

Organic material audit for North West New South Wales

AN OVERVIEW OF RESOURCE AVAILABILITY



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Title: Organic Material Audit for North West New South Wales

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Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of writing (January 2012). However, because of advances in knowledge, users are reminded of the need to ensure that information on which they rely is up to date and to check the currency of the information with the appropriate officer of the Department of Primary Industries or the user's independent advisor.

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Summary

This is a reconnaissance level audit to provide background information for future strategic investigations for activities that could use organic material supplies in the North West region of New South Wales. The study used Statistical Local Areas as reported by the Australian Bureau of Statistics as a basis for reporting (noting that the SLAs are closely aligned to local government areas),.

This audit has been undertaken by the Department of Primary Industries for the Primary Industries Innovation Centre, a partnership between the University of New England and the Department. The Northern Inland Regional Waste (NIRW) organisation has also contributed to the study.

This audit was undertaken utilising data from the following organic material sectors:

- ☐ Agricultural crops, and intensive animal facilities (such as feedlots and dairies)
- ☐ Secondary food (such as abattoirs) and fibre processing
- ☐ Forestry and wood processing
- ☐ Urban material.

The report provides a broad sector analysis based on Statistical Local Areas (Australian Bureau of Statistics, 2006) and helps identify the major sources of organic waste material across these areas and in the region. It provides a guide to the major sources that may warrant further investigation.

The major constraint to the use of any biomass or organic material currently is its existing use or reuse potential. For instance the value of crop residues to soil condition especially nutrient recycling and exposure to erosion is high; the poultry material and cotton trash already has an economic value to other industry; and, urban waste is increasingly being allocated to other uses rather than just landfill. Woody waste from forestry operations is still an available source although there is no accessible supply from native forests due to current legislation.

Other issues that have not been explored in this work are the supply chain constraints including the transport cost of obtaining such material, the impact of seasonality on supply and the varying moisture content of the materials. These are major issues that require consideration prior to calculating the gross energy and economic returns from utilising these sources of organic material.

Major Findings

The major organic stream sources in the North West region in 2006 are in order of amount available:

Agricultural crop biomass at 1,947,000 tonnes.

Forestry residues 882,000 tonnes.

Agricultural processing, animal manure and urban waste make up about 326,000 tonnes.

A total of about **3 million tonnes** of organic material is available in the region on a yearly basis based on mainly 2006-7 data.

Introduction

Organic waste is defined as that of a biological origin and includes paper and cardboard, green and garden waste, animal waste and biosolids and sludge (wastenet Western Australia). In NSW organic waste is defined depending on the type of material and its environmental risk (former Department of Environment and Climate Change NSW).

This study uses the term organic material to better reflect the value of this waste stream to other uses, and avoid the negative connotation and hence perceived low value of such products. The National Waste Policy (Environment Protection and Heritage Council 2009) also seeks that waste streams are managed as a resource to achieve better environmental, social and economic outcomes, including saving water, energy, greenhouses gas emissions and finite resources, and to increased the productivity of the land (Outcome 3).

The Waste Avoidance and Resource Recovery Strategy 2007 (former Department of Environment and Climate Change NSW) also seeks to further reduce and avoid waste in NSW. The strategy also supports voluntary regional waste groups, such as Northern Inland Regional Waste (NIRW) to deal with regional initiatives to contribute to the waste and resource recovery strategies. Hence urban organic waste is included in this report, with the cooperation of NIRW.

The main sources of organic material in the North West of NSW include:

- Agricultural crop residue such as stubble (the material left after the grain has been removed at harvest),
- Forest residues (the material available after a tree has been logged and processed).

Other organic material sources include:

- Animal waste products particularly those associated with the intensive livestock industry.
- Urban waste is that material that is directly disposed of by the urban community often to landfills or other uses. This may include food waste, tree prunings and building wastes such as wood etc. It must be noted that the section on forestry relates to material that is directly derived from forestry activities, as opposed to wood waste that is derived from industrial and urban sources such as timber offcuts, wooden crates and packaging, pallets, wood shavings and other urban tree waste (such as stumps and branches) (Taylor and Warnken, 2008).

Processing industries such as cotton ginning, and sawmilling are also included in the audit to identify other sources of organic material that are related to both the agricultural and forest product processing.

Scope of the study

This is a reconnaissance level audit of agricultural, forestry and urban organic material sources and the corresponding amounts of material available and suitable for potential use in the North West of NSW.

The main incentive to conduct this audit was to provide an overview of organic material availability in the North West for future research, value-adding opportunities and to consider available feedstock for use in carbon mitigation and adaption activities (e.g. biochar).

Many studies in Australia still focus on the urban waste stream due to waste control regulations particularly the accountability of green waste going to landfill, and as such the need to identify other uses or processes to increase landfill longevity. Urban waste is attractive for reuse as it is centralised at waste management facilities making it readily accessible. This study helps build on information available to the local regional waste body Northern Inland Regional Waste.

Northern Inland Regional Waste is supported by 13 councils that concentrate on urban generated wastes at a regional level in an effort to reduce landfill. For the purposes of this work the Walgett Shire Council has also been included, although being a member of the Central West based Net Waste group.

This study identifies current uses of the organic material streams. The importance of some streams is identified at current use and value, in addition it should be noted that some organic materials have other benefits, e.g., environmental - such as the retention of crop stubble. The maintenance of organic matter in farming systems is important for maintaining productivity consequently; losing organic matter to other uses can increase production costs or decrease productivity in the long term. The study identifies further issues in relation to future work that may be required to substantiate the organic waste volumes available for specific industry development.

Organic material audit, data collection and methodology

The study area

The study area was based on 14 local government areas that make up the North West area of NSW (Figure 1).

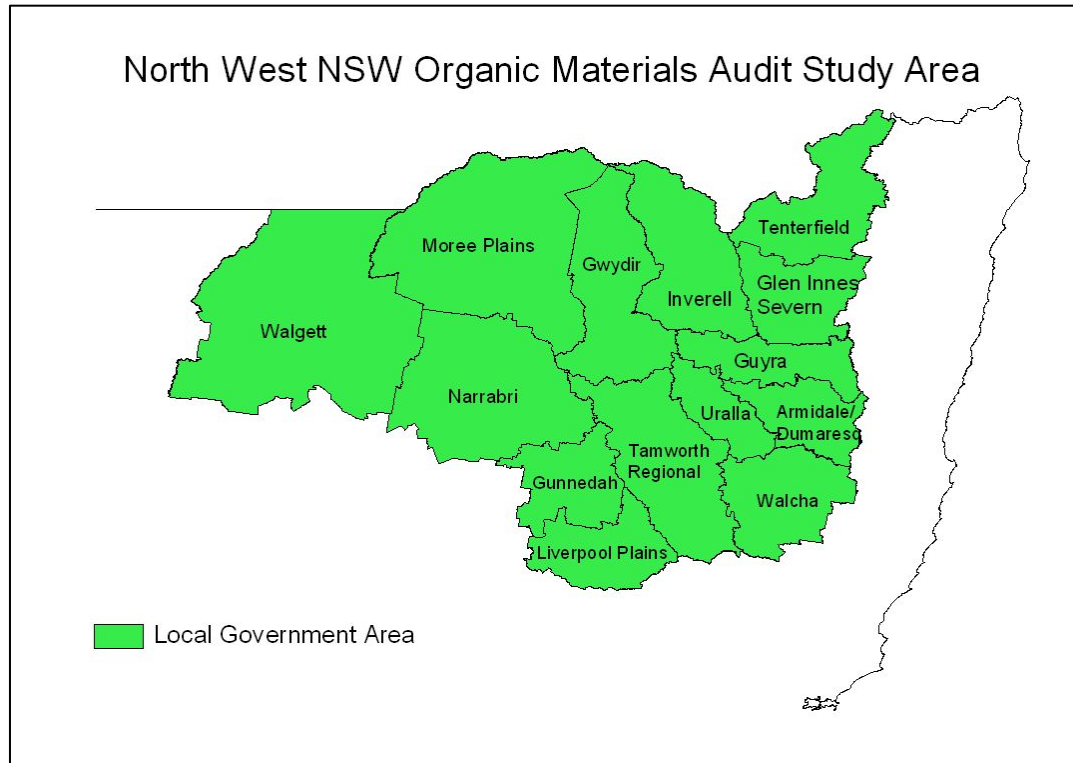


Figure 1: North West NSW Organic Waste Audit Study Area showing statistical local/government areas.

The North West area of NSW includes the New England Tablelands, North West Slopes and North West Plains and can be split roughly into four agricultural-geographical regions:

1. A Southern Plains area (Liverpool Plains /Gunnedah LGAs)
2. A Northern Plains area (Moree, Narrabri and Walgett LGAs)
3. Slopes (Tamworth, Gwydir and Inverell LGAs)
4. New England Tablelands (Walcha, Uralla, Armidale, Guyra, Glen Innes, Tenterfield LGAs)

Each agricultural-geographical region has its strengths for agricultural production. Agricultural systems have adapted to fully utilise the lands physical characteristics such as slope, soil type and fertility. The scale and type of agricultural enterprises across the region have evolved to suit climatic conditions and as such have developed farming techniques, selected crop varieties and animal productions systems to suit. The major urban centres include Tenterfield, Glen Innes and Armidale, Uralla and Walcha on the New England Tablelands; with Inverell, Wyallda and Tamworth in the slopes region; and Moree, Narrabri, Gunnedah, Quirindi and Walgett on the plains to the west of the study area.

The landuse of the area is reflective of the interaction of landforms, topography and climate of the area, with:

1. Grazing and forestry dominating the tablelands areas;
2. A wide range of dryland crops and grazing on the slopes and plains;
3. Irrigated cropping on the flood plains in the western half of the study area;

4. native forests occur across the entire region, with planted softwood forests occurring on the tablelands as they are dependent on the higher rainfalls that occur in this area.

Rainfall typically decreases to the west in the study area. The average annual rainfall in the New England area is 791 millimetres (Armidale – Radio Station 2AD) in the east, decreasing to an average of 413 mm at Walgett airport (Weatherzone) in the west.

The region experiences summer dominant rainfall which is reflected in the types of crops grown however, both winter and summer crops are grown in the area.

Population

The population of the North West Region is important in setting the context for the generation of urban waste. Table 1 summarises the populations of the local government authorities for the period 2007-08 (Australian Bureau of Statistics 2009). The areas of local government are derived from the Department of Local Government publication Local Government Directory available at www.dlg.nsw.gov.au/dlghome/dlg_LocalGovDirectory.asp?index=1&CN=ALL#2053.

Local Government Area	Estimated Population as at 30 June 2008	Area of local government area (square kilometres)
Armidale Dumaresq	25,228	4,235
Glen Innes - Severn	9,145	5,487
Gunnedah	11,985	4,994
Guyra	4,435	4,395
Gwydir	5,328	9,453
Inverell	16,375	8,606
Liverpool Plains	7,880	5,086
Moree Plains	14,338	17,928
Narrabri	13,507	13,031
Tamworth Regional	57,182	9,713
Tenterfield	6,907	7,332
Uralla	6,081	3,230
Walcha	3,276	6,267
Walgett	7,093	22,336

Table 1: Population totals for the local government areas of the North West NSW study area.

These main population centres provide opportunities for the urban organic material streams that are included in this report. The areas for each local government area also provide a guide to the extent of the area and its production related to agriculture and forestry products, and the issues associated with transport.

Agriculture

The North West region is a diverse agricultural region with major dryland and irrigation cropping areas on the slopes and plains with livestock industries important throughout the region.

The Moree Plains Shire Council is regarded as one of the richest agricultural shires in terms of agricultural value of production in the state, with both dryland and irrigated cropping. The processing of cotton also is based in the Moree Plains and Narrabri areas.

The Tamworth Regional Council supports a large chicken broiler industry, with dairying also important in the area extending to neighbouring council areas. The study area also includes a number of large feedlots and small to medium piggeries.

Forestry

Forestry consists of three major sectors in the North West Region; viz., the State Forest estate, administered by Forests NSW; private plantations; and private native forests.

Project steps

The major steps to information gathering, data collection and report production were as follows:

1. Review of current literature and previous studies.
2. Consultation with the reference and advisory group for this project.
3. Collection and coordination of information available with DPI staff, Forests NSW and other relevant organisations (particularly forestry/sawmill, food and fibre processing facilities), industries and advisory bodies.
4. Sourcing of small area data collected by the Australian Bureau of Statistics for the major agricultural sectors.
5. Supply and collation of urban material sources from NIRW, and directly with Walgett Shire Council.
6. Sourcing of Forest NSW estate data (hardwood and native forests) across the region.
7. Collation and extrapolation of data from all sources, ensuring conversion to tonnages.
8. Write report.

Data collation and analysis

The main task of the report is to generate broad supply data that is simple to understand and able to provide the basis for more work in developing a strategic approach for further detailed studies.

Information was collected from a variety of sources as outlined in the following section.

Review of past studies and other relevant information

The 2004 Northern Regional Waste Inventory undertaken by E.A. Systems Pty Ltd for Northern Inland Regional Waste provided the results of a more intensive survey inventory for the area (E.A. Systems, 2006). The E.A. Systems report was more focussed on urban wastes and intensive animal industry establishments, and processing facilities such as saleyards, abattoirs and sawmills. Some estimations were also undertaken to help predict waste quantities for livestock industries based on similar operations. We utilised some of this information as a basis for determining the extent of this audit work, and in justifying and making some assumptions regarding certain organic material streams available.

The E.A. Systems work also considered wastes from supermarkets and sewage plants (both biosolids and effluent), and saleyards. These were not considered in this work due to the supermarket waste and biocides often going to council landfills. The sludge factor from sewage treatment plants was also not considered due to the wet nature of the material.

The North East Waste Forum is the North Coast body for regional waste coordination (similar to the NIRW).who also undertook a study that looked at the sectors of urban, commercial and industrial, agricultural and sawmill residue material and their supply and availability for other uses in 2004. These studies undertook a survey of specific industries. Over 3 million tonnes of biodegradable organic material was generated in that region with about 70% of that material available from the agricultural sector. This study noted that almost all of the agricultural organic by-product was already reused or recovered (North East Waste Forum, 2004).

Bugg et al (2002) provided an Australia wide online mapping and decision support system to identify existing and some new resources for bioenergy use. The report provided data for scoping studies at the national and regional level. As well as identifying resources, it also examined infrastructure availability (such as roads and rails and electricity distribution) as well as resource data derived from 1995-2000. This work provides a broad analysis of organic matter availability and also deals with the logistics of biomass movement and use.

Agricultural industry information

A state wide investigation of potential energy generation from agricultural by-products was undertaken in 2001 (URS Australia Pty Ltd) for the former NSW Sustainable Energy Development Authority. This study identified agricultural production by-products such as crop stubble and processing materials (e.g., rice husks) with data from industry consultation and the Australian Bureau of Statistics. The report gives an economic assessment and outlines the most suitable supply streams and sites for electricity generating facilities. This work also identified the volume and distribution of agricultural production, with the potential by-product resulting from each production system that would be available for fuel. Crops identified for electricity production were based on fuel types which included cereal crops (wheat, oats, barley, and triticale), summer crops (sorghum, millet and sunflower), maize, rice, cotton and oils seeds. Lupins along with other lesser crops were also included. Agricultural product density mapping and volume estimates coupled with transport distance, provided a guide to investigating agricultural by-product density. The areas of Narrabri / Moree and Gunnedah / Tamworth / Quirindi were shortlisted for further study. This study reinforces the approach undertaken with this audit and provides a guide to the crops that were selected.

The approach undertaken for determining the availability of crop stubble for this audit is based on the work by Dunlop et al. (2008b). The Dunlop et al. study used harvest index, ABS statistical regions and simulation modelling for wheat crops across five states and 67 years of data, looking at soil types, water holding capacity and different nitrogen application rates as a way of determining if harvest indices varied. Annual non-harvestable crop residue was estimated at 15% of total residue biomass or 1.5 t/ha per hectare for Queensland and northern NSW wheat sites. This study provided a guide to the other key grain crops, with 20% of non grain biomass assumed to be unharvestable and an additional 1.5 t/ha to be retained. Further information in relation to harvest indices was obtained from this work and from the Department of Primary Industries (D. McCaffery, pers comm.)

There have been other surveys of organic wastes for agricultural use. These are predominantly based on local government urban waste streams in order to redirect landfill disposal to other uses. Recently the South East Resource Recovery Regional Organisation of Councils (SERRROC) undertook a survey that provided an overview of point source organic industries which included extensive and intensive livestock farming, broadacre cropping, horticulture and wood and timber industries. This study noted that wheat residues could supply about 235,000 tonnes of material a year, assuming a recovery of residues from the field of 45% (The Organic Force, 2009). DPI agronomists in the North West region also confirmed that an estimated 45% of wheat straw being available is comparable to this region.

Urban

Data was directly obtained from NIRW with permission from the Department of Environment and Climate Change Council which monitors and assists improvement to waste management and resource recovery in regional areas as an initiative with the Department of Environment and Climate Change. The Walgett Shire Council (who operates in the Central West's NETWASTE area) was directly contacted to obtain the organic material totals for the Council area during the study period.

