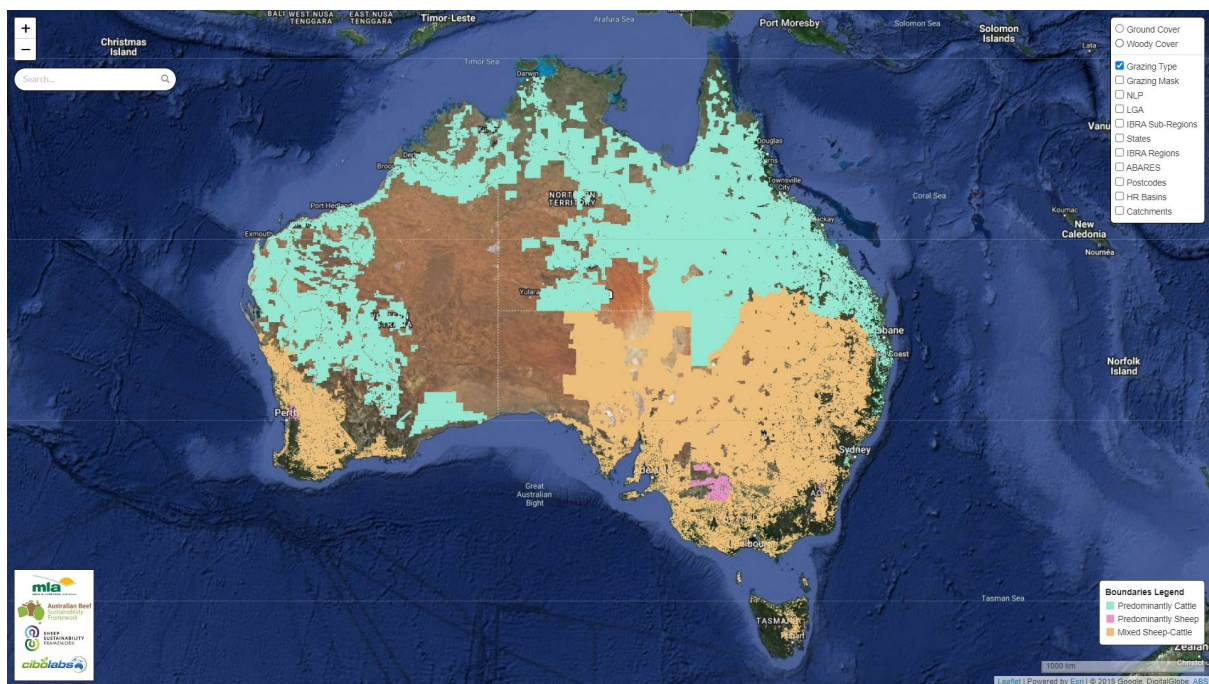


Figure 1. cattle and sheep grazing zones.

Figure 1 provides a map of grazing zones totalling 485.1 million hectares of Australia's 769 million hectare land mass based on land use categories with potential for grazing and ABS farm census data. The zones are based on:

- predominately cattle – 282.2 million hectares;
- mixed sheep and cattle -200.4 million hectares .
- predominantly sheep – 2.5 million hectares.

Figures 2 and 3 provide screenshots of the dashboard showing woody vegetation extent and change and seasonal ground cover for the entire continent since 1990, and an example of the zoom ability into particular localities using the publicly available data.

Figures 4 and 5 provide screenshots of the trends in forest cover change at the national level and for the Burdekin catchment region. The user can specify any region for the trends and statistics reporting including:

- grazing zones; State; Local Government Area; Post Code; Bioregion (IBRA); river catchments and basins; regional forest agreement areas; NRM regions.

From 2005-2021 the extent of woody vegetation nationally has increased from 22.85 percent of land area to 25.5 percent. While there has been a **net** overall increase in woody vegetation, there have also been losses. Nationally we have also seen up to 3.5 percent annual woody vegetation loss due to droughts, fires and land conversation. Within the Burdekin Catchment for the same period woody vegetation has increased from 58.4 percent to 66 percent of the catchment and up to 3.5 annual woody vegetation loss due to droughts, fires and land conversation. There seemingly counter-intuitive statistics are due to regional losses and gains in forest cover adding to a net national increase in forest cover overall. Similarly, apparent losses in primary woodland (sparse woody vegetation) are explained by local and regional increases in woody vegetation density transitioning areas from woodland to forest (sparse to dense woody vegetation).

