Statistics & Economics

Estimating the economic contribution of the forestry industry to Western Australia

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Forest & Wood Products Australia

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Economic contribution of the forestry industry to Western Australia

Prepared for

Forest & Wood Products Australia

by

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ABBREVIATIONS

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
FPC	Forest Products Commission
fte	full-time equivalent
GOS	Gross Operating Surplus
GRP	Gross Regional Product
GSP	Gross State Product
I-O	Input-Output
OVA	Other Value Added
RISE	Regional Input-Output Model
WA	Western Australia

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EXECUTIVE SUMMARY

The forest industry in Australia contributes to jobs and economic activity in multiple regional communities. This contribution results from the growing, management and harvesting of plantations and native forests, and processing of harvested wood.

In 2017, Forest and Wood Products Australia engaged the University of Canberra, working with BDO EconSearch, to provide a socio-economic assessment of the forest industry in Western Australia for the financial year of 2015/16 (Schirmer et al. 2017). This report provides updated economic contributions for the 2019/20 financial year. This study presents findings for the forest industry in Western Australia (WA) and WA forestry regions, and includes activity dependent on the harvest of timber from softwood plantation, hardwood plantation and native forests. It does not examine sandalwood production.

In 2019-20, the direct value of output generated by the WA forest industry at the point of sale of primary processed products was $663 million, increasing to $1,331 million when flow-on effects generated in other industries as a result of spending by the forest industry are included. This total included $235 million dependent on native forests, $543 million dependent on softwood plantation and $553 million dependent on hardwood plantations.

However, value of output is not always a good indicator of the industry's overall contribution to the local economy, as it does not identify the extent to which the economy of a given region benefited from the industry's activity in the form of returns to business owners, wages and salaries, and taxes. Measuring the industry's contribution to Gross State Product (GSP – the state equivalent of Gross Domestic Product) helps address this. In 2019-20, the forest industry directly contributed around $279 million to GSP in WA, and a total of $655 million once flow-on effects through the entire economy were included. This total included $116 million dependent on native forests, $278 million dependent on softwood plantation and $261 million dependent on hardwood plantations.

The forest industry in WA generated a total of 1,960 direct full time equivalent (fte) jobs in 2019-20, increasing to 4,657 fte jobs once flow-on effects through the entire economy were included. Up to the point of primary processing, a total of 1,015 fte jobs were generated by the native forest industry, 1,916 by softwood plantations, and 1,727 by hardwood plantations grown in WA.

In terms of total number of jobs, the forest industry in WA generated 2,134 direct jobs in 2019-20, increasing to 4,941 jobs once flow-on effects through the entire economy were included. Up to the point of primary processing, a total of 1,062 jobs were generated by the native forest industry, 2,059 by softwood plantations, and 1,820 by hardwood plantations grown in WA.

1. INTRODUCTION

The forest industry in Australia contributes to jobs and economic activity in multiple regional communities. This contribution results from the growing, management and harvesting of plantations and native forests, and processing of harvested wood.

In 2017 Forest and Wood Products Australia engaged the University of Canberra, working with BDO EconSearch, to provide a socio-economic assessment of the forest industry in Western Australia for the financial year of 2015/16 (Schirmer et al. 2017). This report provides updated economic contributions for the 2019/20 financial year.

This study presents findings for the forest industry in Western Australia (WA) and WA forestry regions, and includes activity dependent on the harvest of timber from softwood plantation, hardwood plantation and native forests. It does not examine sandalwood production.

This report examines the following aspects of the WA forest industry:

- Employment generated by the industry, including direct and flow-on jobs
- Economic value of the industry, including direct and flow-on economic activity.

2. METHOD AND DATA

The method for the study included industry consultation, forest activity modelling and regional economic contribution modelling. This section describes these components.