Other data collection methods, such as that undertaken by three regional waste management groups in Western Victoria (Hood, 1999), also looked at organic wastes including manure, grain waste, vineyard waste and abattoir waste that could be available for other uses. In this study a survey of individual industries was undertaken to collect data for assessing the quantities available in the region. This study identified that a protocol be developed for the measurement and reporting of green waste organic amounts to allow consistency between Councils. It also highlighted the variety of waste that could be available in different local government areas. This method presents an alternative way of collecting data on urban organic waste which may be considered for further studies.

The handling of municipal organic materials in landfills, and its ability to be reused is a driver for studies across Australia. The South Australian Government have examined the supply of organic material and processing in the greater Adelaide area and other urban areas, determining current and potential markets (Nolan -IT UK, 1999). Composting has been a major focus of this work to support the use of organic horticultural products for soil amelioration. This work identified the material available from municipal waste sources (such as garden waste) as well as that generated from other point sources, particularly intensive horticultural and viticultural material, that was increasingly a useful resource. This work is also relevant to NSW, where reducing organic waste entering landfill is one of the aims of the NIRW body in the North –West.

Forestry

The forestry industry, particularly on the Northern Tablelands (New England region), has been studied examining the ongoing development of forestry in the area, as well as the secondary availability and use of forestry residues. All studies have identified the potential that still exists for the forestry industry with a number of other industries which could be supported by utilising the residues.

A broad study of biomass estimation across Australia (Bugg, et al 2002) identified the main source of biomass to be available from infield agricultural sources. Forest harvest residue, sawmill residue and uncommitted plantations were the major sources across Australia. This work was developed using ABS data for Statistical Local Areas, with multipliers to estimate available materials. Timber plantations were estimated from previous resource studies with the volume production of each state allocated proportionally on a SLA basis on existing plantings. Bugg, 2002 used wood densities of 0.5 tonnes/m³ applied to certain softwood volume estimates to estimate biomass tonnages. For native forests Bugg, 2002, estimated 0.7 tonnes/m³ and this could vary dependant on the region and type of forest present in an area. Farine et al 2012 uses 410-460 kg/m³ for softwood (sawlogs and pulp logs respectively, while using 630kg/m³ for native forests. The figures used in this report are based on Forests NSW density estimates currently used in their operations.

Major Sector Review

Agriculture

Crop materials

The sourcing of the amounts of material from the agricultural sector is mainly based on the Australian Bureau of Statistics Small area data for the 2005/06 census year. The use of this data allows a consistent, repeatable way, to determine past and future trends in supply based on census year intervals.

Crop data for each Local Statistical Area was available from the census. This information provided the basis for stubble volumes to be determined based on a summary of crop Harvest Indices (HI) data used by both data drawn from Dunlop, et al (2008a) and the preliminary work undertaken by Unkovich (2006).

Crop	Mean	Min	Max	s.d.	c.v.	n
Barley	0.38	0.10	0.55	0.09	0.24	35
Canola	0.27	0.10	0.40	0.06	0.22	44
Chickpea	0.36	0.07	0.55	0.11	0.31	52
Faba bean(1)	0.45	0.11	0.60	0.11	0.24	37
Field_pea	0.36	0.06	0.55	0.12	0.33	39
Lupin	0.28	0.07	0.45	0.08	0.29	49
Oat	0.30	0.14	0.50	0.14	0.47	6
Triticale	0.37	0.31	0.45	0.07	0.19	4
Vetch	0.35	0.16	0.45	0.10	0.29	7
Wheat	0.36	0.08	0.50	0.07	0.19	194
Lentil	0.31	0.06	0.50	0.13	0.42	12
Sorghum	0.46	0.27	0.70	0.10	0.22	16

(1)- Faba bean data are probably too high as the data set is likely biased with samplings that did not include fallen leaves.

Table 2: Summary of crop HI from Dunlop et al (2008a) with data from Unkovich et al. (2006), where 'n' refers to the number of site x year mean values. The HI is a unitless parameter (as an indice).

With this harvest indices data the stubble volumes were calculated using the process developed by Dunlop et al. (2008b) where they assumed that 20% of stubble was unharvestable. For this study 1.5 t of stubble/ hectare was retained.

Some crops that are grown in the study area were not included in the Table 2. Harvest indices for sunflowers, safflowers and maize were provided by Don McCaffery from the Department of

Primary Industries based on departmental data. The same assumptions about unharvestable portions and retaining 1.5 t/ha were applied to these crops.

On a landuse basis horticultural land use was not considered to be significant enough to be included in this audit. Both hay and silage production was also not included as this is produced on purpose for a higher valued end use. Spoilt silage and hay may provide a source of organic material, but for this study it was not included.

A major consideration of using ABS data is the standard error associated with the agricultural data. ABS advises that some areas have a relative standard error between 25-50% and should be used with caution, and that some data has been randomly adjusted to avoid the release of confidential data. Hence this study is regarded as one that is an overview to account for this limitation in data.

Animal sector

For the intensive livestock sector, data was obtained from the ABS and then refined based on internal DPI information and related sources. The Public Register created under the Protection of the Environment Operations Act 1997 contains details of facilities that require licensing under this act. This register provided data on relevant facilities and further information is available at <http://www.environment.nsw.gov.au/prpoeo/licences.htm>

Cotton trash

Cotton is an important annual summer crop in the North West area, particularly to the local government areas of Moree, Narrabri, Gunnedah and Walgett. Its production is predominantly based on irrigation in these areas.

Cotton stubble is not considered to be valuable as a potential source of organic material (M. Dunlop, pers comm.). However, cotton trash – that material derived from the cotton ginning process, where the cotton lint is separated from the seed and vegetable matter, is an important organic material source. The trash includes leaves, bark, stems, bracts and soil. In a report examining waste classification of cotton gin trash (Hassall and Associates, 2005) gin managers estimated that 50-60 kg of gin trash is produced for each bale of cotton. Trash is a high volume product with a high risk of combustion, and also has chemical contamination risks. This report also recommended that options for gin trash management be developed to deal with disposal issues.

ABS data has been used as a basis to determining the cotton trash derived from the production of cotton lint and seed.

The following assumptions were made:

1. A bale of cotton weighs 227 kg.
2. For each bale an average of 55 kilograms of cotton trash is produced (Hassalls and Associates, 2005).
3. As a guide to proportion of total cotton production, about 38% is lint and 36% is seed, leaving 26% trash (Janine Powell pers comm.).

Pollution licensing indicates that there are 14 cotton gins currently operating in the North West region of NSW with most of them in the Moree – Narrabri area.

Other Processing Industries

Nuts

The level of horticultural development in the North West is very limited. The pecan grower, Stahmann Farms, at Moree undertakes no processing of nuts in the North West area. Hence there is no available material from this source.

Olives

The Gwydir Grove Olive crusher produces regional olive oil and olive based waste. This material has not been accounted for in this study as it is reused on winter crop production systems.

Tomatoes

Blush Premium Truss Tomatoes at Guyra currently has disposal problems with spent tomato plant material and growing medium. They have about 1,000 tonnes of spent material available per annum, but this is not included in this study.

Composting

The Biotech composting facility based at Moree provides a service to the disposal of cotton trash in the area. This output is not included in this study as waste quantities for cotton are taken at the yield level.

Abattoirs and saleyards

Four licensed abattoirs occur in the North West. Three are located at Tamworth (beef, lamb and chicken) and one at Inverell (beef). Waste from the lamb abattoir at Tamworth has not been included in this study.

No saleyard waste was considered in this study.

Urban

The urban sector information is based on data gathered from the local government areas and supplied to the former Department of Environment and Climate Change, and used with permission for this work. This data is collected annually and three financial years are included in this study.

Forestry and the timber industry

Forestry is a major industry in the region based on softwood and native forests in the higher rainfall tablelands area, changing to white cypress – red ironbark native forests in the drier western slopes of the region.

Radiata pine (*Pinus radiata*) is the main species selected for softwood plantation use in the Tablelands area. This exotic species is harvested when about 35 metres height, generally around 35 years of age, hence providing a viable and useable source of timber in a relatively short time (Forest NSW Planted Forests Operations, 2008).

Various studies have identified the supply of forest materials for potential other uses such as energy sources and increasing industry investment. The Walcha region has been identified as an area with residual wood sources that may be available for other uses by the New England/North West Regional Development Board (ESD Consulting Pty Ltd, 2005).

Work undertaken by Jay (2008) determined that private Radiata Pine plantings could be a source of commercial residues. There is also the potential to recover non commercial residues *in situ* (i.e., logging slash and stumps). 1703 hectares of private pine in the Walcha Shire could yield a total of about 282,700 m³ of residues as at 2008 under current conditions and management (Jay 2008). Jay estimates if private plantations were optimally managed, about 42,915 m³ of residues (based on annual figures) would potentially be available given annual growth rates of current stands. There may be more due to less productive forests being thinned as part of better management regimes. This converts to 18,000 tonnes of residues that may be available should these private forests be subject to best management practise and anticipated predicted growth rates.

The New England – North West Forestry Investment Group (2002) and the New England – North West Regional Development Board Inc (2001) have identified a large native forest

resource potential on private lands in the New England area. This is a potential growth area that would also provide further organic material derived from hardwoods, but again dependent on private landholder interest and motivation. Developments in terrestrial carbon markets may provide an incentive to further manage forests for economic and environmental opportunities, and encourage reforestation activities (Johnson and Coburn, 2010).

For consistency volumes for this study have been converted to tonnages based on bulk densities of wood materials as calculated by Forest NSW at current conversion rates. Conversions used include 350kg/m³ for *Pinus radiata* (radiata pine) and 595kg/m³ for *Callitris glaucophylla* (white cypress pine). Conversion rate for native forest in the tablelands is 700kg/m³ as used by Forests NSW. Green waste residues have higher moisture contents described by Hobbs (2008).

Forestry Processing (Sawmills)

There are a number of licensed sawmills operating in the North West area that produce forest product residues (including sawdust, woodchips and scolding) as secondary products to milled timber. The information used in this report is derived from a number of sources that include:

- Information supplied on licensed facilities (Forests NSW),
- Information from E.A. Systems (2006),
- Data derived from Jay (2008) and Northern Forestry Services (2005), and ESD Consulting (2005).
- Forest NSW staff have also assisted in estimations of sawmill production and outputs.

Results

Agriculture

Crop residues

Approximate crop residues are based on the current CSIRO methodology for the region (Dunlop et al 2008b). The Statistical Local Area (SLA) with the highest potential source of crop residue is the Moree Plains, with a total of over 600,000 tonnes available. Narrabri and Gunnedah local government areas also provide sources of up to 540,000 tonnes combined (Figure 2).

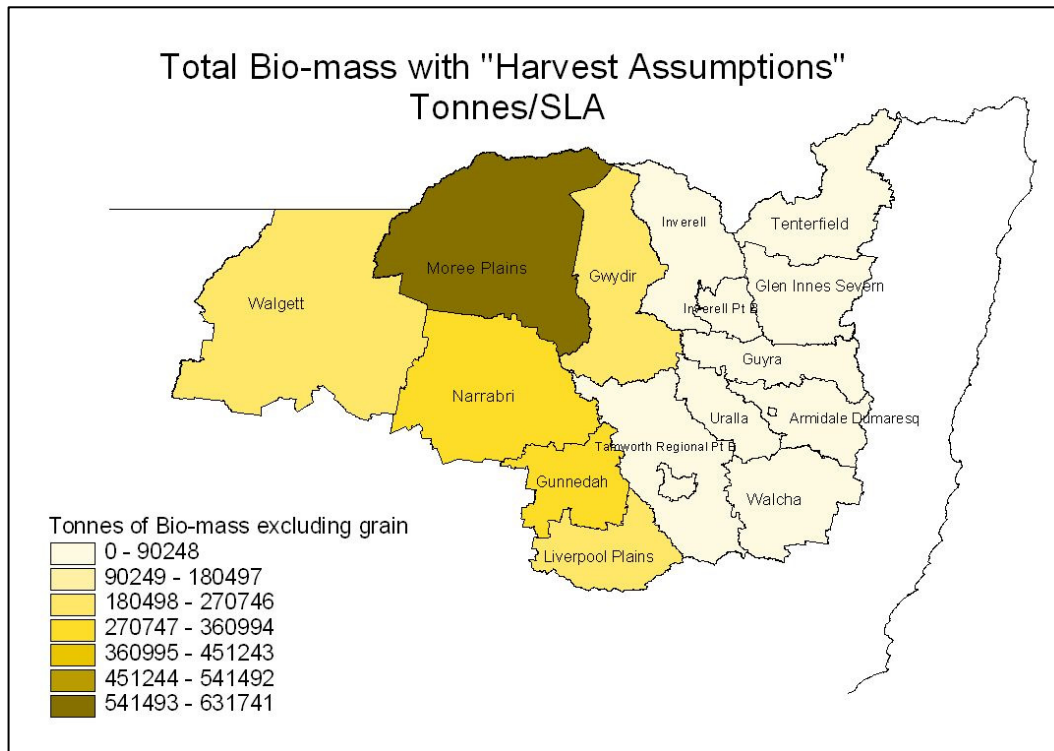


Figure 2: Total estimated available agricultural crop residue/biomass (t) for the Statistical Local/Government Areas for the year 2005/06.

On an area basis the largest production occurred in the Gunnedah Shire (Figure 3). The tonnage per area basis takes the total tonnes of crop residue per SLA and divides that figure by the area of that SLA. This analysis is not fine enough to take into consideration the area of non cropping land such as State Forests and National Parks or grazing land. However, the analysis is broad enough to give a good representation of where the high yielding cropping areas are. As such the tonnes/ha in shires such as Narrabri are underestimated as they have large areas of National Park and State Forests.

Due to limited GIS resources the crude analysis of tonnes/ha/SLA was used to give a broad guide to highest yielding areas. The utilisation of known cropping areas divided by tonnes/ha was also considered but factors such as the area under crop changes between years also has error margins. Herr & Dunlop (2011) also offers a more improved approach that includes using national land use maps with regional agricultural statistics, to provide a more accurate spatial distribution of feedstocks and availability.

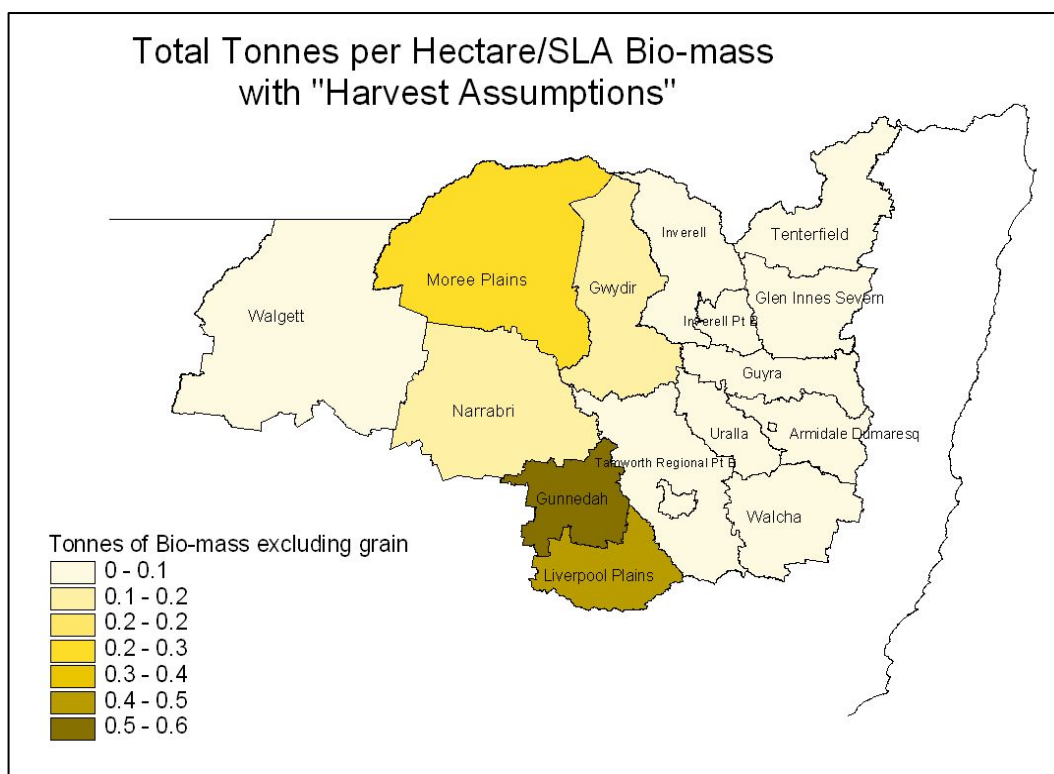


Figure 3: Total estimated available agricultural crop residue/biomass on an area basis for the Statistical Local/Government Area for the year 2005/06.

Current use, value and limitations as an organic material source

One of the major limitations in using crop stubble is its role in protecting topsoil from wind and water erosion, the conservation of soil moisture, and soil physical, chemical and biological processes. It has been acknowledged, for example, that not all the available residue could be used for ethanol production (Department of Primary Industries (2004)). The 2004 report identified that only 15% of total dryland crop stubble (wheat, oats, barley, triticale and grain sorghum) could be available as a resource for ethanol production. The SERRROC study of the south east of NSW (The Organic Force, 2009) also identified that minimum tillage and sheep/cattle graziers would prefer to leave crop residues and would be unwilling to remove all or some of the residue biomass from farms. Hence the total amount of stubble that might be available would be lower than the tonnages estimated through this study.