This highlights the differences between national and local or regional trends. The dashboard allows users to select any number of combinations of regional reports relevant to administrative or environmental and bioregional interests.

Table 1. National trends in primary and secondary forest

	Metric	2019	2020	2021
1	Extent of primary forest on beef cattle properties (ha)	51,754,673	51,983,866	52,230,460
2	Extent of secondary forest on beef cattle properties (ha)	14,733,351	15,289,385	15,819,880
3	Extent of primary woodland on beef cattle properties (ha)	21,081,473	20,257,792	19,517,779
4	Extent of secondary woodland beef cattle properties (ha)	27,292,930	27,256,382	27,293,718
5	Extent of native grasslands on predominantly beef cattle properties (ha)	268,295,215	268,295,215	268,295,215
6	Extent of native grasslands on beef cattle and sheep properties (ha)	126,122,037	126,122,037	126,122,037
7	Extent of primary woody vegetation <b>loss</b> on beef cattle properties (ha)	570,783	594,489	493,419
8	Extent of secondary woody vegetation <b>loss</b> on beef cattle properties (ha)	2,028,906	1,756,201	1,578,204

Table 1 provides a summary of trends in primary and secondary forest extent, annual net change and losses. In the last 3 reporting years 2019-2021 the net national extent of primary forest has increased slightly from 51.75Mha to 52.23Mha. This is largely due to increases in canopy density (woody thickening) resulting in a shift from woodland to forest resulting in a similar localised reduction in the woodland. Nationally, annual losses in primary forest and woodland (woody vegetation over the same period varied from 0.493Mha to 0.5594Mha. These losses can be attributed to the local impacts of fire, drought and land conversions. The area of secondary (regrowth) forest and woodland increased by around 1.1Mha during the same period.

Figures 6 and 7 provide screenshots of trends in seasonal ground cover nationally and regionally – again for the Burdekin catchment region.

At the national level since 1990 there have been 5 seasons where around 60 percent of the continent achieved 50 percent ground cover. In the case of the Burdekin there have been 4 seasons where around 80 percent of the catchment achieved 50 per ground cover.

Nationally, in 2023, 31 of the 54 NRM regions achieved regionally appropriate healthy groundcover thresholds for the late dry season (September as per available imagery). For rangeland regions in semi-arid parts of Australia, the threshold is 50% groundcover. This increases to 70% for coastal and tropical regions and 80% for high rainfall regions.

The dashboard allows users to report on absolute ground cover levels for any region and season, and also the proportion of any region achieving a specific ground cover target and the trends over time.