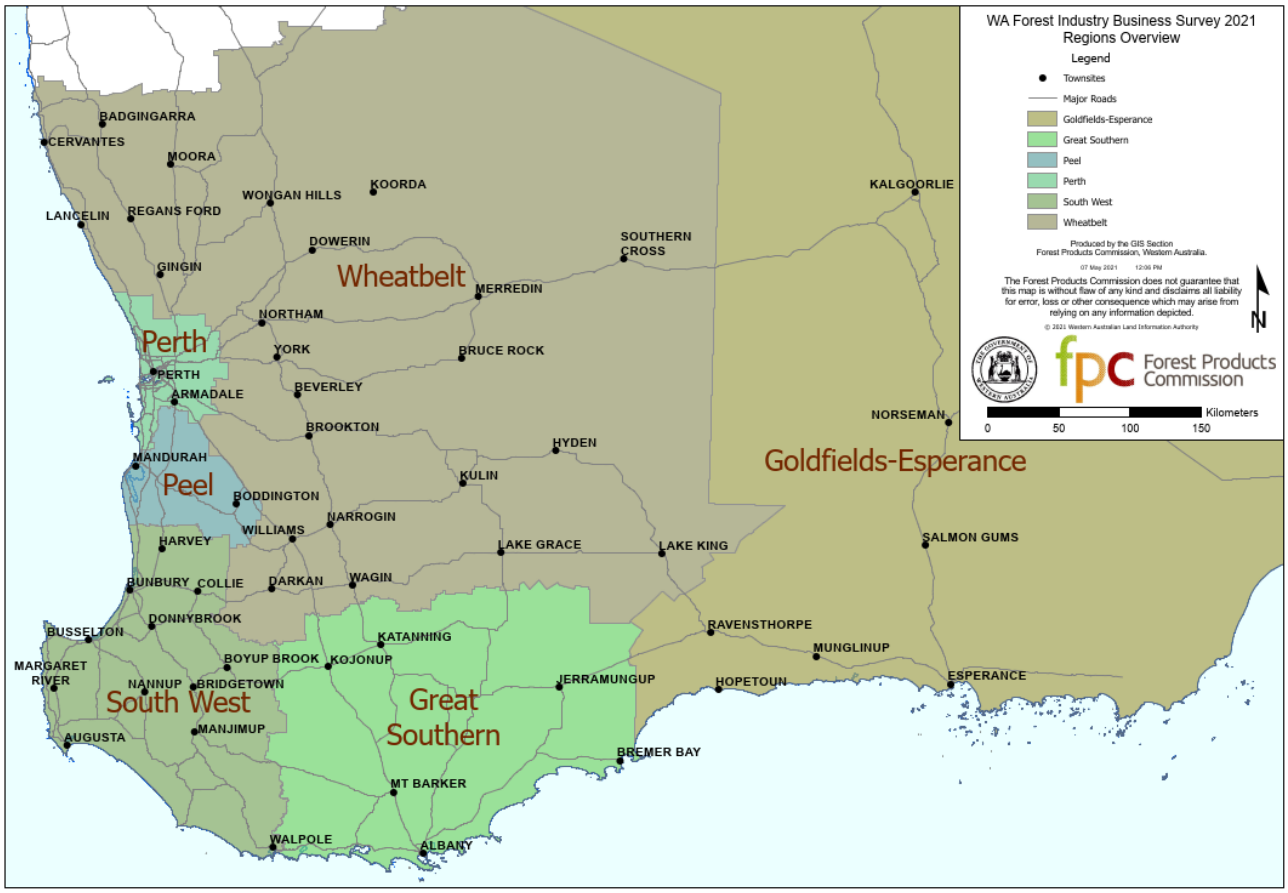
2.1. Regions

This report presents economic contributions separately for each of the following regions:

- Western Australia (state level)
- Great Southern and Esperance
- South-West
- Wheatbelt
- Perth and Peel
- Other WA.

The regions, excluding Other WA, are shown in Figure 2-1. Other WA is the residual of WA State and the above forestry regions.