Other factors that affect supplies of organic crop materials include the volume of feedstock required, size of market and the economies of scale in the future development of any ethanol facility (Department of Primary Industries 2004). Seasonality and future projected climate changes will also have an impact on the supply of materials both in the short and long terms. Intensive Animal Industries

Poultry Industry

About 55,500 tonnes of poultry manure is available from the Tamworth area annually¹. There are 13 chicken meat growers in the Tamworth area (2006) which includes individual farmers,

¹ Data for the poultry industry was supplied by Joanna Blunden, former Livestock Officer (Poultry) NSW DPI.

processor owned and operated farms and a corporate company that has several large farms. At any one time there would be about 4.5 million meat birds in sheds, with a yearly production of over 23.65 million birds.

A summary of the methodology and calculations is as follows:

- Broiler industry figures in the Tamworth area 135 sheds that average 1800 m² each. Each is cleaned out 5.5 times per year.
- Each shed uses an average of 85 m³ of sawdust in per batch.
- The conversion ratio of new litter to that spent is 1.6.
- Hence 100,980 m³ of spent litter is produced.
- One cubic metre of poultry litter weighs 550 kg.
- Therefore Tamworth broiler farms produce about **55,539 tonnes of litter/annum**, or an average of about 2.3 kg/bird.
- This is over the estimate of 1.72 kg of litter per broiler every seven weeks (Poultry Hub, 2010) however, this lower figure may be accounted for due to regional differences.

Dead birds are processed at the local rendering facility and as such do not form part of this study.

Breeder and layer farms also exist in the Tamworth area. Both are low in numbers and the level of clean out is lower so no estimation of litter has been made from these sectors of the poultry industry.

It is expected that the broiler industry will remain strong in the Tamworth area with some expansion potential.

Current use, value and limitations as an organic material source

Poultry manure is currently used on farm as a fertiliser source that has a high nutrient value particularly in Nitrogen and Phosphorous.

Poultry manure has an estimated fertiliser value to be worth \$54.21 per tonne (Griffiths 2007) based on its available nutrient levels. Hence the 55,539 tonnes of poultry litter generated in the Tamworth area has a fertiliser value of \$3,010,769. The value of this resource may well be higher with current fertiliser prices (Ian Kruger and Greg Mills, DPI pers comm; 2009).

Although not a perfect fertiliser as there is odour and dust issues associated with land application. The current limitation of poultry manure is its competing value as a fertiliser source for agricultural crops.

Seasonality is not considered to be a major influence on the supply of this resource. The cost of sawdust will be a factor in the pricing of this organic material as poultry growers seek to cost recover.

Piggery industry

Although the piggery sector is considered to be important to the area (62,000 pigs in the region in the 2005-06 ABS census) there are only 4 medium sized commercial operations (those in the 50 to 500 head) licensed under a pollution licensing agreement under the *Protection of Operations Environment Act 1997* (Environment Protection Authority). Most operations form part of a mixed farming operation that integrates the waste from the piggery with cropping. The four operations licensed under the POEO are not all operating, and are flushing systems (liquid based) with residue used on farm. For the purposes of this audit no piggery material is being considered as being available.

Feedlots

Information derived from E.A. Systems work (undertaken in 2004) has been used as a basis for this work (Table 3).

Local Government Area	Numbers of cattle/Number of feedlots	Available Manure (E.A. Systems) tonnes/annum
Glen Innes/Severn	24,000/1	45,000
Gunnedah	24,000/1	Unknown but assumed to be 45,000
Gwydir	20,500/1	16,000
Inverell	10,000/1	16,000
Liverpool Plains	20,000/1	20,000
Moree Plains	3,500/1	3,000
Tamworth Regional	500/1	1,825
TOTAL		146,825

Table 3: Number of feedlots and manure production for local government areas (E.A. Systems, 2004)

Current use, value and limitations as an organic material source

Much of the manure resource is already utilised as fertiliser on existing feedlot establishments or disposed of on other agricultural lands. The cost of transport is a factor that limits its movement.

Hulugalle et al (2009) estimated the cost of collecting cattle manure at \$15 per tonne with transport costs of \$10 for a distance of 0-10 km from the distribution point, and an increase of \$1 for each 5 km increment after that.

Dairy farms

The ABS figures indicate the Tamworth Regional Council area has the greatest concentration of dairies. Information gained from DPI Livestock Officer (Dairy)² indicates 17 dairies now exist in the area, ranging in size from 40 to 800 head, with 200 being the average number of head. There is also a large dairy at Walcha (up to 800 head), one 600 head dairy at Upper Manilla and two other 400 head dairies in the Tamworth area. Most dairies still operate a pasture based system, except for one freestall barn operation and one that uses a feedpad for four months per year. The volume of manure potentially available is limited to the time the cows are in the milking shed and pens.

The E.A. Systems study (2004) identified nine dairies in the Tamworth Regional Council area. Four of these produced about 10.6 million litres of effluent, and about 2000 tonnes of manure (based on 1710 head). The number of dairies in the E.A. Systems study was limited to respondents that volunteered to be included in the survey.

For the purposes of this audit the following is assumed:

² Information supplied by Regional Team Coordinator (Dairy), Anthea Young, Scone

The average cow (of 636 kg) produces 54.5 kg/day (I. Kruger, unpublished). It is assumed that each cow will spend 20% of the day in a feedpad/ yard area. Hence this will be the only recoverable portion that is considered in this study.

Current use, value and limitations as an organic material source

Much of the manure is stockpiled and is often contaminated with rocks and grass when yards and feedpads etc are cleaned. This presents some limitations to its use as sieving of the manure may be required. The availability of the product is not limited by other uses, although it may be of composting value or other direct use on cropping lands due to its fertiliser value.

The cost of transporting manure (at \$8-10/tonne (below 50km) is a limitation to its use on farmlands as a soil ameliorant. Hulugalle et al 2009 estimated manure transport cost at \$10 for the first 10 km with an increase of \$1 for each five km increment after that. FSA Consulting³ estimates its value to be \$10-30 per m³.

Figure 4 depicts the total amounts of feedlot and dairy residue available for each statistical local government area. Both Glen Innes/Severn and Gunnedah areas have the highest production of up to 45,000 tonnes per annum.

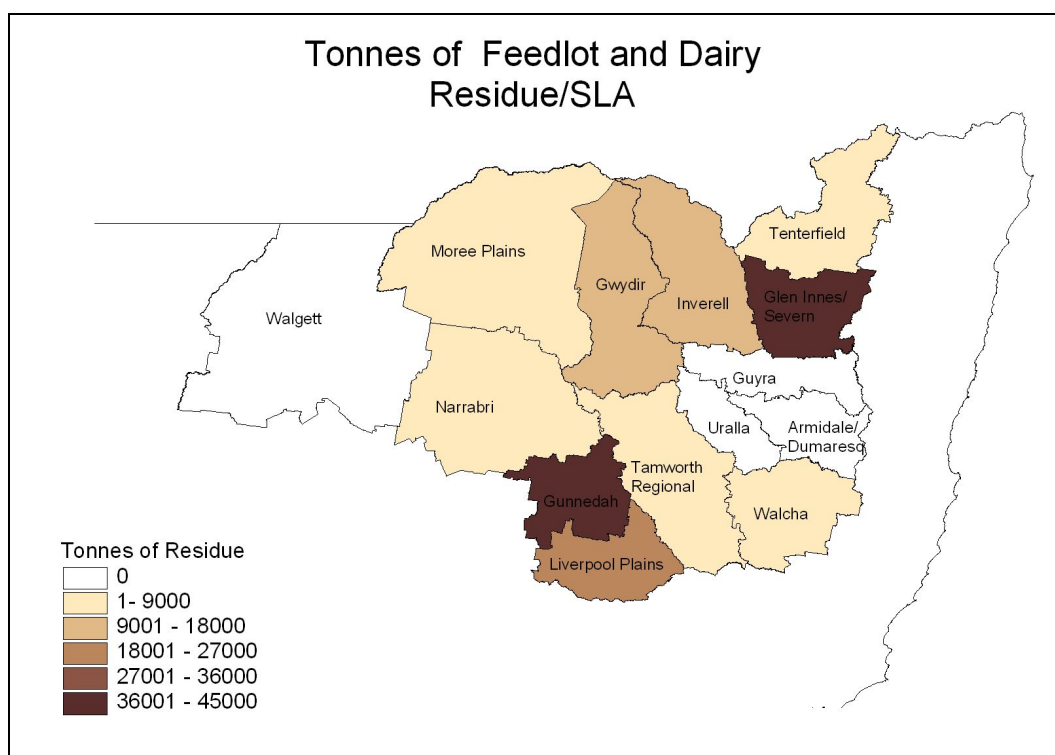


Figure 4: Tonnes of feedlot and dairy residue available for each Statistical Local/Government Area based on E.A. Systems data (2004) and calculations for dairy cattle.

Cotton trash

We estimate a total amount of 68,000 tonnes of cotton trash is available based on ABS 05-06 figures, with Moree Plains and Narrabri statistic local areas producing about 80% of this.

Cotton trash is a processing by-product when the seed, along with vegetable matter, is removed from cotton lint. The seed is a valued commodity while the vegetable matter is referred to as "cotton trash".

³ http://www.dairyinfo.biz/images/Content/PDF/6701Workshop_Report_Final.pdf

Current use, value and limitations as an organic material source

This material is predominantly composted (e.g., by Biotech Recycling) with the rest being disposed of on farm. There is a net import of such material from other areas such as the Central West of NSW.

Current limitations to this source include its existing use for composting, with cotton gin trash also being used as an amendment to soils. Hulugalle et al (2009) investigated the use of composted cotton trash and the associated cost of transport. Composted cotton trash was sold at a value of \$25 per tonne, with transport costs of \$10 from 0-10 km from the source (and \$1 for every five km increment after this). Transport distance and the amount of composted cotton trash required were determined to be the limiting factors to its use.

The impact of reduced water allocations in dry times on cotton production is critically important, as the cotton yield decreases. Cotton is a summer grown crop hence, the seasonality of supply can be significant within the season and between years.

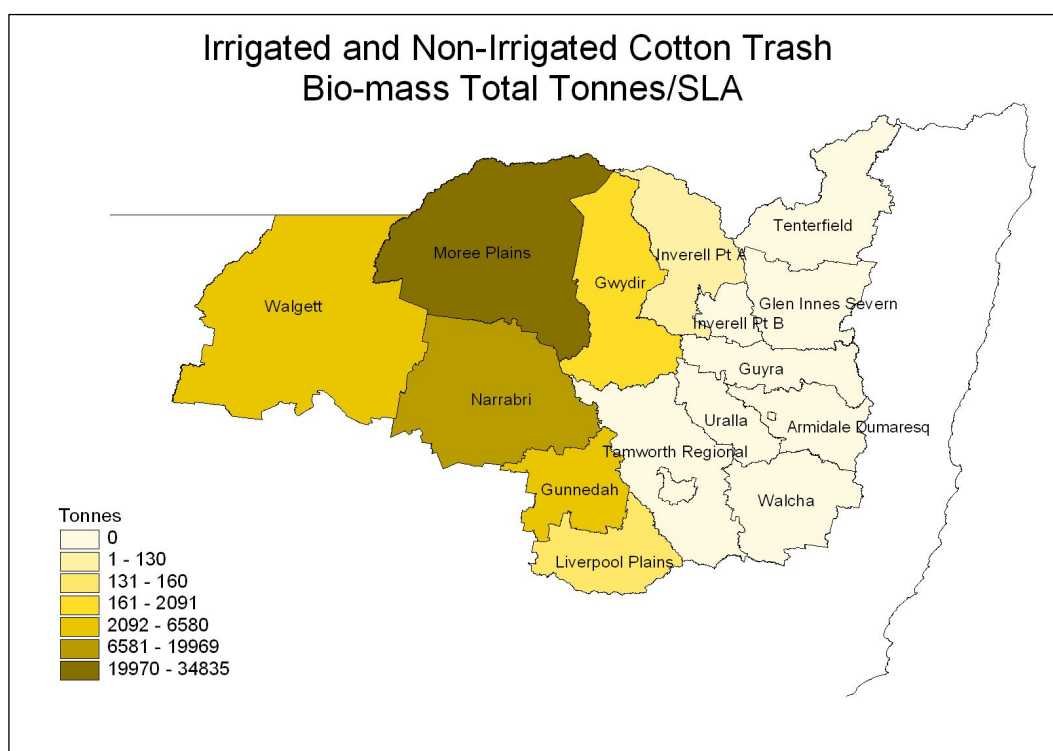


Figure 5: Total estimated available cotton trash/biomass for the Statistical Local/Government Area for the year 2005/06.

Abattoirs

About 70,000 tonnes of waste is estimated to be available from meat processing, most of it in the Tamworth Regional Council area. There are three abattoirs based in this area – lamb, beef and poultry operations. The poultry and beef abattoir have reported to produce 64,400 tonnes of meat processing waste per annum according to E.A. Systems work, which does not include liquid sludge. The processing waste includes dried blood, feathers, offal, bone and paunch material.

Bindaree Beef at Inverell has an average throughput of 997 head /day (based on January –June 2010 production statistics). They produce a total of 6,310 tonnes of organic material (mainly paunch, manure and ash).

Urban material

Approximately 29,000 tonnes of organic material derived from urban waste is available in the region based on the data reported from the Northern Inland Regional Waste organisation.

The local government areas that are members of the Northern Inland Regional Waste include all the areas except for Walgett which is a member of Netwaste group (Central West NSW).

The following table is from information derived from three financial years of local government reporting. This information is used with the permission of the former Department of Environment and Climate Change and local government in the reporting region.

Table 4 shows some variation in total organic material for each year due to individual council differences in green waste collection depending on the level of collection and drop off and separation arrangements. Some Councils have not started to collect green waste due to resourcing (particularly with costs to some of the smaller councils) and current licensing requirements that do not address mandatory green waste material collection. A major limitation is the quantity, and variation of supply as shown in the table below. Some Councils, such as Tamworth Regional and Moree have alternative uses for the urban organic waste stream through composting arrangements.

Dept. Local Govt. No.	ABS	Council Name	2005/06 Total Organics (Kerbside, Drop off, Clean Up) Tonnes	2006/07 Total Organics (Kerbside, Drop off, Clean Up) Tonnes	2007/08 Total Organics (Kerbside, Drop off, Clean Up) Tonnes
4	110	Armidale Dumaresq	3,486	8,000	5,255
6	3020	Glen Innes Severn			
11	3550	Gunnedah	1,679	1,540	1,873
9	3650	Guyra			
10	3660	Gwydir	217	557	616
11	4200	Inverell	211		
10	4920	Liverpool Plains	4	515	12
11	5300	Moree Plains	1,633	799	2,027
11	5750	Narrabri			
4	7310	Tamworth Regional	11,548	16,466	16,596
10	7400	Tenterfield	300	472	804
10	7650	Uralla		518	896
9	7850	Walcha		230	250
NIRW			19,078	29,098	28,331

Table 4: Total regional collection of domestic organic material for the Northern Inland Regional Waste area (that excludes the Walgett Local Government area) for the years 2005/06 to 2007/08

Walgett Shire Council produces about 300 tonnes of organic material per annum.

Table 5 summarises the total domestic organic material for all NIRW councils, over three financial years. The data available for 2007-08 is used in the final analysis comparing all organic material streams, and is spatially depicted in Appendix 2.

Year	Total Domestic Garden Organics Collected from the Kerbside	Total Domestic Garden Organics deposited into a Drop off Facility	Total Domestic Garden Organics collected from Council Cleanups	Total Domestic Organics
	Tonnes	Tonnes	Tonnes	Tonnes
2005/06	8,512	10,562	4	19,078
2006/07	11,025	18,016	57	29,098
2007/08	9,446	18,822	63	28,331

Table 5: Total regional collection of domestic organic material for the Northern Inland Regional Waste area for 2007/08 (excluding the Walgett local government area).

Current use, value and limitations as an organic material source

In relation to future supplies, some Councils are currently considering the inclusion of food waste into their green waste bins at the kerbside to further reduce the amount of urban organic waste to landfill. Constraints exist in this area due to the costs of collecting, handling and processing this material.

The recently introduced exemptions under the *Protection of the Environment Operations Act 2007 Act* has also limited some forms of organic waste being processed at Council waste facilities. One such example is paunch material from abattoirs; this had previously been incorporated into mulch/compost stockpiles at one member Council facility (a valuable source of nitrogen). An exemption for paunch has been granted, resulting in this material now being able to go to composting but requiring prior pasteurising.

While all NIRW member Councils have their greenwaste collected, only a handful of Councils undertake any further processing to value-add to this material. At Tamworth's Forest Road waste management facility, greenwaste receives further treatment so mulch and compost is produced to Australian Standards. Mulch is for sale to the public for up to \$14/m³. Other Councils use the 'chipped' material as mulch cover, and make the material available for free collections by members of the public. Some Councils are also looking at supplies to other independent processors (Newlan, pers comm.).

For Councils to undertake further treatment of their processed greenwaste they need to be receiving appropriate volumes of material for processing and have a market for the end product. Processing material to current voluntary industry standards published by Standards Australia (for more details see <http://www.environment.nsw.gov.au/warr/OrganicsForCompostProducers.htm>) could potentially open up market opportunities as members of the public may have more 'confidence' in the end product.