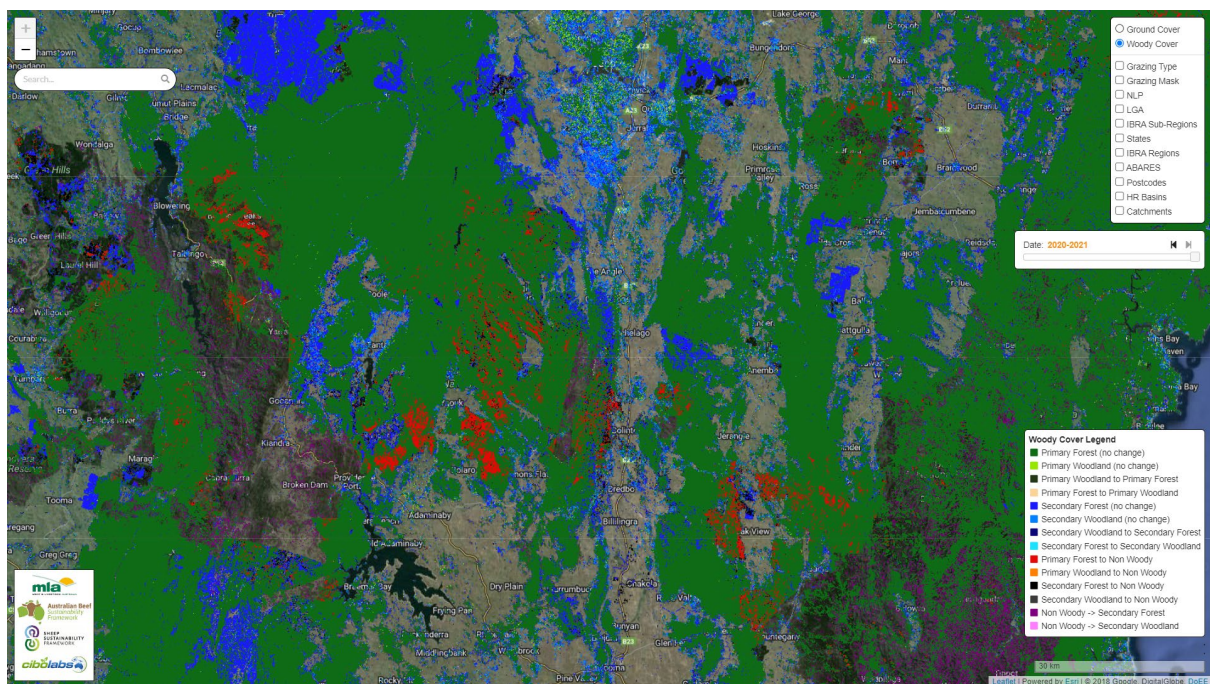
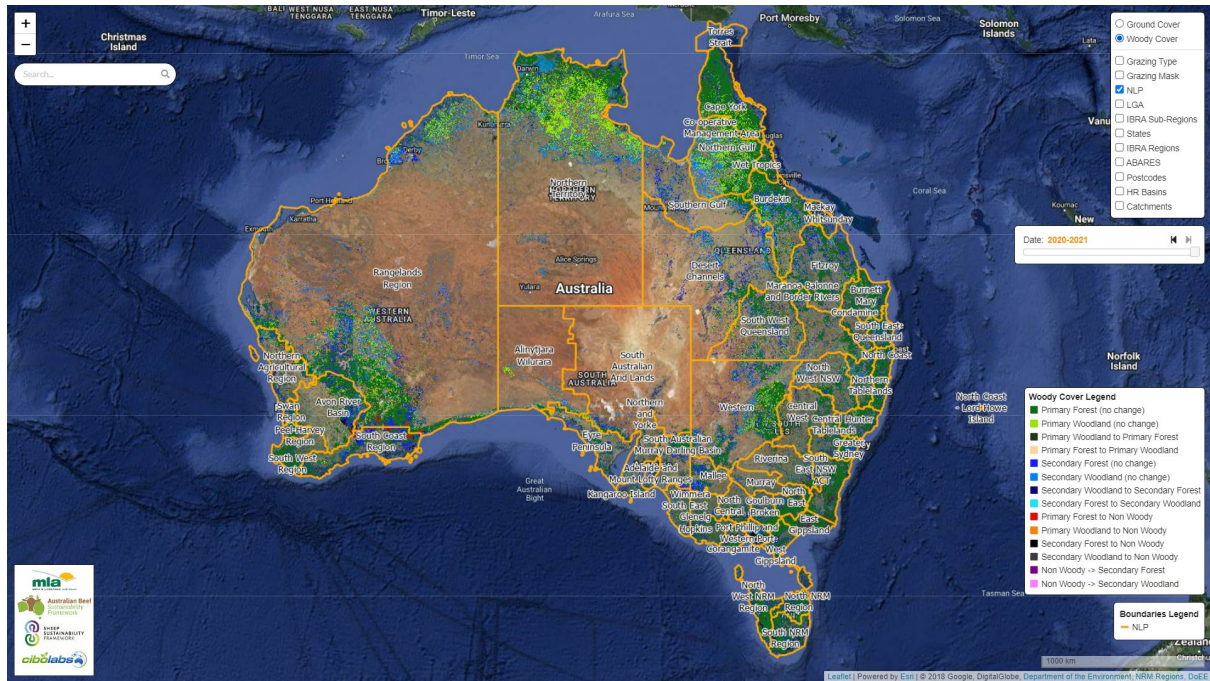


Figure 2. Woody vegetation extent and change dashboard, showing the entire continent and the ability for users to zoom into particular localities using the publicly available data.