Figure 2-1 Map of WA forestry industry regions



Source: Forest Products Commission (FPC)

2.2. Consultation and Data

The data analysed for this report was drawn from the following sources:

- 2019-20 Industry Survey: A survey of forest industry businesses operating in the five WA forestry regions, conducted between July and December 2021. A total of 44 businesses operating in the industry in the five regions (including nurseries, plantation management businesses, silvicultural contractors, harvest & haulage contractors, and primary processors), participated in the survey. The industry survey collected the following data
  - Business details: name and locations.
  - Employment: number of workers in each region, hours worked and basic demographic information.
  - Financials: Total business turnover and expenditure across 13 expenditure categories.
  - Supply chain specific activities: see Table 2-1 below
- 2015-16 Industry Survey: economic modelling data from the 2015-16 study (Schirmer et al. 2017) was used to fill data gaps identified in the 2019-20 Industry Survey. Data used were updated to 2019/20 levels using regional trends estimated from a combination of Australian Bureau of Statistics (ABS) and Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) sources.
- ABARES Australian forest and wood product statistics datasets (Gavran 2020): Total statewide value of production was estimated by combining this source with survey data on firewood production (which is excluded from the ABARES value). The proportion of product processed within Western Australia was estimated as the residual between the value exported and value harvested.

Table 2-1 Data collected for supply chain specific activities, 2019-20 industry survey.

Supply chain stage	Description
Growing	• Forest area managed and involving active operations by resource type • Volume of each resource type sold to each business type and region.
Silviculture	• Percentage of revenue: earned in each activity type, earned in each forest type, and earned in each region.
Harvest & haulage	• Percentage of revenue: earned in harvest vs haulage, earned in each forest type, and earned in each region • Volume of forest resource harvested, chipped in-field and/or hauled.
Processing	• Mill names and locations • Input volumes, mill-door prices and source regions for each forest resource type • Total production volume, value and market destination (or final use) across 6 product categories.
Firewood	• Input volumes, prices and source regions for each forest resource type (FPC, non-FPC, offcuts and other) • The percentage of firewood harvested by the business itself vs by contractors • Volumes and sales prices, for direct sales and sales to wholesalers/retailers, sold as bulk, packaged or other firewood.
Other	• Percentage of revenue: earned in each activity type, earned in each forest type, and earned in each region.

Source: BDO EconSearch analysis

2.3. Economic Modelling

The regional economic contribution and impact analyses use an extension of the conventional input-output (I-O) method. Over the past decade BDO EconSearch has developed an extended input-output model known as the RISE model. The RISE model provides a comprehensive economic framework that is extremely useful in the resource planning process, particularly for regional economic impact analyses.

The RISE I-O models of regional economies, constructed by BDO EconSearch, are widely used by Government, and are available at the national, state and regional levels. RISE models for the WA and WA forestry regions were used for this assessment. The assumptions embodied in the input-output model itself are discussed in Appendix 2.

The indicators used in contribution and impact analyses typically include gross regional product and employment, which are used in this report.

2.3.1. Economic activity

Economic activity indicators: the focus of this report is the generation of economic activity resulting from the existence of the forest industry and of changes to it. The key economic activity indicators considered in the analysis are output, Industry expenditure, gross state product (GSP) and gross regional product (GRP), and employment.

Economic contribution: the existing (baseline) level of economic activity generated by an activity is referred to as economic contribution. In this analysis the concept of economic contribution includes the whole forest industry supply chain (unless specified) and the economic activity that supports it from all industries.

2.3.2. Indicators of economic activity defined

Output (Value of) of an industry is a relatively simple measure: it is the total revenue earned by forest industry businesses from sales of goods and services. This provides useful information about the total economic size of an industry and its output. When reporting value of output, it is important to estimate value at a specific 'end point of sale' – i.e. a particular point in the supply chain. In this report, the 'end point of sale' is the value of the sale of goods from primary processing. Note that this value excludes sales of products and services between industry businesses at earlier points in the forest industry supply chain to avoid double counting.

While this indicator provides a useful estimate of total value of an industry at a particular stage of production – in this case, at the point of sale of primary processed wood products – it does not provide substantial information about how that industry has contributed to the local economy, for two key reasons.