In terms of looking at the security of available feedstock for an external processing facility, seasonal variability in green waste collections/drop off could be a potential constraint.

Contamination of greenwaste is an issue for Councils, especially in the greenwaste delivered to waste management facilities via kerbside collections. Significantly lower levels of contamination are found in greenwaste dropped off to the facilities.

Contamination such as weeds is a major issue with unprocessed green waste when it is to be used for land rehabilitation (Midwaste Regional Waste Forum 2004). Food waste can also pose a problem with odour, flies and vermin. Urban timber wastes also have varying issues depending on the end use. Treated and composite timbers require separate treatment due to chemicals used in their production inhibiting composting. Other issues associated with composting include odour, fire potential, dust, and longevity to break down of chemical compounds. The storage space and transport were also highlighted in this study, as being barriers to its reuse.

Forestry

Forestry is a major industry in the North West area, comprising of both native hardwood and exotic softwood in both state owned and private estates. The main product is sawlog production.

The total amount of organic residue material from forestry operations in the region is estimated by this study to be over 880,000 tonnes. This material includes non-merchantable timber contained in the main stem, non-merchantable branches of the tree up to the point defined as top height, stumps, defected sections of the bole and pieces too small to be merchantable and sawmill material. The source of the material is depicted for each statistical local/government area in Figure 6. Both Walcha and Tenterfield LGAs produce the highest amounts of forestry residues.

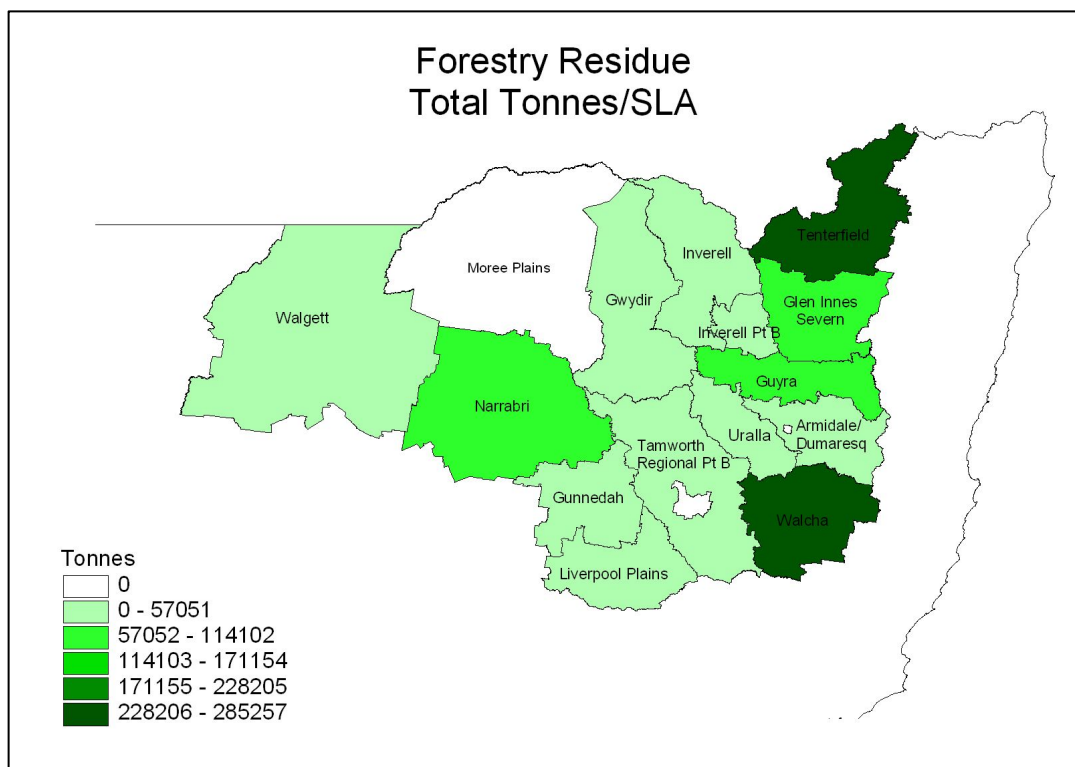


Figure 6: Available annual estimated total forestry residue yield (t) for the Statistical Local/ Government Area from data for 2005 and 2008.

Figure 7 shows the statistical local/government areas that produce the highest amounts on an areal basis. Again Walcha and Tenterfield dominate in terms of yield tonnes/ha basis. The area basis analysis takes the total tonnes of organic residue material from forestry operations per SLA and divides that figure by the area of each SLA. This analysis is not fine enough to take into consideration the size and distribution of areas held under public and private plantations as opposed to other land based activities (e.g., grazing). However, this coarse analysis gives a good representation of where the priority, higher yielding areas are.

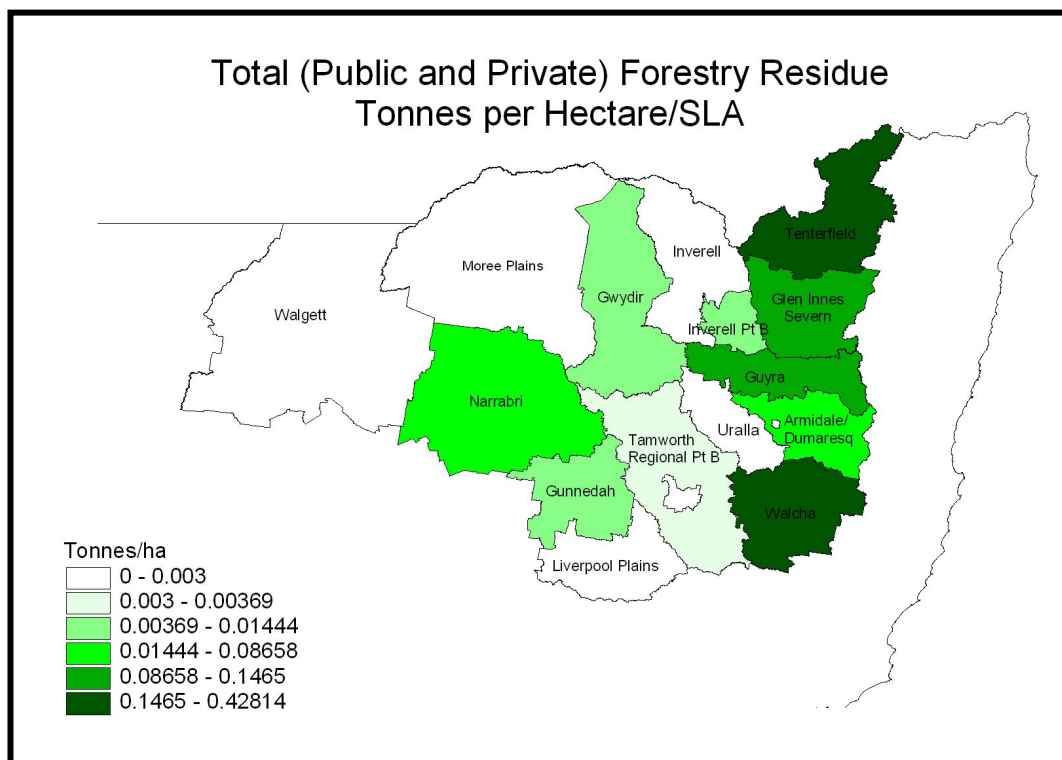


Figure 7: Available total estimated forestry residue per hectare for the Statistical Local Area/Government from data from 2005 and 2008.

Both native forests and softwood forestry is examined separately in the following section. The availability of the subsequent different forestry residue sources is included as there are differing factors that will impact on further feasibility studies.

Native forests

There are two major components of native forest in the region – the eucalypt dominant forests of the tablelands (both natural and plantation) and the western forests that often consist of white cypress pine (*Callitris glaucophylla*) – ironbark (incl. *Eucalyptus sideroxylon*) dominant woodlands. The data sourced for public state forests provides a guide to the volumes of woody waste available from associated forest operations. The original data in relation to these figures is included in Appendix 3.

State Estate

The data obtained from Forests NSW provides estimated standing volumes of state managed native forest estates for each local government area, with an estimated sustained annual yield for sawlogs, pulpwood and other woody waste. The data is used with assumptions including:

1. Sawlog volumes include high and low quality sawlogs.
2. Pulpwood is the non-sawlog merchantable product that meets pulp specifications. It is assumed that no timber in the western region will meet current/conventional pulpwood specifications, certainly in no marketable volume.
3. Other woody waste includes the volume of non-merchantable timber contained in the main stem and merchantable branches of the tree up to the point defined as top height. This includes stumps, defected sections of the bole and pieces too small to be merchantable.
4. Standing volumes were calculated using FRAMES.

5. Sustainable yields were based on High Quality Sawlog weighted proportions of the total HQ sawlog sustainability defined for the broader analysis regions. Non-HQ sawlog estimates, along with pulpwood and other woody waste were calculated as a standing volume proportion of HQ sawlog estimates.

This information for state native forests was gained from state forest staff at Dubbo, Grafton and Wauchope. The base data is also available in Appendix 3.

Private Estate

The area data derived for the five local government areas of Armidale, Glen Innes/Severn, Guyra and Tenterfield is taken from a study undertaken by Northern Forestry Services (2008) which derived the information from the existing regulatory agreements. The Walcha information is obtained from ESD Consulting (2005).

It should be noted that the work by Northern Forestry Services considered that the native forest and plantation resource in the Armidale, Glen Innes/Severn, Guyra and Tenterfield area to be 'small' relative to the north coast region further to the east.

The size of the area under private native forests in the New England is increasing according to former forestry staff in Walcha. This could provide a further source of residues depending on management and availability in the future.

Private native forestry in the western part of the region is minimal and has not been included.

Total native forest residue

Figure 8 indicates the availability of sustainably harvested native forest residue in the North West area. The local government areas comprising of the tablelands SLA's and Narrabri dominate areas with available native forest residues.

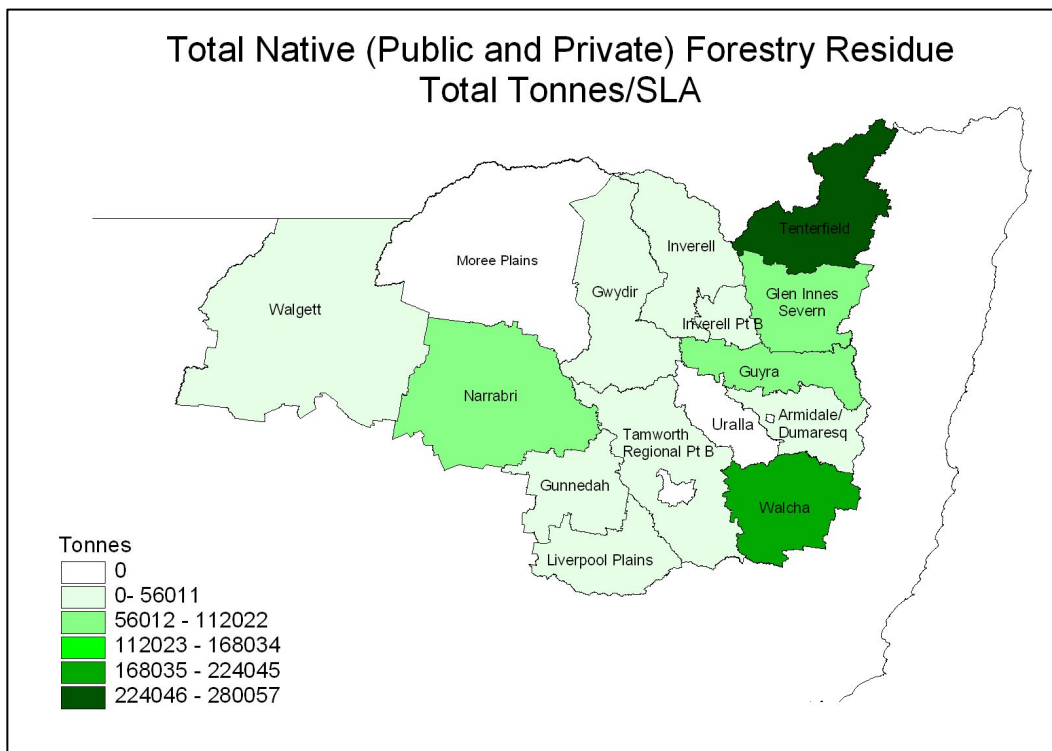


Figure 8: Estimated Sustained Yield of Other woody waste (forestry) residue for native forests for the Statistical Local/Government Area for the year 2005/06.

Current use, value and limitations as an organic material source

There is no availability of any native forest residues or bio-material from standing forests (*note: this does not include plantations*) as the *Protection of the Environment Operations (General) Regulation 2009* (Reg 97) prohibit its use for electricity generation. Current uses of the residues include some low scale firewood collection. The ground debris left from native harvest operations is important to habitat and nutrient cycling. In Western forests, the removal of some debris would be advantageous to fire management, and thinnings from cypress regeneration would aid management of cypress forests while providing another potential source of organic material (W. Bratby, pers comm.). Ongoing management of these forests is very long term (at least 100 years), and expensive so this source is limited in availability.

Softwoods

State softwood plantations

The information for state softwood forests has been derived from data from the Northern NSW Forestry Services (2005). Data was also derived from ESD Consulting for the Walcha “region”. Please note that this may not correspond to local government/ Statistical Local Areas.

There has been a recent increase in the demand for softwood- in the Walcha forestry region, about 65,000 hectares of forest is being harvested mainly for export to China for structural timber (Godson, per comm.). This will also have a potential increase in the amount of woody waste available.

State managed softwood dominates the supply of softwood residue available in the area.

Private softwood plantations

The more recent information for the Walcha area is derived from Jay 2008. The ESD study also estimated that the private softwood estate could yield about 14,600 m³ per annum of residual wood as a resource for industry development. This is similar to the 15,600 m³ per annum estimated by Jay (2008).

Total softwood forestry residue

Figure 9 shows the availability of softwood residues across the statistical local /government areas in the North West area.

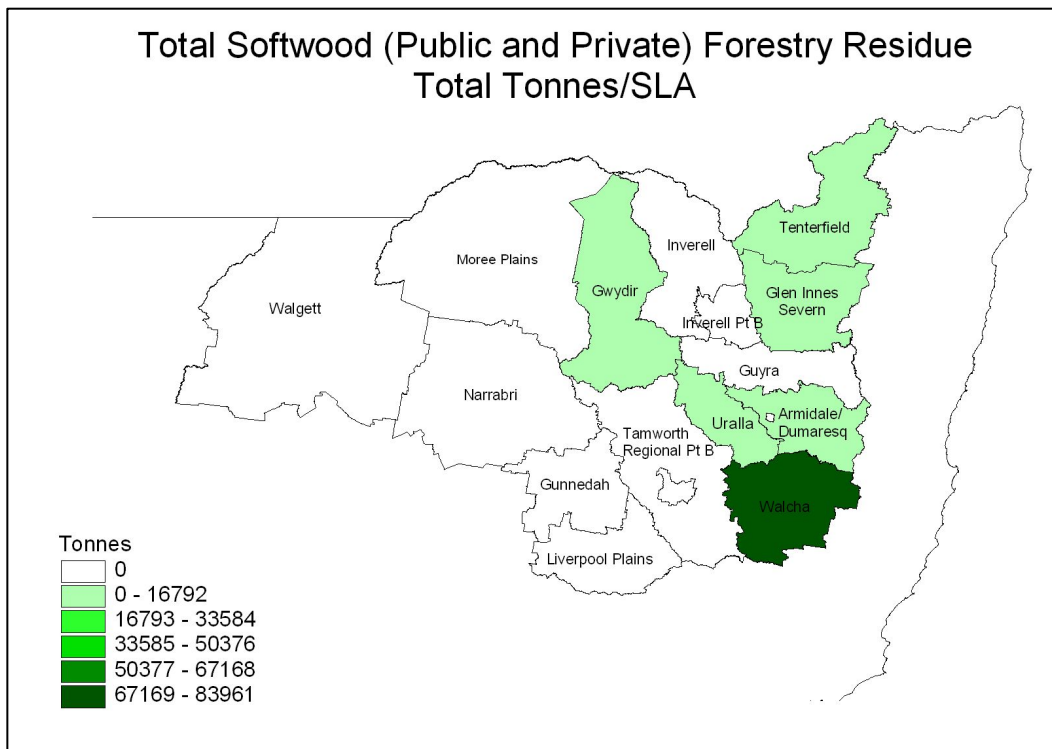


Figure 9: Available estimated total forestry residues for all softwoods for the Statistical Local/Government Area for the year (based on data for 2005 and 2008).

Current use, value and limitations as an organic material source

A number of studies in the area have indicated that the landed costs for forestry residue depend on a number of factors these include: harvesting and handling costs of the material; transport; cost of residues (such as royalties). Considering these costs any forestry residues that have to be transported beyond 100km from their source were considered to be marginal in terms of economic return (Northern NSW Forestry Services, 2008).

Forest processing (Sawmills)

The following table indicates the residues currently available from sawmills in the region.