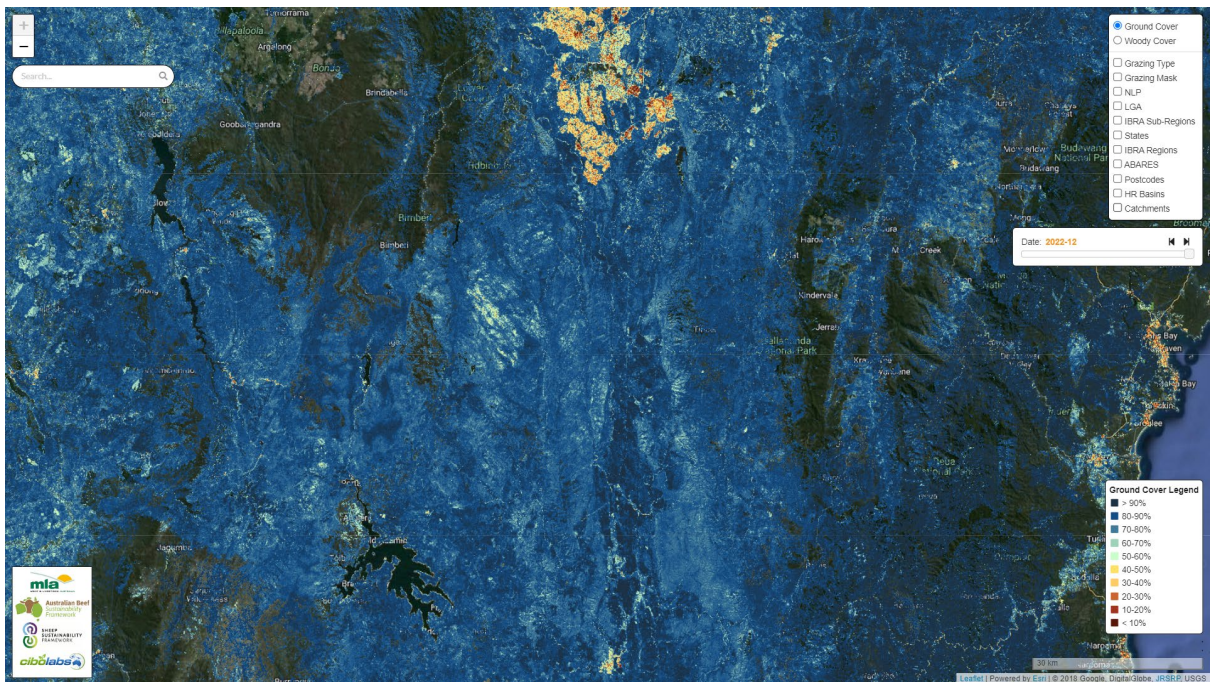
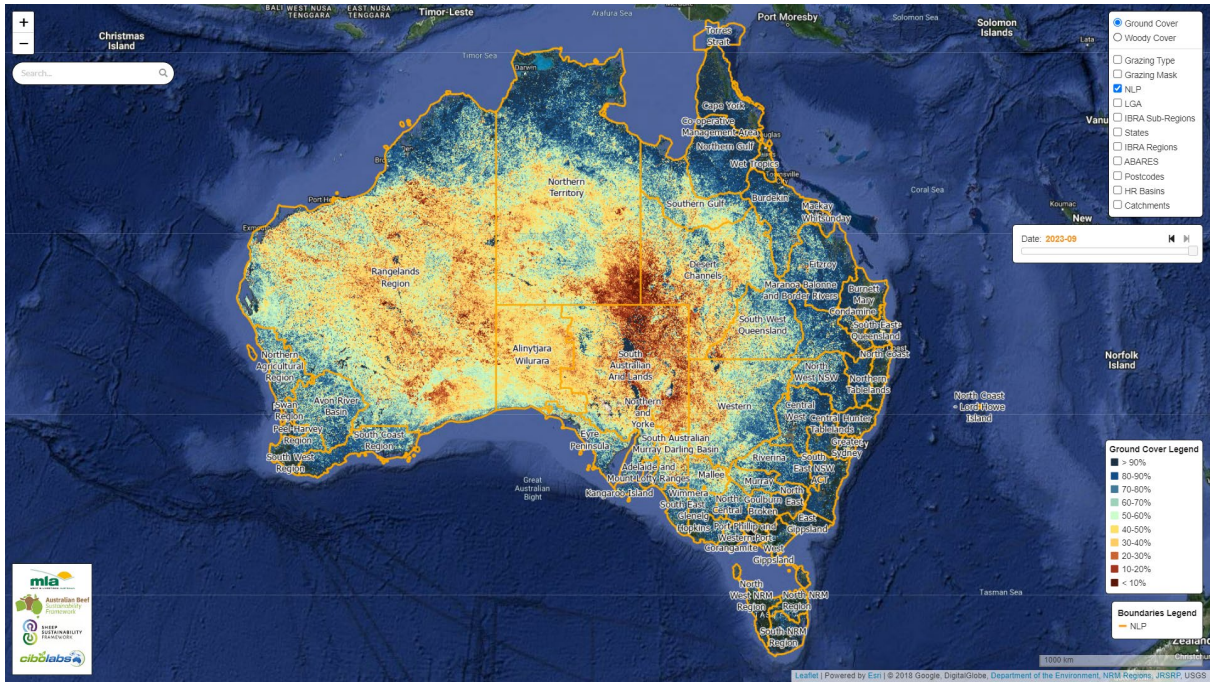


