

Queensland technical methods - Cropping (sugarcane)

Australian Biomass for Bioenergy Assessment

March 2018

This document is part of a series describing the technical methods used to publish the Queensland based data for the Australian Biomass for Bioenergy Assessment (ABBA) <arena.gov.au/projects/the-australian-biomass-for-bioenergy-assessment-project>. All documents in the series are available to view and download at <publications.qld.gov.au>.

What is the Australian Biomass for Bioenergy Assessment?

ABBA provides detailed information about biomass resources across Australia. This information will assist project developers make decisions for new bioenergy projects, and provide linkages between potential biomass feedstocks—through the supply chain—to end users. To achieve this, ABBA collects datasets, on a state- by-state basis, about the location, volumes and availability of biomass, and publishes them on the Australian Renewable Energy Mapping Infrastructure (AREMI) platform <nationalmap.gov.au/renewables>. ABBA is managed by AgriFutures Australia with funding support from the Australian Renewable Energy Agency (ARENA).

Why sugar industries?

The sugarcane industry is widely recognised as a source of biomass feedstock with great potential for bio industrial use in Australia. Fibrous residue from sugarcane crushing (known as bagasse) has long been used by the industry as a furnace fuel to provide steam and electricity for raw sugar production. The combustion energy in bagasse is significantly in excess of the minimum required to process the cane and so factories have in the past been designed to operate at sufficiently low thermal efficiencies to ensure that all surplus bagasse is consumed over the season. In more recent years, some factories have been reconfigured to increase their thermal efficiency with the aim of producing surplus bagasse. Purpose built high efficiency power generation equipment has been installed in these modified factories to consume surplus bagasse and generate electricity for additional export income (Stucley et al 2013).

Residues left in the field after harvesting of sugarcane (known as trash) have also attracted attention as a potential feedstock for bioenergy and other bio industrial process such as production of plastics (Mackay Renewable- Bio commodities Pilot Plant, 2016).

The characteristics of sugarcane residues (trash and bagasse) that make them attractive when compared with alternative potential bio industrial feedstocks available in Australia include:

- Large quantities are produced in concentrated areas with good access to existing infrastructure networks. In Australia, sugarcane is produced in concentrated pockets of land along the east coast between Cairns in the north and Ballina in the south. These areas are flat, well-serviced with rail/road transport and close to population centers.
- The heating value is high whilst yields of ash and other residues is low.

The existing production systems either already concentrate residues (e.g. bagasse at mills) or can be readily customised to concentrate residues in conjunction with normal operations (e.g. through modified mechanised field harvesting).

What data about sugar industries is published by ABBA?

ABBA has published data about:

- infrastructure (mills)
- residues (both trash and bagasse)

Data for both residues is published at a local government area (LGA) level. This data is produced as a broad scale and is therefore not suitable for use at a local scale.

Methods

Infrastructure

The data published show the locations of the infrastructure resources from sugarcane production in both Queensland and New South Wales, including:

- sugar mills—from the Queensland Agricultural Land Audit (for the Queensland mills only) <daf.qld.gov.au/environment/ag-land-audit> and sourced and verified in Google Earth (for the New South Wales mills).

Residues

The data published indicates the quantity of biomass residues from the sugarcane industry. Residues are split into total sugarcane trash (field residues) and estimated available bagasse (mill residues) produced.

Estimated available is defined as biomass not required for primary production processes.

Sugarcane industry residues are calculated from cane production figures (t/ha harvested) published annually for each Mill Supply Area (MSA) by the peak body for Australian sugarcane growers, Canegrowers <canegrowers.com.au>.

The spatial footprint of MSAs have been delineated based on industry advice, mill location, and connectivity of land use and transport (Table 1). These MSAs are then allocated to a LGA dependant on the proportion of the sugar land use footprint within that MSA. The sugar land use footprint data is obtained from the Queensland Land Use Mapping Program (QLUMP) <qld.gov.au/environment/land/vegetation/mapping/qlump>.

Table 1: Mill supply areas used in ABBA sugarcane datasets

Mill Supply Area (MSA)	Average area of cane harvested annually ha 2004–14 (NSW data only available from 2010)
Broadwater (NSW)	5,000
Bundaberg	22,000
Burdekin	70,000
Condong (NSW)	4,200
Harwood (NSW)	4,000
Herbert	53,000
Mackay	71,500
Maryborough	10,100
Mossman	8,200
Plane	16,500
Proserpine	21,200
Rocky Point	3,400
South Johnstone	37,200
Tableland	6,700
Tully	24,000

Residues are reported for Queensland areas from 2004. For New South Wales MSA's cane production data is available only since 2010.

Estimated available bagasse

Total bagasse production is calculated using the industry standard relationship with cane production (Kent 2010) (Equation 1).

Equation 1:

$$\text{Total bagasse (t DM)} = mc \cdot 0.95Fc / (100 - Mb - Bb)$$

Where: mc = green cane production (tonnes), Fc is the fibre content of cane, Mb is the moisture content and Bb the brix of the final bagasse.

Typical industry figures are assumed for Fc, Mb and Bb of 15%, 50% and 2.5% respectively (Hobson et al 2006).