Name	Location/ LGA	Product	Licensed intake ('000 m3/annum)	Assumed intake (m3/annum)/t per annum	Estimated residue (t)**
Austin's	Gunnedah	Cypress Pine		400/238	143
Correctional Services Industries	Glen Innes	Plantation softwood	5-19	12,000/4200#	2,520
Dale & Meyers	Nundle/ Tamworth Regional Council	Plantation softwood	5-19	35,000/10,500#	6,300
Farrell's	Bendemeer/Tamworth Regional Council	Plantation softwood		1500/525	315
Gunnedah Timbers	Gunnedah	Cypress Pine	5-19	-/11000	6,600
Kootingal Treated Timbers	Kootingal	Plantation softwoods (private)	-	1500/525	315
McVicar	Quirindi	Plantation softwood	100-499	120,000/42,000	25,200 sawdust*
New England Hardwoods (not operating in 2010)	Glen Innes	Hardwood (private)	-	1,500/1,500	900
Riamukka	Riamukka/Walcha	Plantation softwood	-	5000/1750	1050
Taminda Timbers	Tamworth	Hardwood (private)	-	1500/1500	900
Zeilinski Mill)	Armidale	Hardwood (private)	500	500/500	300

Table 6: Current Working Sawmills, wood volume and estimate residues 2011.

* Data derived from E.A. Systems 2006.

** Assumed processing residues average of 60% from log intake (Wells, pers comm.)

Jay 2008

Sawmill data and licensing has been supplied by Forest NSW Spatial Data, David Thompson, Northern Inland Forestry Investment Group as well as local Forests NSW information, 2010.

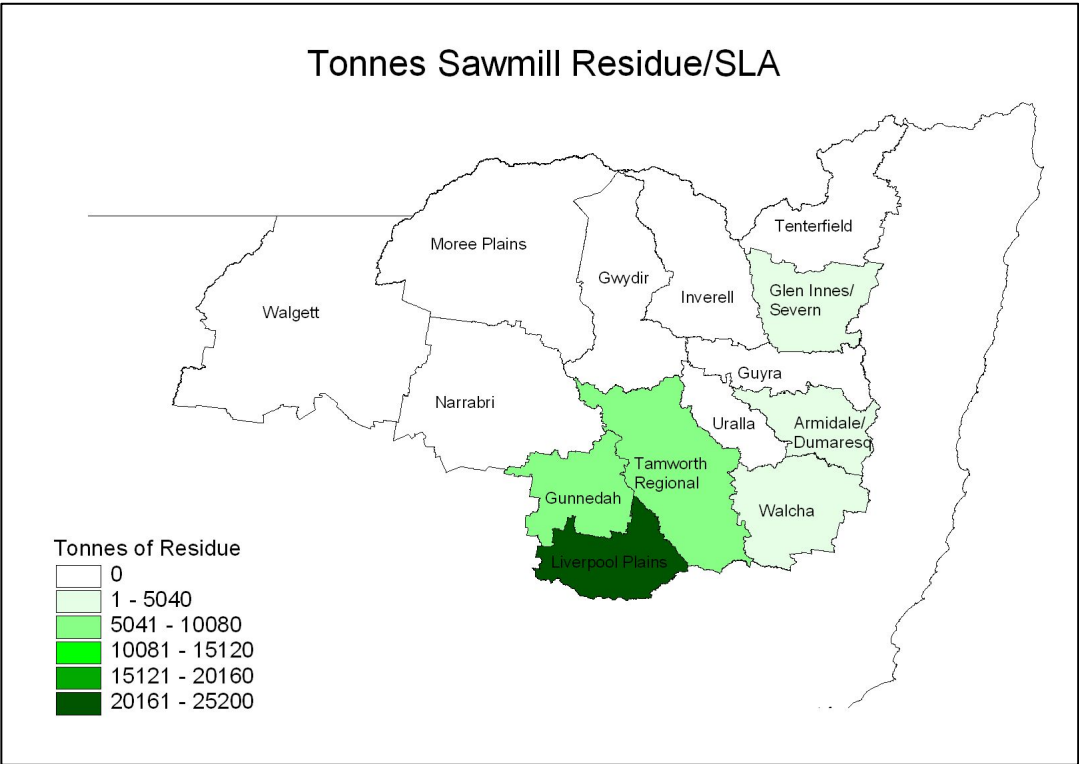


Figure 10: Sawmill residues available for each Statistical Local Area based on: Sawmill data and licensing information supplied by Forest NSW Spatial Data and local information, 2009.

Over the last 5 years, many of the smaller mills have closed as a result of restructuring through the Regional Forest Agreement implementation. Fenning Timbers (now Boral) mill in Walcha is also not operating but has potential for the generation of a medium volume of hardwood residues should it again be commissioned (currently licensed for 20,000-49,000 cubic metres of hardwood per annum). Hence there is potential for more residual material to be derived should markets improve for the company to reopen this mill.

Table 7 shows the sawmill residue available on a statistical local area.

Statistical Local Area	Sawmill Residue (Tonnes)
Armidale Dumaresq (A) - City	300
Armidale Dumaresq (A) Bal	
Glen Innes Severn (A)	3,420
Gunnedah (A)	6,743
Guyra (A)	
Gwydir (A)	
Inverell (A) - Pt A	
Inverell (A) - Pt B	
Liverpool Plains (A)	25,200
Moree Plains (A)	
Narrabri (A)	
Tamworth Regional (A) - Pt A	7,830
Tamworth Regional (A) - Pt B	
Tenterfield (A)	
Uralla (A)	
Walcha (A)	1,050
Walgett (A)	

Table 7: Sawmill residues available on a Statistical Local/Government Areas.

Current use, value and limitations as an organic material source

Current uses of the sawmill residues include provision of sawdust and other woody residues to various processors and users in the region.

Jay (2008) also indicates that sawdust disposal was a problem with the Dale and Meyers Mill at Nundle due to the location of the mill from other potential markets.

The cost of transport for sawmill wood residues is a limitation – the cost of transport between sawmill sites is \$10 per tonne for a 100km round trip. There may be advantages to increase the bulk density of the residues to minimise the volume of material – an extra \$6-8 per tonne for pellet processing (Goble and Jarvis 2007) could make transport more economical. The Northern NSW Forestry Services study (2008) indicated that residues that had to be transported beyond 100 km were economically marginal.

Major organic material sources in the North West region

This audit has found that about 3 million tonnes of organic material was available in the North West region from the agricultural, urban, forestry and other related processing sources. This is shown in Figure 11.

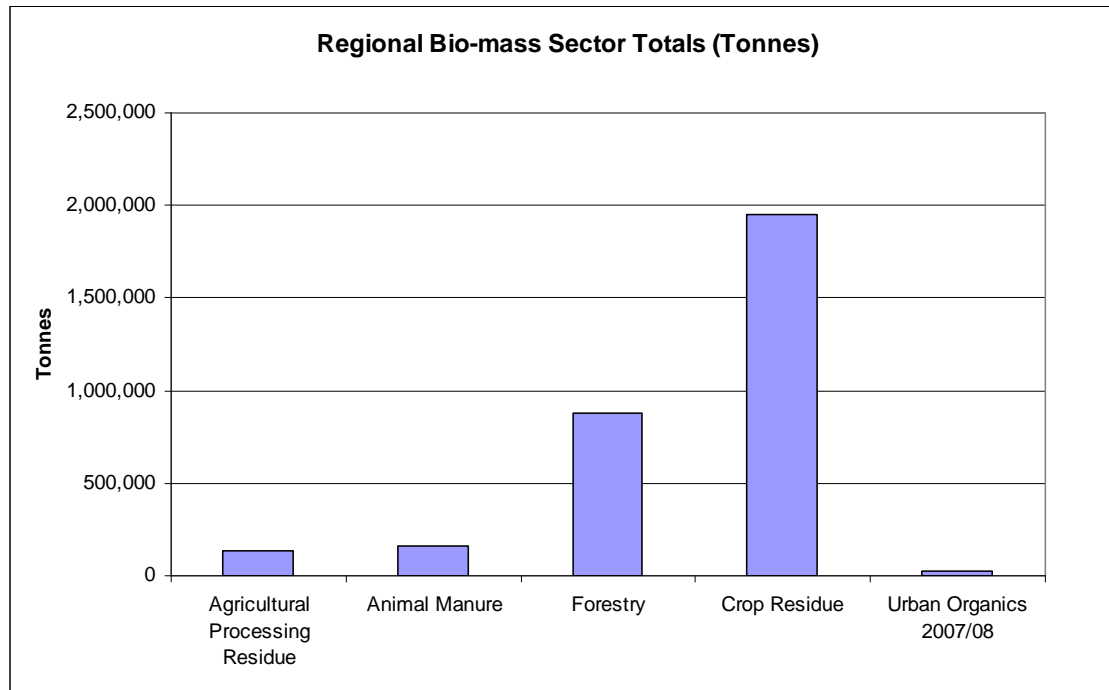


Figure 11: Total bio-mass of organic material for each sector (tonnes) for the North West of NSW.

The agricultural sector has the potential to generate nearly 2 million tonnes based on the available census data for 2006-7. Much of this is based on crop residues particularly for wheat, sorghum and barley, and agricultural processing industries.

The forestry sector (including forestry processing) generates annually about 880,000 tonnes of residues per year, with the dominant source available from Tenterfield and Walcha local government areas.

From a locality viewpoint, the local government areas that have most of the organic material are Moree Plains, Narrabri and Gunnedah. This is mainly from available crop bio-mass residues, forestry and forestry processing industries in the area. The total organic material available for each local government area is shown in Figure 12. From a tonnes per hectare view point the highest ranking LGA's are Gunnedah Liverpool Plains and Walcha shown in Figure 13. While these LGAs have the highest tonnes/hectare the cost of collecting and transporting organic material to a central processing facility requires careful consideration.

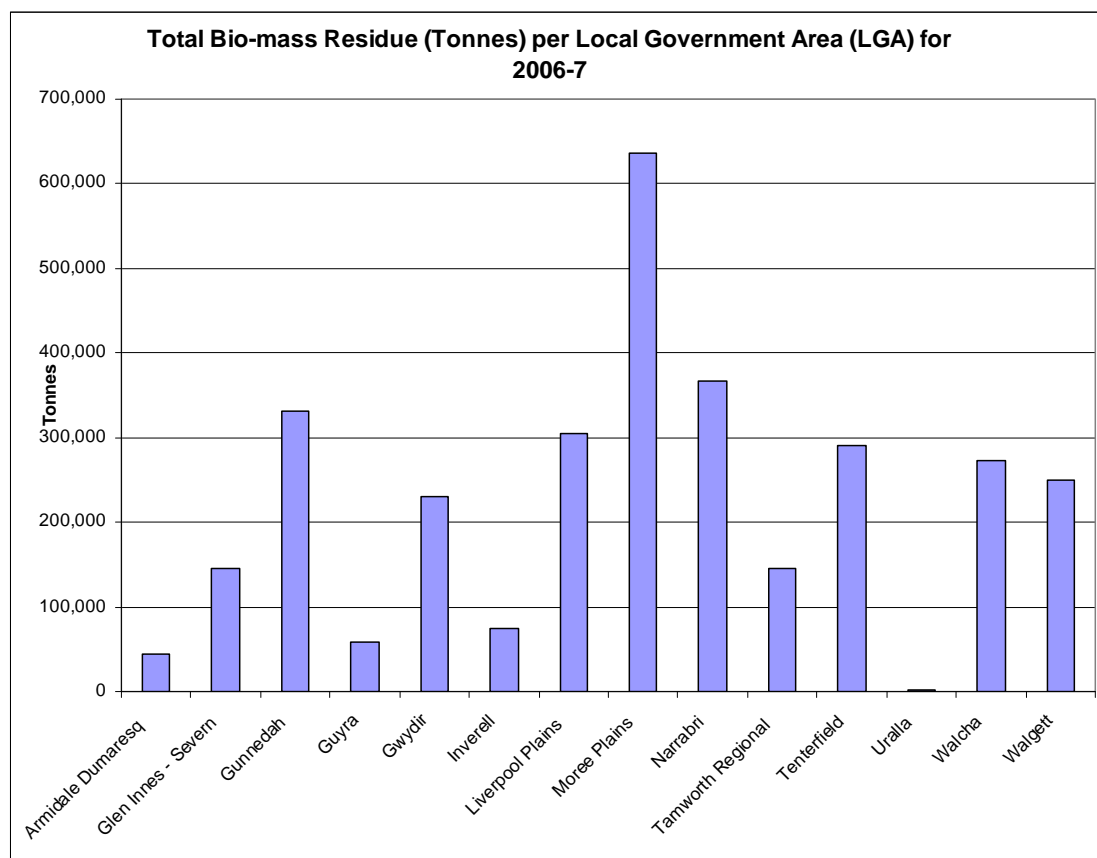


Figure 12: Total mass of all organic material per Statistical Local/Government Area for 2006-7 (tonnes).

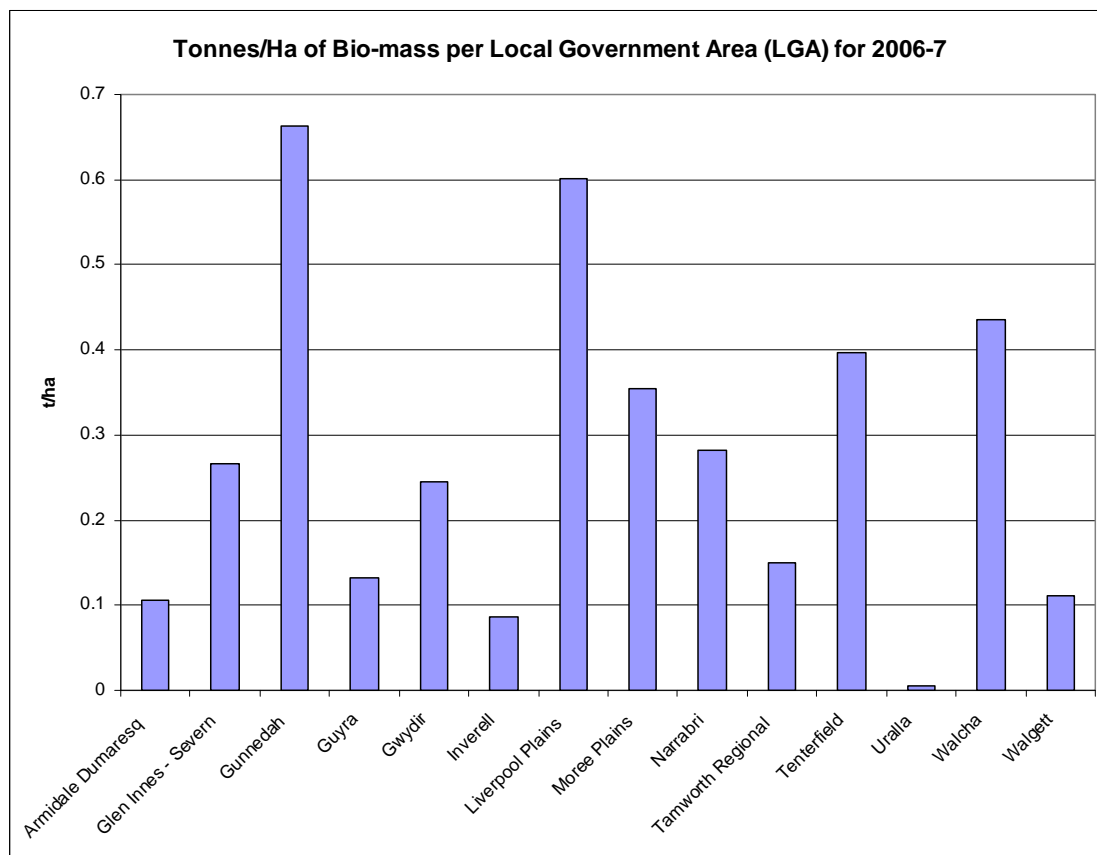


Figure 13: Tonnes/Hectare of all organic material per Local Government Area for 2006-7

Point source material

Point source organic material is that material which is generated at a single site. In this study, the material collected from urban wastes, sawmills, intensive animal industries (including dairies), animal processing industries (abattoirs) and other agricultural processing industries (cotton gins) have been grouped. This sector has the advantage of being able to collect the material in specific location. This has major collection and transport advantages in comparison to the collection of crop biomass and forestry residue material over larger areas.

The most lucrative point source supply of organic material is the Tamworth Regional local government area (at about 98,000 tonnes of organic material available in the one year). Tamworth region has a large poultry industry, 3 abattoirs, a number of dairies and some sawmill activity. Tamworth is also the largest urban area in the region.

Gunnedah, Glen Innes- Severn, Liverpool Plains and Moree Plains also have point source product that is estimated to generate between 40,000 and 60,000 tonnes of organic material per year. Much of this relies on sawmill, cotton trash material and feedlot manure that occurs in the area.

Figure 14 shows the point source comparisons between the statistical local/government areas.