Figure 3. Seasonal Ground Cover Change dashboard, showing the entire continent and the ability for users to zoom into particular localities using the publicly available data.

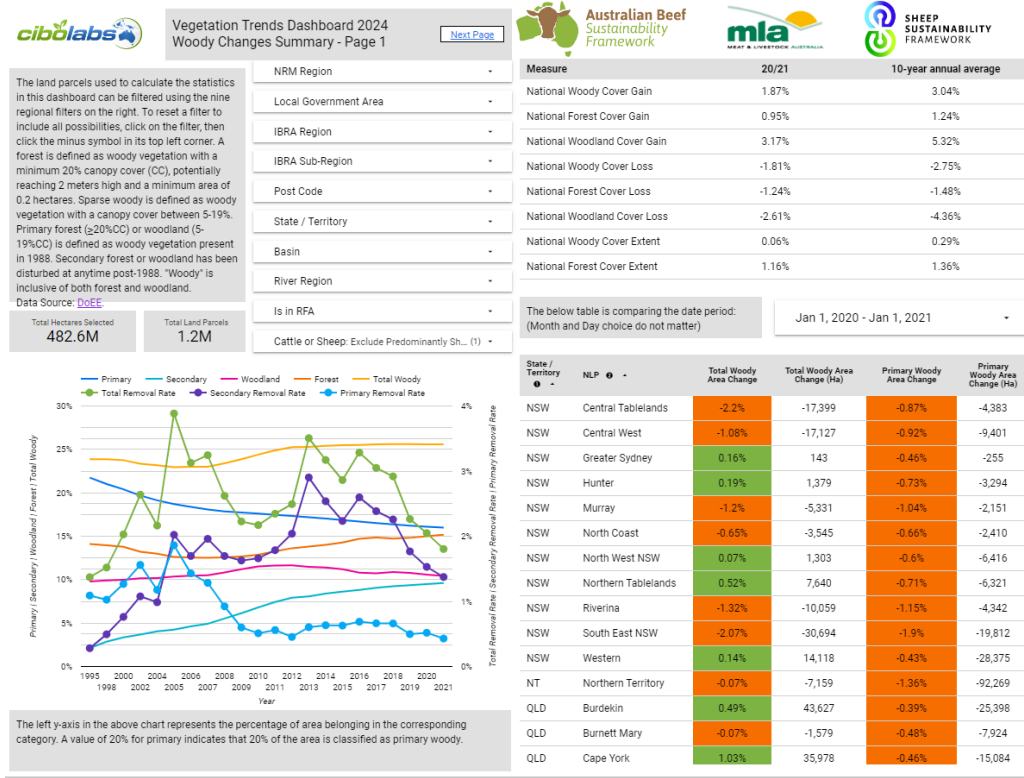


Figure 4. Forest and sparse woody vegetation trends dashboard - national trends.