1. It doesn't consider the cost of producing the output. For example, an industry with a turnover (output) of two billion dollars and expenditure on goods and services of two billion dollars creates less value-add than one that has a turnover of two billion dollars and expenditure on goods and services of one billion dollars.
2. It matters where expenditures occur when considering flow-on impact. For example, an industry might generate two billion dollars of sales in a given region, but rely largely on imported goods and services to produce its output, generating very little local spending or employment as a result. Another industry, meanwhile, might also generate two billion dollars of sales, but do this through a locally-based supply chain, generating substantial jobs and expenditure in the local area as a result.

Industry expenditure is a measure of how much is spent by the industry on goods and services as part of generating the final goods and services sold. When measured at regional level, this indicator provides an idea of the extent to which the industry contributes to the economy locally, as it will show how much the industry has spent within the region versus outside it. Value of expenditure can be measured in two ways, both of which are presented in this report:

- Gross expenditure – total expenditure by all forest industry businesses, including spending within and outside the industry. This means some expenditure is 'double counted' as it involves 'within industry transfers'. For example, if expenditure by a wood processor purchasing logs from a plantation growing company is included as well as the expenditure incurred by that company in growing the plantations, this results in 'double counting': the gross expenditure includes the amount spent by the processor on the logs, and also includes the amount spent by growers to produce those logs. Because of this double counting, gross expenditure does not indicate the extent to which spending by the industry contributes to the broader economy.
- Net expenditure – expenditure by the forest industry excluding transfers within the industry. This measure excludes payments made by businesses in one part of the industry to businesses in another part of the industry. It is a better indicator of the overall economic activity the industry provides to the local economy, as it identifies the net expenditure the industry as a whole contributes to the rest of the economy.

Measures of expenditure differ to value of output, for a range of reasons. In particular, expenditure excludes business profits (which are captured in value of output), expenditure can sometimes be higher than value of sales over a given period depending on business investment and timing of production; and not all the expenditure used to produce a given amount of output will have occurred in the region in which expenditure is being estimated. For example, a business may have generated $1 million in sales in a given region, but only spend $200,000 in that region as part of generating those sales, with the business purchasing most goods and services from other regions as part of the production process.

Industry expenditure is a useful indicator and provides more concrete data on the extent to which production of wood products results in local economic activity compared to value of output measures. However, it is still subject to some problems of double counting: if the net expenditure of all industries in a region is added together, it will result in a value that is larger than the total value of production in that economy. This is due to the multiple transactions occurring between different industries in any given economy, some of which are double counted when expenditure of each individual industry is added together. This potential for double counting means it is also important to identify the net contribution of the industry to a regional economy, after taking into account the interactions between all sectors of the economy. This is done through identifying industry contribution to Gross Regional Production (GRP), described below.

Employment units: Employment numbers are usually reported in either full time equivalent (fte) units or total job units defined as follows:

- *fte*: is a way to measure a worker's involvement in a project or industry activity. An fte of 1.0 means that the person is equivalent to a full-time worker, while an fte of 0.5 signals that the worker is only half-time. Typically, different scales are used to calibrate this number, depending on the type of industry and scope of the analysis but the basic calculation is the total hours worked divided by average annual hours worked in full-time jobs.

  In this report, an fte of 1.0 was calculated as equivalent to a 37.5 hr working week.

- *Jobs*: is used to refer to the number of workers employed (regardless of full- or part-time) in an industry or on a project at any point in time. It typically refers to either:
  - the *maximum* number of workers required at any point over the analytical period or the duration of the project; or
  - the *average* number of workers required over the analytical period/duration of the project. This can be calculated on a daily, weekly, monthly or annual basis.

In this report, employment is reported in terms of total and full-time equivalent jobs on a per annum basis.

Gross regional product (GRP): is a measure of the contribution of an activity to the regional economy. GRP is measured as value of gross output (revenue) less the cost of goods and services (including imports) used in producing the output. In other words, it can be measured as the sum of household income, gross operating surplus and gross mixed income net of payments to owner managers and taxes less subsidies on products and production. It represents payments to the primary inputs of production (labour, capital and land). Using GRP as a measure of economic impact avoids the problem of double counting that may arise from using value of output for this purpose. Gross state product (GSP) is the equivalent of GRP at the state level.