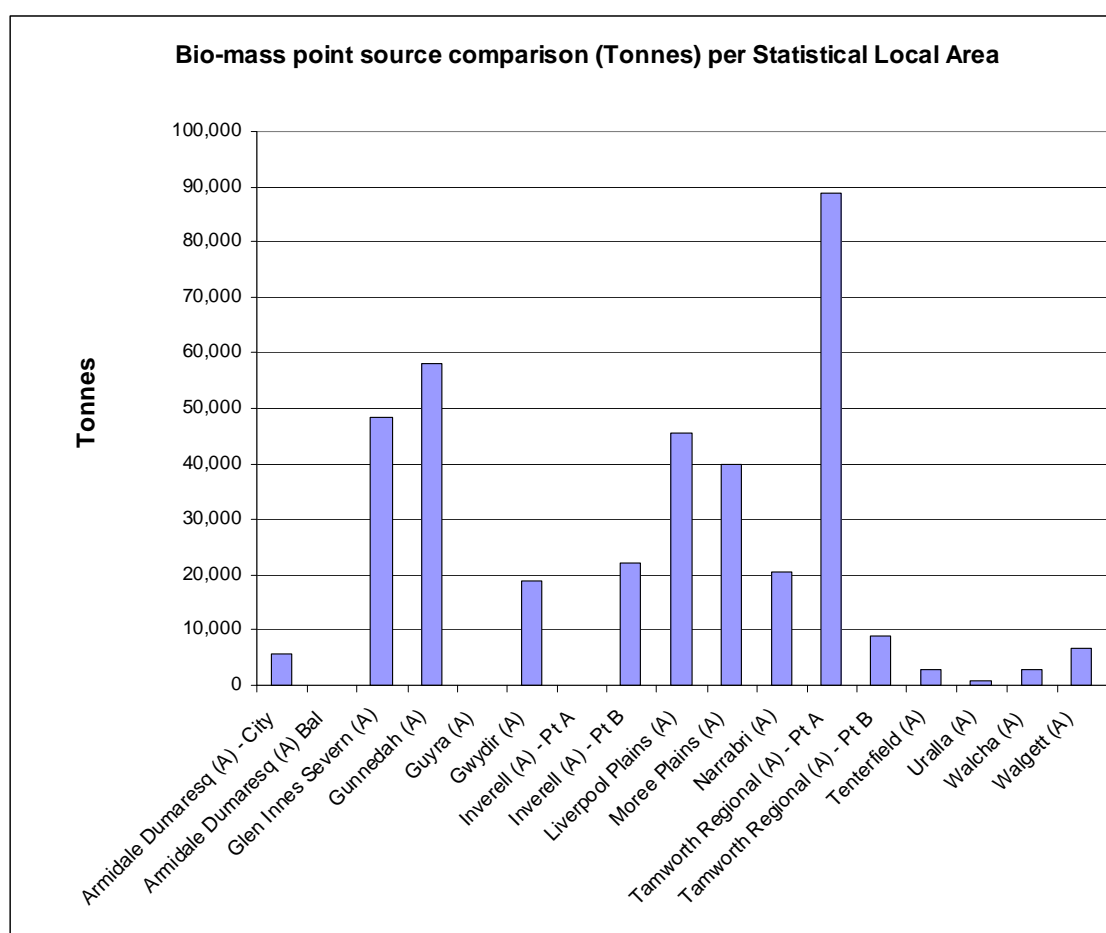


Figure 14: Organic material point source comparison (tonnes) per Statistical Local/Government Area.

RECOMMENDATIONS AND FURTHER STUDIES

Overall considerations

1. There are some significant volumes of biomass available for energy in North West New South Wales. However, the supply chain management is critical for economic resource utilisation.
2. Further understanding of the true availability of biomass volumes is required. When determining feedstock's of organic material – the quantity, type, price, seasonality, logistics of the supply of organic material to be sourced must be assessed in detail. These factors should underpin the basis for a feasibility study for any processing opportunity. This study has provided a broad analysis of the sources of various organic material types and quantities available in North West NSW.
3. The competition effect of utilising biomass (and removing it from other uses) needs to be better understood. Further investigation to determine what type and quantity is “really” available and the willingness of agricultural producers/ forestry operators/urban waste managers to supply it should be undertaken. Any survey should include the incentives required, and other harvesting/collection factors that would influence in the supply of the necessary type of material.
4. The ability to competitively source organic material against pre-existing uses, value added products and established markets is required. For example, cotton trash and urban material from Tamworth and Moree Plains Local Government Areas are already being value added and marketed. This has been found to be a major limitation of material reuse in the North East (North Coast region) where about 90% of green waste is already committed to other value adding uses (pers comm., Gordon Fraser-Quick). A further example, poultry waste is already valued for use in agriculture for its nutrients and as a soil conditioner. The pre commitment of organic material by-product streams is a major issue that will affect any major investment in the North West region. There may be scope for the development of an organic materials “market” particularly if demands increase in line with end use values.
5. Further understanding of the characteristics of biomass is required. The volumes calculated in this study do not consider uniform moisture content especially in crop residues. Future work is needed to address this issue when looking at quantities of specific waste streams.

Agricultural sector

6. An improved approach to spatial distribution of feedstocks and availability is offered by Herr & Dunlop (2011). This approach includes using national land use maps with regional agricultural statistics to improve accuracy.
7. Other data sources such as grain receivable sites may also assist in more accurately determining the stubble yields based on grain volumes in cropping areas.
8. Sustainability issues remain (particularly soil health). There is a need for further analysis concerning the amount of stubble that should remain on the land to maintain levels of agricultural productivity. The stubble required for erosion protection and to maintain overall soil health in a farming system should be taken into account to ensure that stubble removal does not result in a decline in agricultural productivity.
9. Short term localised impacts of climate and market that are inherent to crop production alter the type and quantity of crops grown. This needs to be further considered in future assessments.

10. The methodology used to calculate stubble yields highlights that legume crops provide low or negative organic matter yields. Legume crops as a source organic material requires careful consideration.
11. Impact of climate change and carbon sequestration initiatives will also affect organic material supplies. Modelling of agricultural production and the ability of lands to be accessed under alternative landuse or management agreements (such as contracts to conduct a certain landuse or manage land in a prescribed way for soil carbon sequestration activities) may limit the availability of crop stubble as a source of organic residue and should be further considered.

Forestry

12. There are some limitations in the current regulations that will reduce the opportunity for potentially viable use of biomass. If electricity generation greater than 200 kilowatts supply is to be sought from organic materials it must be noted that any native forest residues or bio-material from standing forests (not plantations) cannot currently be utilised due to the associated regulations (*Protection of the Environment Operations (General) Regulation 2009 (Reg 97)*) and as such this regulation may need to be reviewed and/or considered as a constraint for future industry development.
13. Private softwood forests in the Walcha area have the potential as an additional source of commercial forest residue provided they can be managed for that purpose (as identified by Jay 2008).
14. Newly planted private hardwood plantations in the Walcha area provide an opportunity for more sources of forest residues. This forestry development should be considered when determining future quantities of available feedstock in the area.
15. Impact of fire management may also need to be considered in managing forests in changing climates. There may be opportunity to be able to use forest residues as a mitigation measure to reduce fire risk, therefore increasing potential availability.

Urban

16. A protocol be developed for the measurement and reporting of green waste organic amounts to allow consistency between Councils.

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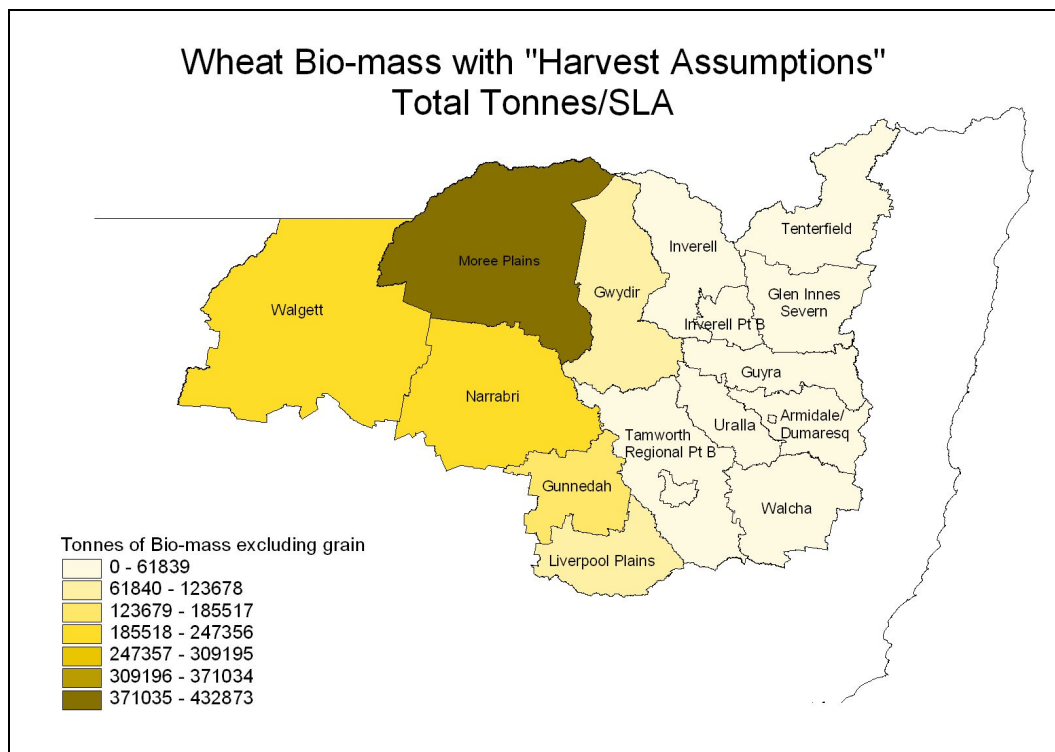
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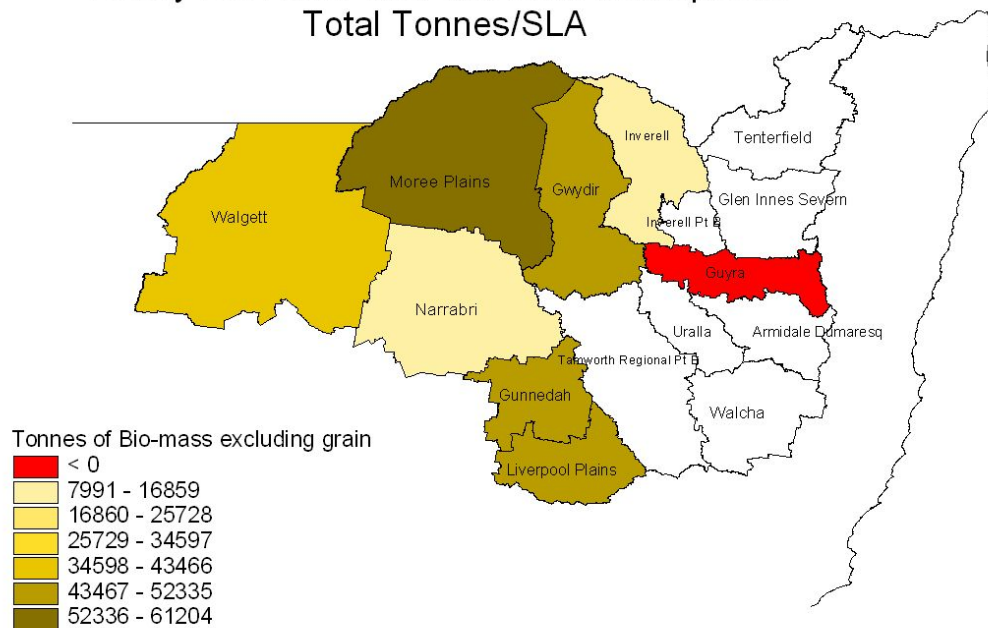
Appendix 1A Potential availability (tonnes) of crop biomass

The following maps show the availability of crop biomass for each statistical local area across the North West Region based on 2005-06 ABS agricultural census data. These are in order of the highest available crop residues after application of the harvest index and assumptions as described under Crop Materials (page 10). It should be noted that some Statistical Local Areas have a negative bio-mass figure for some crops. This negative figure is derived as a result of the assumption of having to leave 1.5t/ha of crop stubble residue behind.