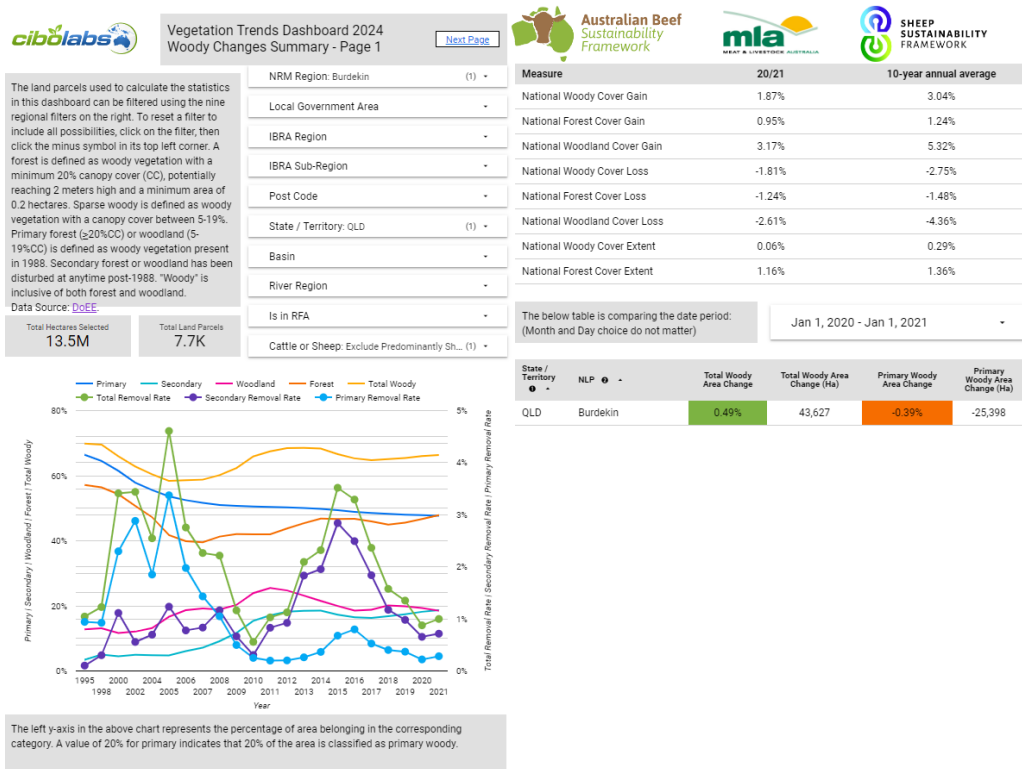


Figure 5. Forest and sparse woody vegetation trends dashboard - Burdekin catchment trends.