Household income: is income earned by employees of businesses and owner-operators. This is a component of GRP that describes how much of the GRP is passed directly to households so it is a useful indicator of the welfare of households.

2.3.3. Categories of economic activity

A useful way to think about economic contribution and economic impact is using the concept of a 'supply chain'. The supply chain, in the context of the forest industry, includes forest management and silviculture, harvest & haulage, processing and other businesses that support these activities such as utility and fuel suppliers and services such as accounting and maintenance.

Broadly speaking there are four categories of activity along the infrastructure supply chain.

1. *Direct activity* – refers to activity of firms, businesses and organisations that are directly engaged in providing goods and services to the development. In this analysis this refers to all activity that handles forest resources from growing to processing.
2. *First round activity* - refers to activity of firms that supply inputs and services to the 'direct activity' businesses. For example, first round activity associated with harvest & haulage businesses includes fuel supply, repairs and maintenance to equipment and business administration services such as insurance services, legal services, communications and so on.
3. *Industrial-support activity* – refers to the 'second and subsequent round' effects as successive waves of output increases occur in the economy to provide industrial support, as a response to the original wave of expenditure.
4. *Consumption-induced activity* - is the term applied to those effects induced by increased household income associated with the original expenditure and its flow-on effects. The expenditure of this increased household income, a result of all three categories of activity (direct, first round and industrial-support), will generate economic activity that will in itself generate further activity.

Flow-on (or *indirect*) *economic impact* is the sum of categories 2, 3 and 4. In this analysis *direct (1)*, *production-induced (2+3)* and *consumption-induced (4)* activity is reported.

3. ECONOMIC CONTRIBUTION

3.1. Direct Economic Contribution

3.1.1. Output

In 2019-20, the direct output from the growing, harvesting, primary processing, firewood sales and other forestry activity in WA was $663.0 million. This excludes sales of products or services occurring at earlier points in the supply chain prior to primary processing, to avoid double counting.

This included $140.2 million generated in Great Southern & Esperance, $422.3 million in South West, $1.9 million in the Wheatbelt, $95.8 million in Perth & Peel and $2.8 million in Other WA. By resource type $114.0 million was generated by the native forest industry, $271.7 million by activities dependent on softwood plantations, and $277.3 million dependent on hardwood plantations.

Table 3-1 Direct gross output ($m) generated by the WA forest industry in different regions, by supply chain stage, 2019-20

Supply chain stage	Great Southern & Esperance	South West	Wheatbelt	Perth & Peel	Other WA	Total State[a]
Growing	57.1	121.3	0.0	9.8	1.5	189.7
Silviculture	6.5	8.1	1.5	0.0	0.4	16.6
Harvest & haulage	43.2	105.3	0.0	6.5	0.9	156.0
Processing	33.3	173.6	0.5	76.7	0.0	284.1
Firewood	0.0	3.1	0.0	2.1	0.0	5.2
Other	0.0	10.9	0.0	0.5	0.0	11.4
Total	**140.2**	**422.3**	**1.9**	**95.8**	**2.8**	**663.0**

Source: BDO EconSearch analysis

Table 3-2 Direct gross output generated by the WA forest industry, by resource type, by supply chain stage, 2019-20

Supply chain stage	Native	Softwood	Hardwood	Total State
Growing	19.3	76.5	94.0	189.7
Silviculture	1.8	7.4	7.4	16.6
Harvest & haulage	20.9	43.4	91.6	156.0
Processing	65.3	140.9	77.9	284.1
Firewood	5.2	0.0	0.0	5.2
Other	1.5	3.5	6.4	11.4
Total	**114.0**	**271.7**	**277.3**	**663.0**

Source: BDO EconSearch analysis

3.1.2. Industry expenditure

Value of output does not always provide a picture of the extent to which an industry contributes directly to the region it is located in. Examining expenditure helps to answer questions such as whether industry expenditure largely occurs locally, or is mostly occurring some distance from the region in which the business is located. In total, in 2019-20, the forest industry generated $533.4 million in direct net expenditure in WA as a whole up to and including the point of primary processing.