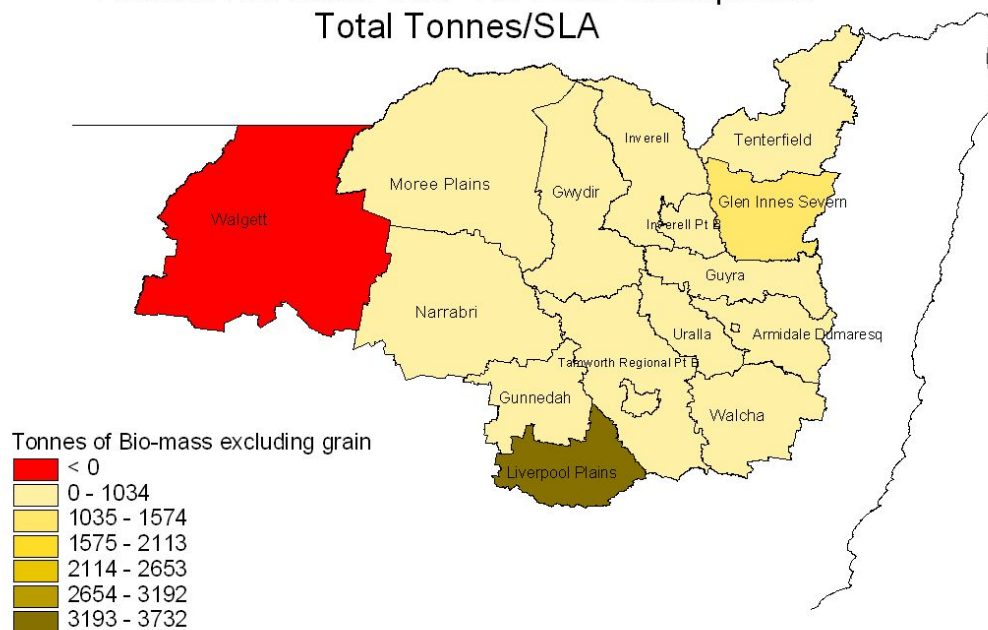
Winter Cereal Crops

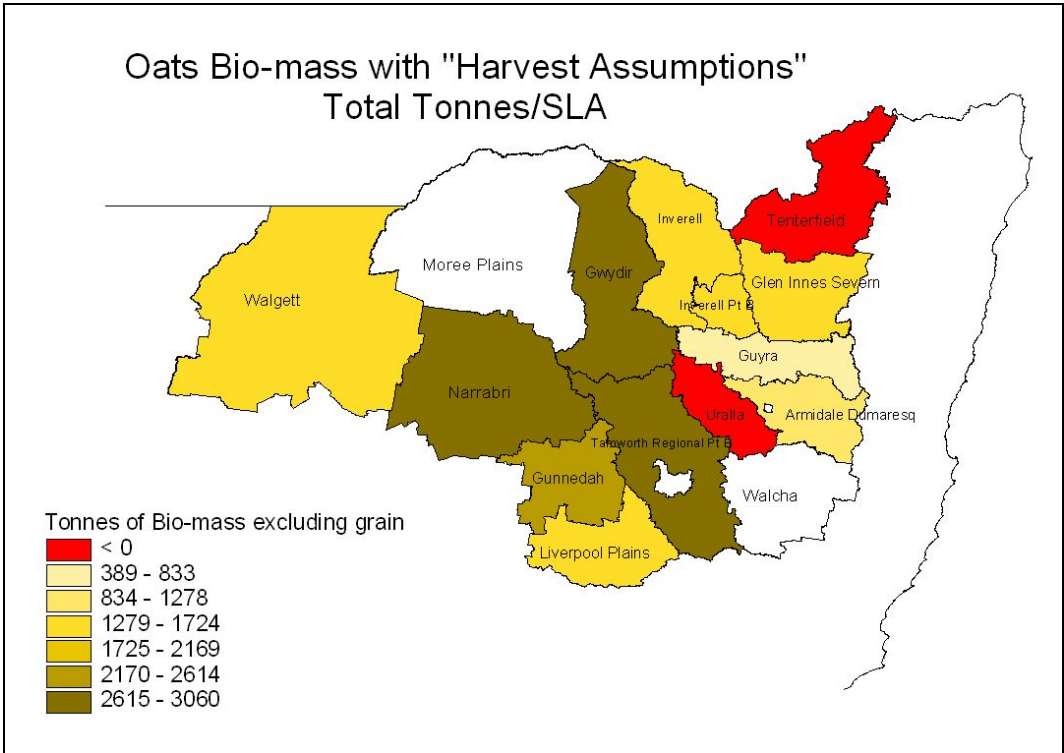


Barley Bio-mass with "Harvest Assumptions" Total Tonnes/SLA

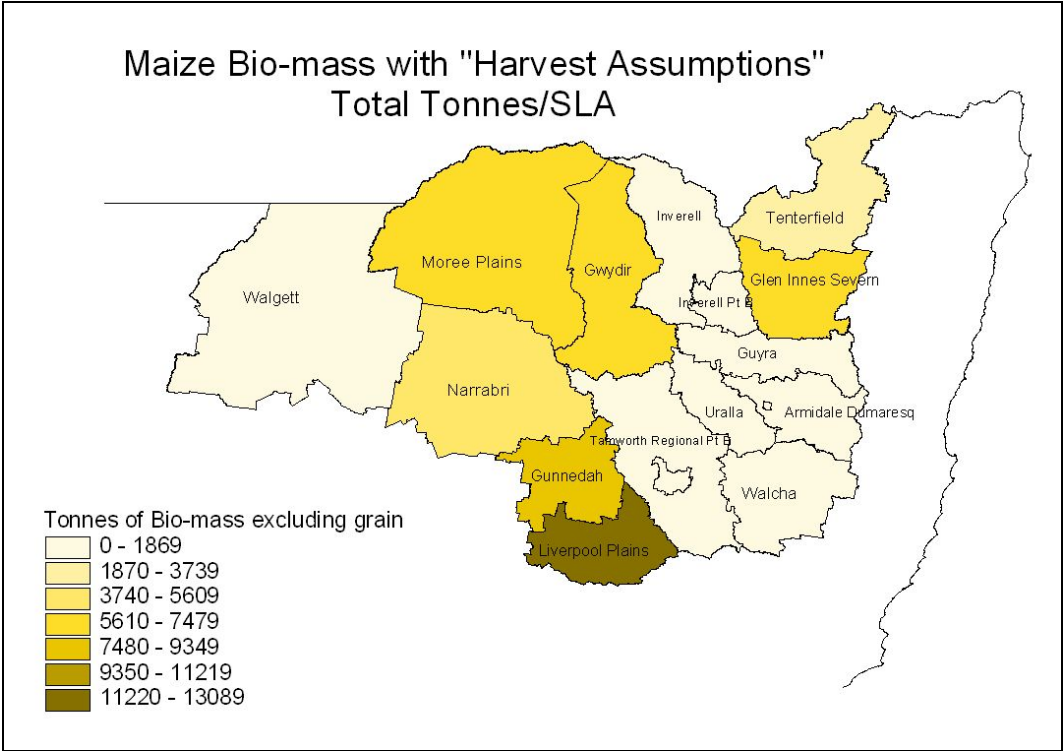
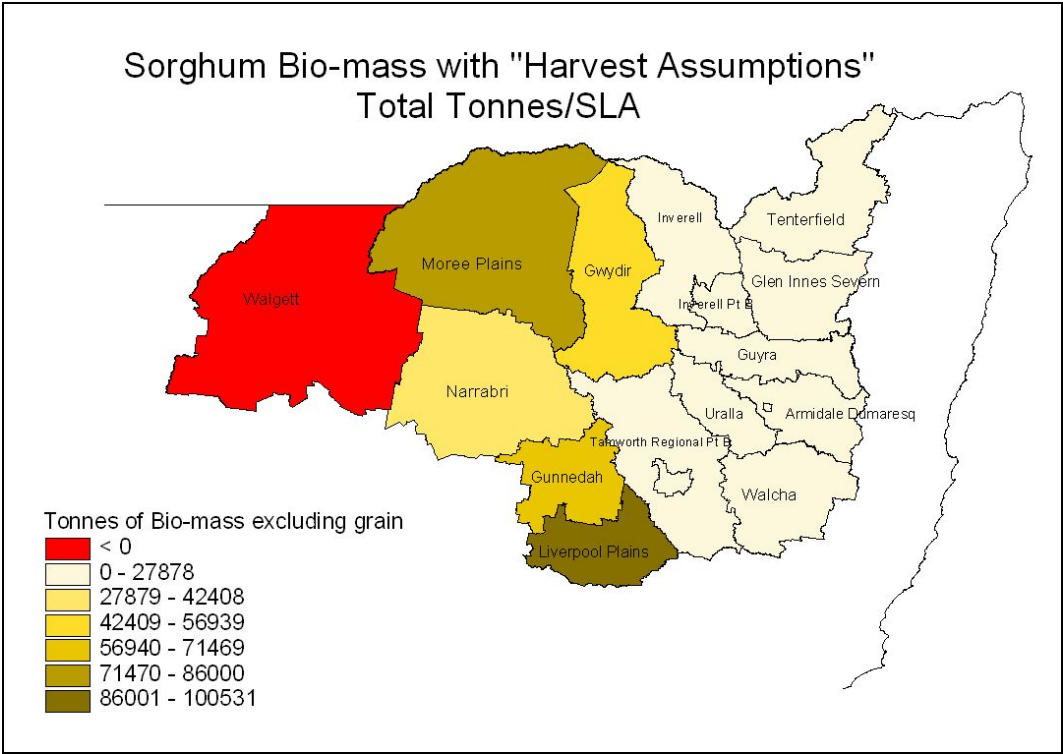


Triticale Bio-mass with "Harvest Assumptions" Total Tonnes/SLA

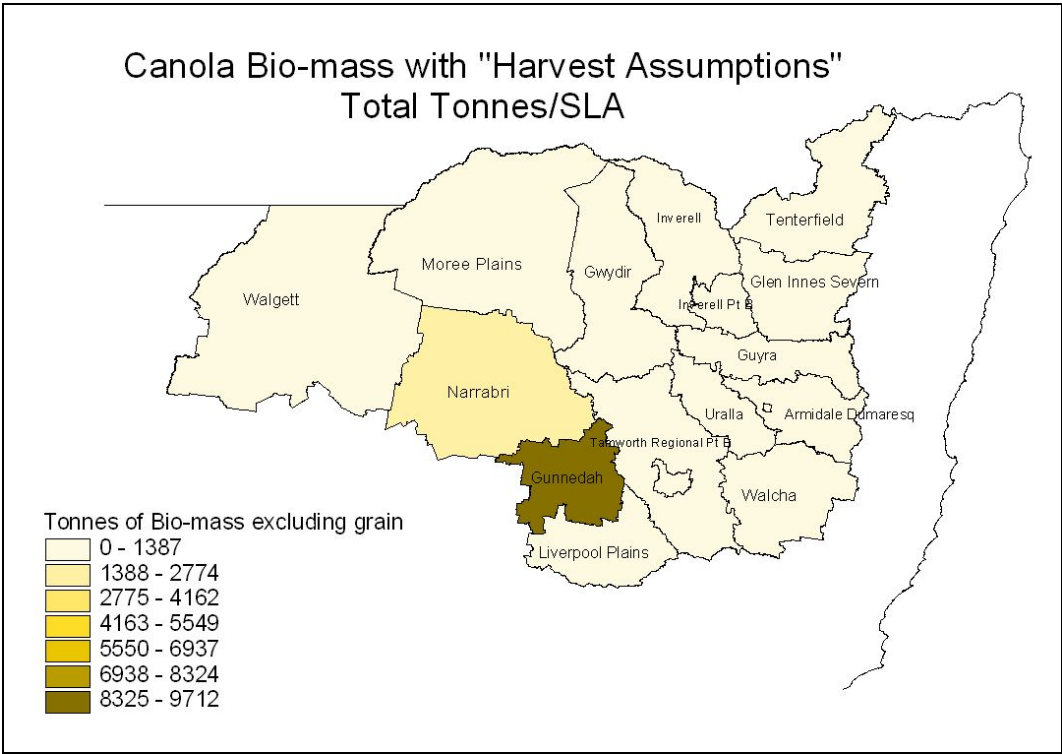
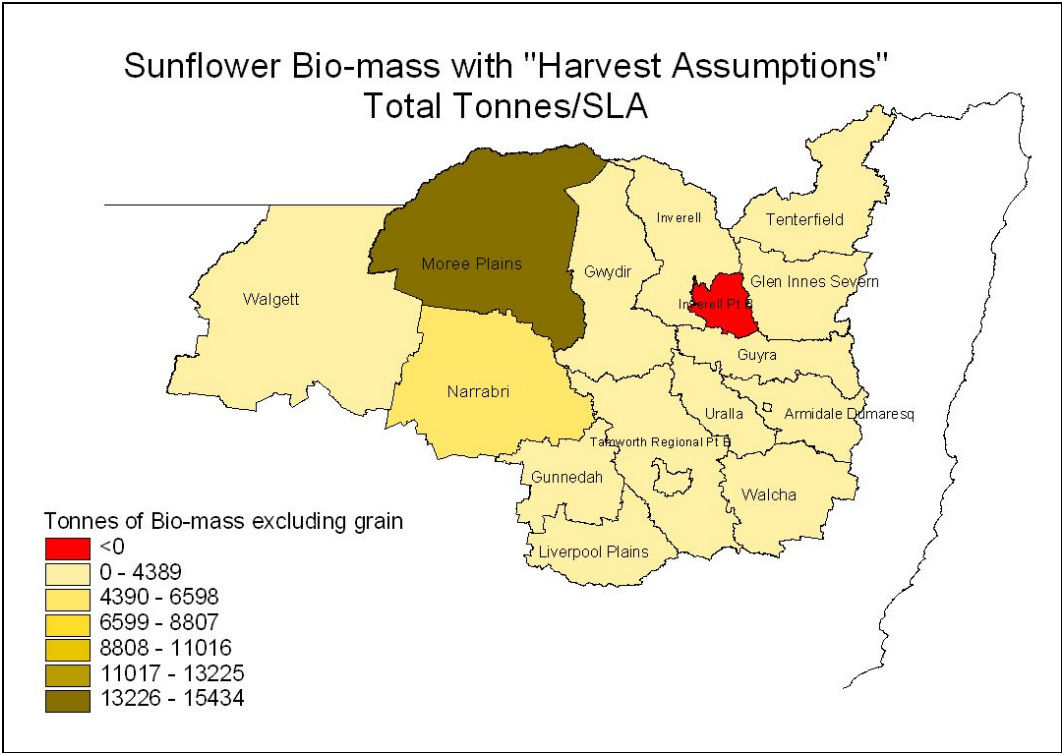




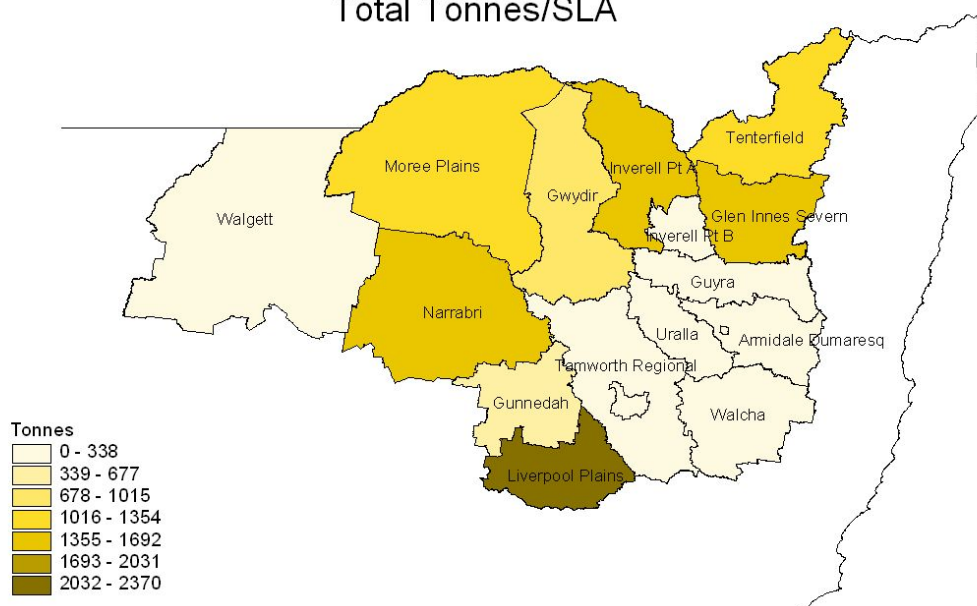
Summer Cereal Crops



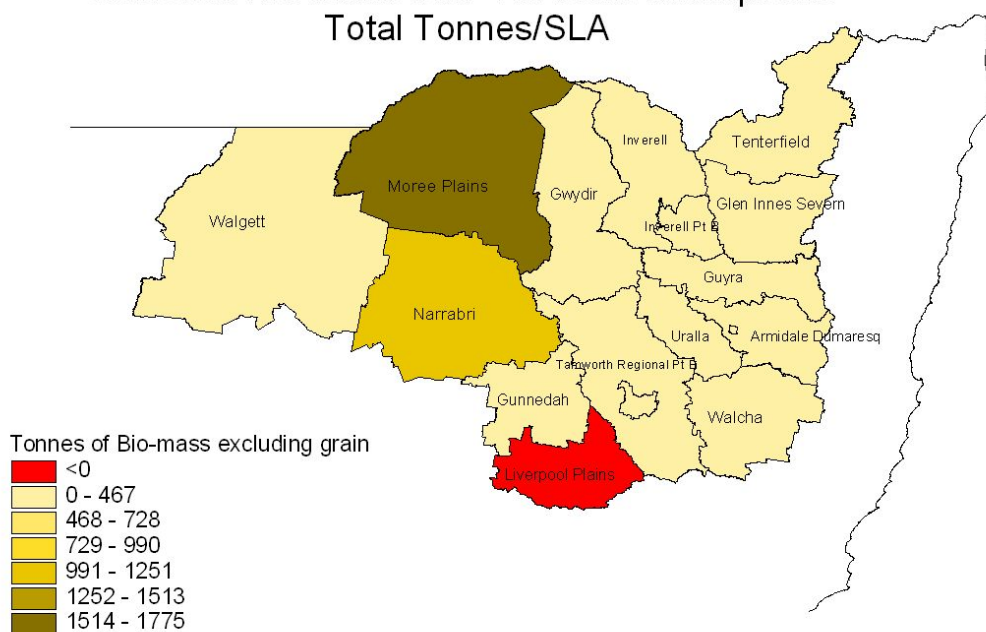
Oilseed Crops



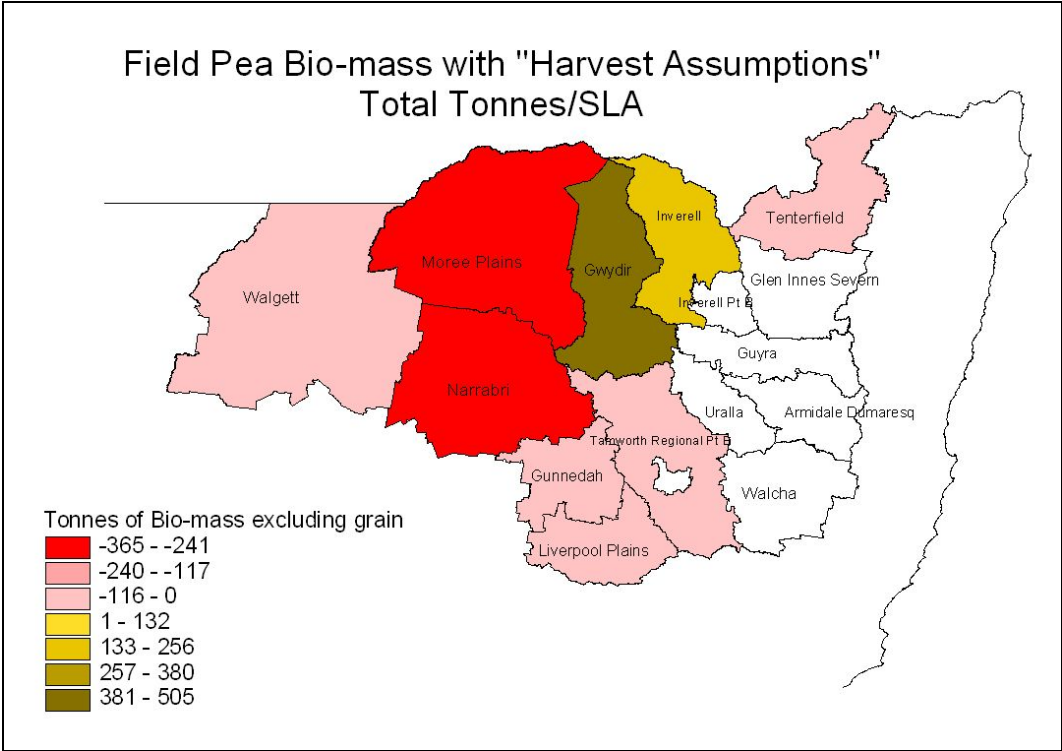
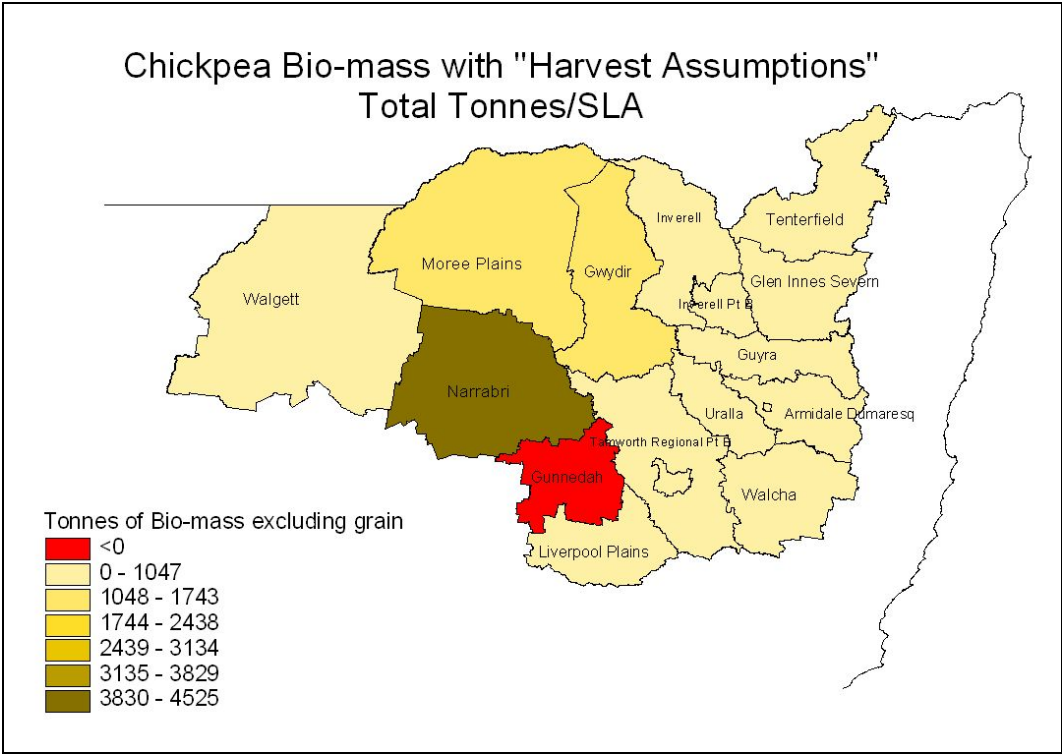
Soybean Bio-Mass With "Harvest Assumptions" Total Tonnes/SLA