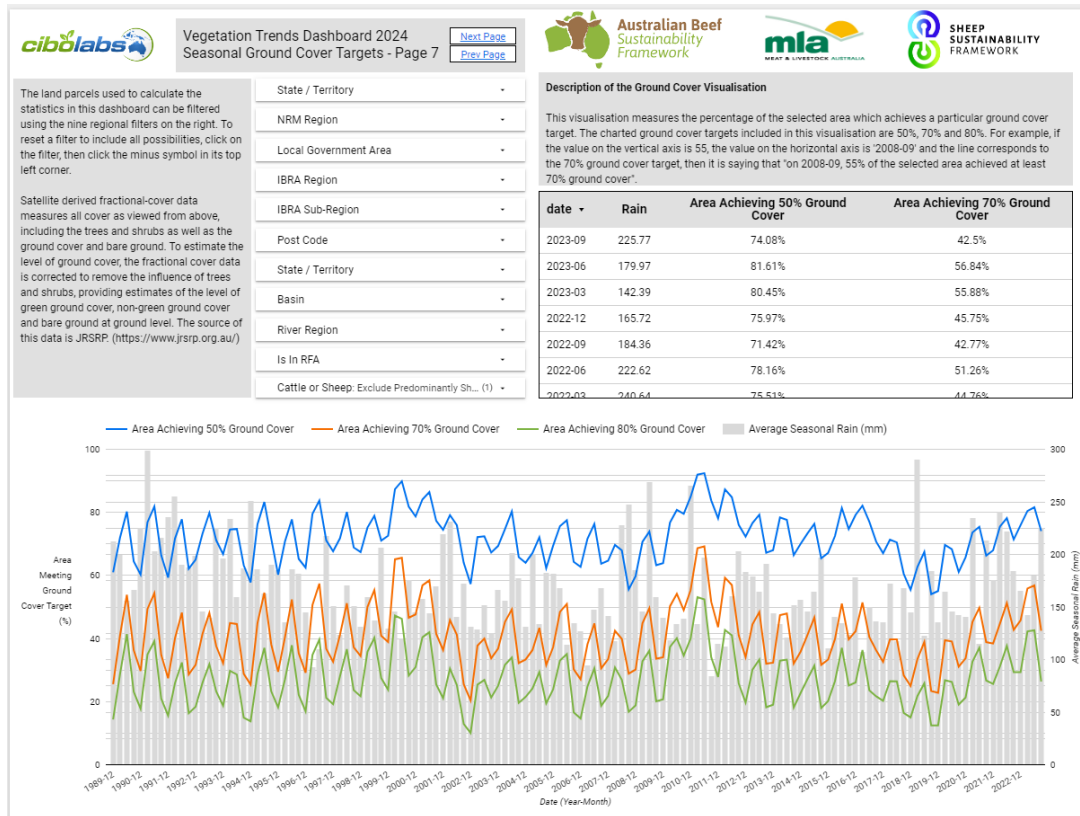


Figure 6. Seasonal ground cover trends dashboard - national trends

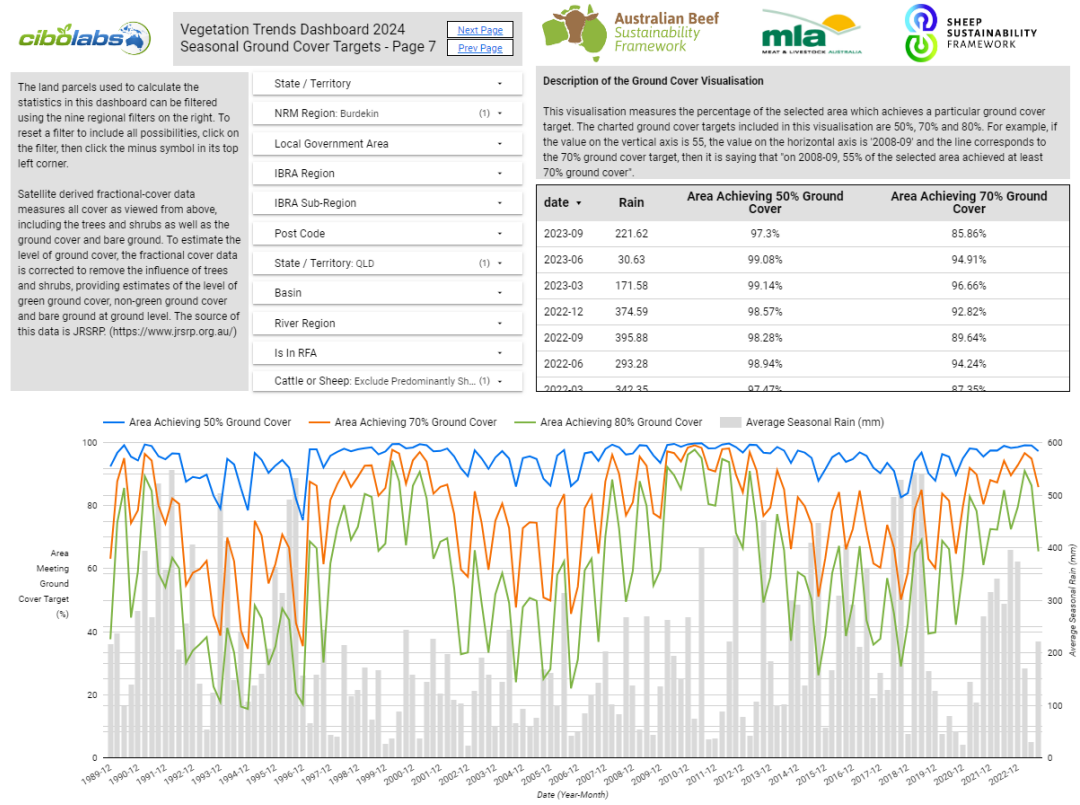


Figure 7. Seasonal ground cover trends dashboard - Burdekin catchment trends

The ABSF and SSF reporting on woody vegetation change at the national level is currently reliant on the Australian Government National Greenhouse Gas Inventory (NGGI) Annual Forest and Sparse Woody Vegetation mapping which has typically been released early each calendar year for 2 years previous. i.e. in early 2024 we would have expected an update for 2022. Unfortunately, this data did not become available for the 2024 report.

Unlike previous versions of the National Forest and Sparse Woody Vegetation data releases where 35 tiles have been released as part of the product, only the 25 southern tiles have been supplied in this release.

We were informed that the 10 northern tiles would later than expected due to methodological changes. Unfortunately, as of June 2024, we have been unable to get response on likely release dates. This obviously puts this element of the program at significant risk. Over the coming months alternative options need to be considered for 2025 reporting of woody vegetation change nationally.

## 5. Conclusions and Recommendations

The ABSF BoTGC reporting process and dashboard have set the international benchmark for transparent agricultural industry reporting. No other major agricultural commodity in Australia, or internationally has the capability put in place by the ABSF in partnership with Cibo Labs.

The ABSF Platform is unique in that unlike other national reporting systems that generate national and state level statistics, this platform provides seamless reporting from local, regional to national levels, and gives the user the ability to generate statistics and trend data for specific regions. In the last year around 43,000 user queries were made to the platform, with around 3-10 users per day generating reports or maps. In the future, additional web analytics need to be put in place to track the number of individual users on the platform.