Estimated available bagasse is calculated as the proportion of bagasse that would not be required to power an efficiently operating mill. An efficiently operating mill is estimated to have a steam on cane (SOC) requirement of 45% (Lavarack et al 2005).

Total trash

Total trash is calculated using a relationship with cane yield published by Mitchell and Larsen in 2000 (Equation 2).

Equation 2:

$$\text{Total trash (t/ha DM)} = 0.18 * yc - 2.5$$

Where: yc = the freshweight yield of cane (t/ha)

It should be noted that retaining trash residues provide benefits of environmental stewardship and sustainability to reduce sediment, nutrient and pesticide losses, while enhancing moisture retention, weed management and soil health.

For further information regarding water quality outcomes (in reef catchments) please visit <reefplan.qld.gov.au>.

The final data is rounded to the nearest 10 by the following rules:

- Data at the midpoint is rounded up (e.g. 35 has been rounded to 40)
- Data less than five is given a value of zero
- Data five or larger (but less than 10) is given a value of 10.

Outputs

- Location of sugar mills
- A table of average annual sugarcane trash—total (dry tonnes) by LGA
- A table of average annual sugarcane bagasse—estimated available (dry tonnes) by LGA

Future potential

Between 2004 and 2014 sugarcane residue production across the whole of Australia experienced a small steady decline punctuated by a large year-by-year fluctuation in 2009–11.

The fluctuation was the result of cyclones, in particular Yasi, which subjected the Tully and Innisfail areas to extreme winds and heavy rainfall in February 2011 greatly reducing sugarcane yields in these core production areas. Climatic modelling indicates that sugarcane growing areas in north Queensland area could expect to experience a severely damaging cyclone every seven to ten years <daf.qld.gov.au/environment/ag-land-audit/agricultural-climate-risk-information>.

The overall small steady decline over the last decade can be largely attributed to a contraction in the area planted. Whilst average yield per hectare of greencane (and hence of trash and bagasse) across the whole harvested area remained relatively consistent across this period the area harvested declined by on average 1 per cent per year

(data from Annual Reports of Canegrowers Association).

This decline was most pronounced in the Maryborough, Rocky Point and Tableland MSAs (each of which fell by three times this rate) and in the South Johnstone and Bundaberg MSAs (each of which fell by twice this rate). Mossman and Tully were the only two MSAs to experience significant expansion (at around 1.5% per year on average).

Business-as-usual scenario

Some areas that have been retired from production of cane for sugar due to processing constraints (such as has occurred in the Maryborough MSA due to the closure of the Nambour sugarmill in 2003) may be comparatively easily returned to production of cane for biomass. However, in many MSAs contraction in the area of sugarcane plantings has been due to displacement by much higher value uses as a result of urban expansion (e.g. at Rocky Point south of Brisbane and at Mackay) (Norman and Shephard 2014). With population predicted to continue to grow in these areas it is to be expected that pressures for land to be withdrawn from sugarcane production will continue, and there is likely to be little prospect of such land returning to sugarcane production.

In the medium term, this decline in planted areas within traditional regions appears likely to be compensated for by expansion beyond the current planting envelope.

Three major irrigated agriculture developments involving sugarcane cultivation and associated processing are currently under development in northern Australia:

- Integrated Food and Energy Developments project west of Georgetown (projected to grow to a size sufficient to produce an estimated 2.8 Mt of sugarcane trash and bagasse per year). A draft EIS is currently in preparation for this development <statedevelopment.qld.gov.au/assessments-and-approvals/etheridge-integrated-agricultural-project.html>.
- Pentland Bioenergy Project west of Charters Towers (projected to grow to a size sufficient to produce an estimated 1.8 Mt of sugarcane and sweet sorghum biomass per year). Feedstock production and conversion technologies are currently being trialed as part of developing a detailed business case for this project <arena.gov.au/project/pentland-bioenergy-project>.
- Ord River Irrigation Area in Northern Western Australia: a small sugarcane industry (generating around 200,000 tonnes per year of trash and bagasse) operated in the area until 2007. Low sugar prices, declining yields, competition for land, and limited scope for expansion contributed to the closure of the mill and ultimate cessation of sugarcane cultivation in the region. A sugar industry is planned to be re-established in the area as part of expansion currently underway. Sugarcane production is expected to recommence in 2020 (Ash 2014) reaching sufficient size to produce an estimated 700,000 tonnes per year of biomass residues in the medium term growing ultimately to 1.5 Mt year (Department of Agriculture and Food 2016).

Accelerated biomass production scenario

There is scope to significantly increase the production of sugarcane biomass by further expansion. Across Queensland almost seven million hectares has been assessed as having the biophysical potential to grow sugarcane (Queensland Department of Agriculture and Fisheries, 2013). This includes large areas in the northern inland where sugarcane is not currently produced.

Production of cane for biomass is not as severely constrained as production of cane for sugar by the need for short haul distances to a mill.

Production of biomass could also be increased by substituting high fibre yielding varieties. Results from trials in Brazil (Hussuani et al Eds) indicate that it may be possible to increase biomass production by 50% or more through the choice of cultivar.

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