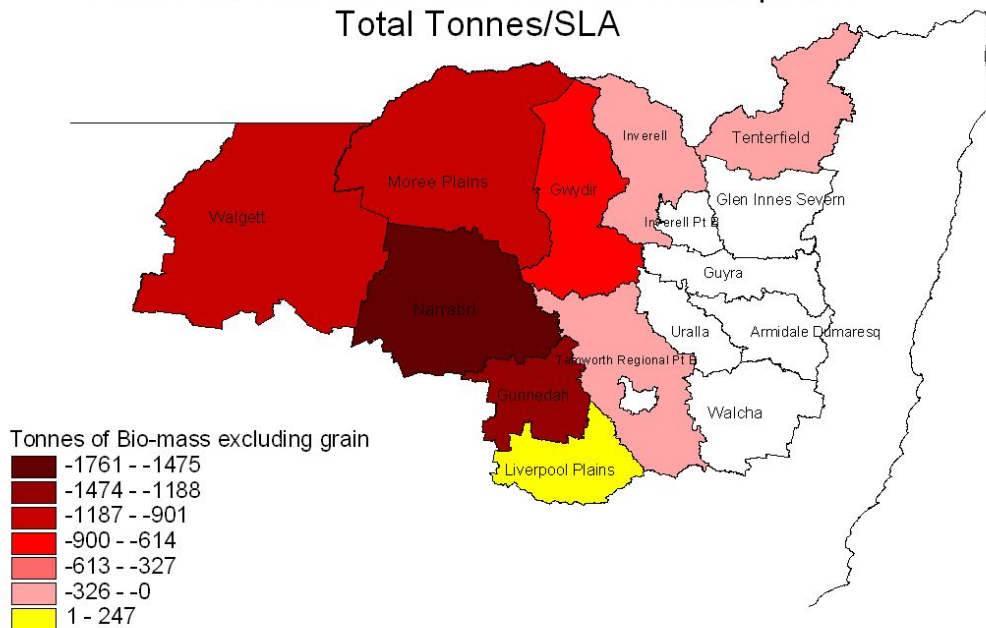
Safflower Bio-mass with "Harvest Assumptions" Total Tonnes/SLA



Legume Crops



Field Bean Bio-mass with "Harvest Assumptions" Total Tonnes/SLA



Lupin Bio-mass with "Harvest Assumptions" Total Tonnes/SLA

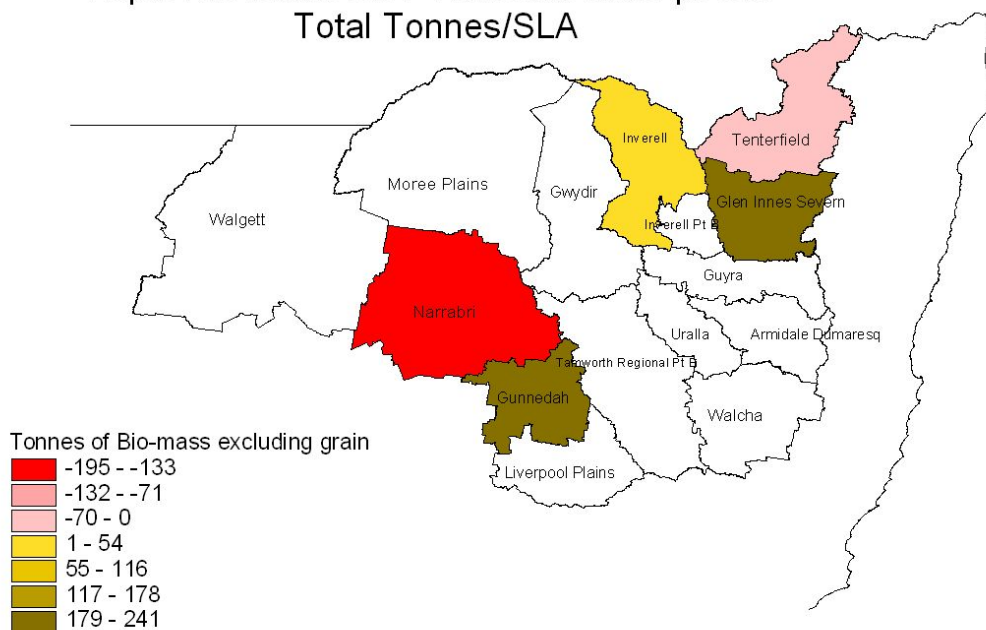


Table 1.1 Crop Stubble Residue available for each Statistical Local Area based on harvest assumptions (Dunlop et al 2008) as described under Crop Materials (page 10).

Statistical Local Area	Wheat (t)	Oat (t)	Barley (t)	Triticale (t)	Canola (t)	Safflower (t)	Soybeans (t)	Sunflower (t)	Chickpeas (t)	Field Beans (t)	Field Peas (t)	Lupins (t)	Sorghum (t)	Maize (t)	Total (Tonnes) Given Harvest Assumption
Armidale Dumaresq (A) - City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Armidale Dumaresq (A) Bal	1,538	973	338	15	0	0	0	15	0	0	0	0	0	160	3
Glen Innes Severn (A)	4,571	1,419	322	1,341	184	0	1,380	0	0	0	0	240	0	7,204	11
Gunnedah (A)	132,375	2,176	51,227	583	9,712	0	497	3,455	-343	-1,394	-81	241	62,452	8,231	26
Guyra (A)	36	466	-879	455	0	0	257	138	0	0	0	0	359	4	
Gwydir (A)	92,316	2,873	49,991	81	0	0	929	2,046	1,654	-729	505	0	42,764	6,336	19
Inverell (A) - Pt A	7,926	1,325	15,857	68	0	79	1,562	367	550	-121	191	8	8,803	1,614	3
Inverell (A) - Pt B	989	1,382	3,607	0	0	0	44	-28	34	0	0	0	2,706	239	8
Liverpool Plains (A)	84,866	1,701	47,336	3,732	1,240	-56	2,370	3,877	315	247	-26	0	100,531	13,089	25
Moree Plains (A)	432,873	15	61,204	0	90	1,775	1,352	15,434	1,472	-1,059	-365	0	78,437	5,678	59
Narrabri (A)	203,203	3,060	15,784	182	2,211	1,078	1,422	4,790	4,525	-1,761	-328	-195	27,908	5,279	26
Tamworth Regional (A) - Pt A	1,588	68	551	42	0	0	0	0	3	0	0	0	47	155	2
Tamworth Regional (A) - Pt B	24,494	3,028	7,644	561	0	0	0	0	0	-24	-15	0	5,538	13	4
Tenterfield (A)	7	-10	284	0	0	0	1,056	0	0	-50	-2	-2	0	2,146	3
Uralla (A)	0	-57	422	72	0	0	0	0	0	0	0	0	0	0	
Walcha (A)	177	156	0	0	0	0	0	0	0	0	0	0	0	0	
Walgett (A)	196,221	1,320	41,196	-44	505	455	199	2,028	411	-1,027	-23	0	-1,183	0	24

Appendix 1B Other Agricultural Organic Materials data

Table 1.2 Agricultural Processing Residue Data

Statistical Local Area	Abattoir Waste (Tonnes)	Irrigated Cotton Trash (Tonnes)	Non-Irrigated Cotton Trash (Tonnes)	Total (Tonnes)
Armidale Dumaresq (A) - City				
Armidale Dumaresq (A) Bal				
Glen Innes Severn (A)				
Gunnedah (A)		4,293	230	4,523
Guyra (A)				
Gwydir (A)		1,950	141	2,091
Inverell (A) - Pt A		130		130
Inverell (A) - Pt B	6,310			6,310
Liverpool Plains (A)		156	4	160
Moree Plains (A)		32,211	2,624	34,835
Narrabri (A)		19,364	605	19,969
Tamworth Regional (A) – Pt A (City)	64,400			64,400
Tamworth Regional (A) – Pt B				
Tenterfield (A)				
Uralla (A)				
Walcha (A)				
Walgett (A)		6,355	225	6,580

Table 1.3 Animal Manure Data

Statistical Local Area	Feedlot Manure (Tonnes)	Dairy Manure (Tonnes)	Total (Tonnes)
Armidale Dumaresq (A) - City			
Armidale Dumaresq (A) Bal			
Glen Innes Severn (A)	45,000		45,000
Gunnedah (A)	45,000		45,000
Guyra (A)			
Gwydir (A)	16,000		16,000
Inverell (A) - Pt A			
Inverell (A) - Pt B	16,000		16,000
Liverpool Plains (A)	20,000		20,000
Moree Plains (A)	3,000		3,000
Narrabri (A)		400	400
Tamworth Regional (A) – Pt A (City)			
Tamworth Regional (A) – Pt B	1,825	7,167	8,992
Tenterfield (A)		1,991	1,991
Uralla (A)			
Walcha (A)		1,593	1,593
Walgett (A)			

Appendix 2 Total Domestic (Urban) Organic Material

Total Domestic (Urban) Organic Material for 2007-2008 for each Statistical Local Area, showing major urban Centres (from Northern Inland Regional Waste records and Walgett Shire Council).

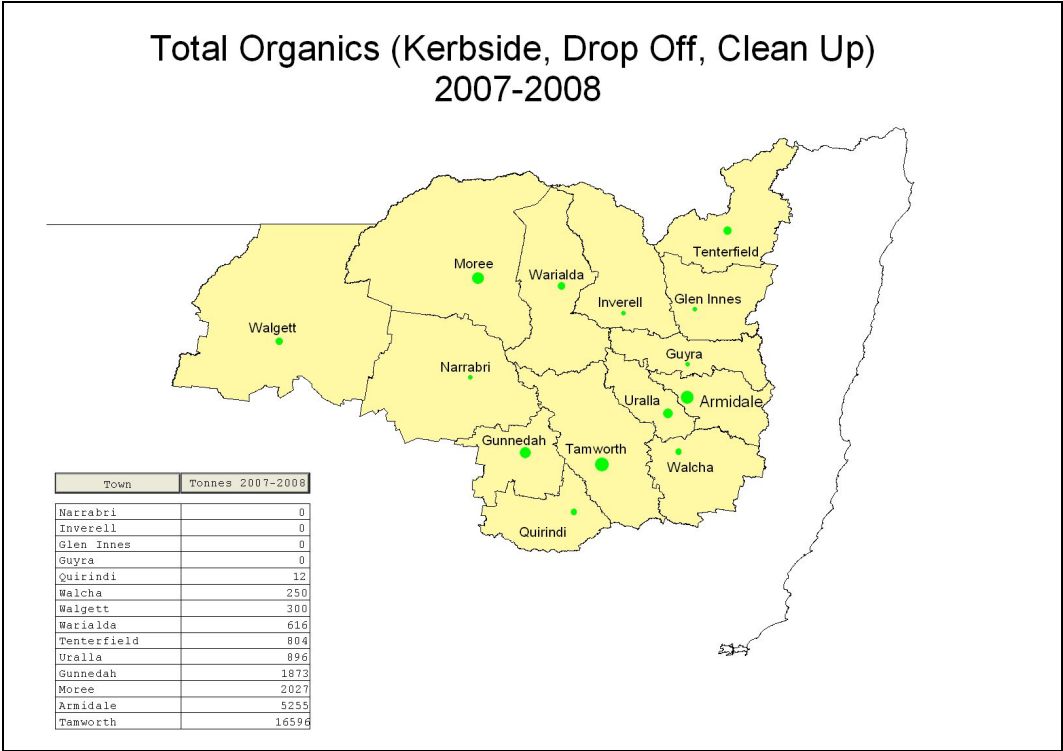


Table 2.1 Urban waste Total Organics (Kerbside, Drop off, Clean Up) (information supplied by Northern Inland Regional Waste and Walgett Council)

Local Government Area	Tonnes 2005/06	Tonnes 2006/07	Tonnes 2007/08
Armidale Dumaresq (A) – City	3,486	8,000	5,255
Armidale Dumaresq (A) Bal			
Glen Innes Severn (A)			
Gunnedah (A)	1,679	1,540	1,873
Guyra (A)			
Gwydir (A)	217	557	617
Inverell (A) - Pt A	211		
Inverell (A) - Pt B			
Liverpool Plains (A)	4	515	12
Moree Plains (A)	1,633	799	2,027
Narrabri (A)			
Tamworth Regional (A) - Pt A	11,548	16,466	16,596
Tamworth Regional (A) - Pt B			
Tenterfield (A)	300	472	804
Uralla (A)		519	896
Walcha (A)		230	250
Walgett (A)	300	300	300

Appendix 3 Forestry data

Public Native Forests

Table 3.1 Estimated Sustained Yield of Forestry Residues for State Native Forests (includes Plantations) for each Local Government Area (information supplied by Forests NSW 2009)

Local Government Area	Estimated Sustained Yield of Forestry Residues (m ³ /annum)	Estimated Sustained Yield of Forestry Residues (tonnes /annum)
Armidale	25,700	30,840
Glen Innes - Severn	18,400	22,080
Gunnedah	4,000	4,000
Guyra	300	360
Gwydir	1,700	2,040
Inverell	3,400	4,080
Liverpool Plains	900	1,080
Moree	0	0
Narrabri	65,900	79,080
Tamworth Regional	2,900	3,480
Tenterfield	74,700	89,640
Uralla	0	0
Walcha	88,400	106,080
Walgett	2,300	2,760

Private Native Forests

Table 3.2 Estimated Sustained Yield of Forestry Residues for Private Native Forests (includes Plantations) for each Local Government Area (information derived from Northern Forestry Services, 2008 and ESD Consulting, 2005)

Local Government Area	Area (ha)	Estimated Sustained Yield of Forestry Residues (m ³ /annum)	Estimated Sustained Yield of Forestry Residues (t/annum)
Armidale	1,900	4,259	5,111
Glen Innes - Severn	23,600	43,148	51,778
Guyra	10,100	5,136	6,163
Tenterfield	60,180	158,681	190,417
Walcha		66,000*	79,200

* ESD Consulting, 2005 – existing and future private hardwoods

Total Native Forests

Table 3.3 Total Estimated Sustained Yield of Forestry Residues for all native forests for each Local Government Area (includes plantations)

Local Government Area	Estimated Sustained Yield of Forestry Residues (Tonnes /annum)
Armidale	35,951
Glen Innes - Severn	73,858
Gunnedah	4,000
Guyra	6,523
Gwydir	2,040
Inverell	4,080
Liverpool Plains	1,080
Moree	0
Narrabri	79,080
Tamworth Regional	3,480
Tenterfield	280,057
Uralla	0
Walcha	185,289
Walgett	2,760

State estate softwood plantation

Table 3.4 Estimated Sustained Yield of Forestry Residues for State Softwood Forests (includes Plantations) for each Local Government Area (information derived from Northern NSW Forestry Services, 2008 and ESD Consulting, 2005)

Local Government Area	Area (ha)	Estimated Sustained Yield of Forestry Residues (m ³ /annum)	Estimated Sustained Yield of Forestry Residues (Tonnes/annum)
Armidale	0	0	0
Glen Innes - Severn	1,025	6,230	6,815
Guyra	0	0	0
Tenterfield	771	4,685	5,200
Walcha*	9,872	60,000	66,600

*Data derived from ESD Consulting for the Walcha "region". Please note that this may not correspond to local government/ Statistical Local Areas.

Private softwood plantation

Table 3.5 Estimated Sustained Yield of Forestry Residues for Private Softwood Forests (includes Plantations) for each Local Government Area (information derived from Northern NSW Forestry Services, 2008, and Jay 2008)

Local Government Area	Area (ha)	Estimated Sustained Yield of Forestry Residues (m3/annum)	Estimated Sustained Yield of Forestry Residues (Tonnes /annum)
Armidale	54	495	550
Glen Innes - Severn	0	0	0
Guyra	0	0	0
Tenterfield	0	0	0
Uralla	36	330	366
Walcha #	1,703	15,600	17,316

Jay 2008

Total softwood plantation

Table 3.6 Estimated Sustained Yield of Forestry Residues for all Softwood Forests for each Local Government Area (includes Plantations)

Local Government Area	Estimated Sustained Yield of Forestry Residues (Tonnes/annum)
Armidale	550
Glen Innes - Severn	6,815
Guyra	0
Tenterfield	5,200
Uralla	366
Walcha	83,916