The platform takes advantage of big data systems that enable the underlying data and statistics to be processed and stored at individual cadastral land parcel level in a secure environment and to aggregate that data “on-the-fly” for industry reporting. This allows Cibo Labs to support other farm-level reporting initiatives including the MLA – Environmental Credentials for Grassfed Beef IT Platform (ECGBITP); the Australian Feedbase Monitor (AFM) Farm Reports, and the rapidly approaching European Union Deforestation Free Beef Regulations (EUDR).

The BoTGC Platform currently utilises, key national ground cover datasets based on Landsat satellite imagery maintained by the Terrestrial Ecosystem Research Network (TERN), the Joint Remote Sensing Research Program (JRSRP), and the Forest and Sparse Woody Vegetation mapping program managed by DCCEEW to underpin Australia’s National Greenhouse Gas Inventory obligations.

While the data inputs to the ground cover reporting components of the ABSF are secure and robust, the forest cover change data inputs are far less certain. DCCEEW have failed to deliver the latest 2024 (actually 2022) forest cover change updates, and no delivery date has been forthcoming. These datasets are based on 30m resolution Landsat data, and in fragmented and sparse woodland environments we and many others have found the data quality less than optimal. We have been told that DCCEEW are developing a new product based on Sentinel 10m resolution satellite imagery (the reason for the delay) but this also brings challenges to support consistent trend analysis prior to 2017.

The need for consistent, high-quality time-series remote sensing products is rapidly increasing to support customer, producer, supply chain, finance and industry expectations. Given these

uncertainties, it is a matter of urgency for the ABSF and other agricultural commodities in Australia to confirm government's role in supporting these needs.