This included $113.7 million of industry expenditure in Great Southern & Esperance, $340.0 million in South West, $1.4 million in the Wheatbelt, $75.8 million in Perth & Peel and $2.4 million the Other WA. By resource type $93.7 million of industry expenditure was generated by the native forest industry, $216.3 million by activities dependent on softwood plantations, and $223.3 million dependent on hardwood plantations.

In the native forest industries and the softwood plantation sector, most of this expenditure is generated by the processing of wood products. For the hardwood plantation sector most of this expenditure is generated by harvest and haulage activities, reflecting the relatively smaller amount of processing activity in the hardwood plantation sector compared to the native forest and softwood sectors.

To help understand where industry expenditure is generated, Table 3-3 and Table 3-4 show both gross and net expenditure: while gross expenditure is not a true measure of economic contribution, as it double counts some expenditure that involves transfers within the industry, it helps show the relative size of different parts of the supply chain. Net expenditure is a measure of economic contribution and shows how much expenditure outside of the forest industry is added at different points in the supply chain.

Table 3-3 Direct expenditure ($m) generated by the WA forest industry in different regions, by supply chain stage, 2019-20

	Great Southern & Esperance		South West		Wheatbelt		Perth & Peel		Other WA		Total State	
Supply chain stage	Gross	Net[a]	Gross	Net[a]	Gross	Net[a]	Gross	Net[a]	Gross	Net[a]	Gross	Net[a]
Growing	108.6	53.4	230.2	106.7	0.0	0.0	17.1	9.1	2.5	1.4	358.4	170.5
Silviculture	3.7	3.7	4.9	4.9	0.9	0.9	0.0	0.0	0.3	0.3	9.8	9.8
Harvest & haulage	39.7	39.5	99.4	97.2	0.0	0.0	6.2	6.2	0.8	0.8	146.0	143.7
Processing	73.7	17.1	270.1	123.1	0.8	0.5	109.5	58.9	0.0	0.0	454.1	199.6
Firewood	0.0	0.0	2.6	2.0	0.0	0.0	1.5	1.3	0.0	0.0	4.1	3.2
Other	0.0	0.0	10.4	6.2	0.0	0.0	0.5	0.3	0.0	0.0	11.0	6.5
Total	**225.6**	**113.7**	**617.6**	**340.0**	**1.7**	**1.4**	**134.8**	**75.8**	**3.6**	**2.4**	**983.3**	**533.4**

[a] This table shows expenditure net of transfers within the industry. The net figure ensures there is no double counting by ensuring that payments made from one part of the industry to another (and then expended in that other part of the industry) are not included. The transfers excluded from net figures include payments made to harvest, haulage, roading, earthworks and silvicultural contractors by plantation managers, and payments made to plantation managers or to other processors for fibre inputs used by wood and paper processors.

Source: BDO EconSearch analysis

Table 3-4 Direct expenditure ($m) generated by different the WA forest industry, by resource type, by supply chain stage, 2019-20

Supply chain stage	Native		Softwood		Hardwood		Total State	
	Gross	Net[a]	Gross	Net[a]	Gross	Net[a]	Gross	Net[a]
Growing	42.2	18.1	123.6	69.9	192.6	82.4	358.4	170.5
Silviculture	1.1	1.1	4.5	4.5	4.2	4.2	9.8	9.8
Harvest & haulage	20.2	18.9	40.2	39.8	85.7	85.0	146.0	143.7
Processing	82.5	51.4	185.9	100.2	185.7	48.0	454.1	199.6
Firewood	4.1	3.2	0.0	0.0	0.0	0.0	4.1	3.2
Other	1.5	0.9	3.4	2.0	6.1	3.6	11.0	6.5
Total	**151.5**	**93.7**	**357.5**	**216.3**	**474.3**	**223.3**	**983.3**	**533.4**

[a] This table shows expenditure net of transfers within the industry. The net figure ensures there is no double counting by ensuring that payments made from one part of the industry to another (and then expended in that other part of the industry) are not included. The transfers excluded from net figures include payments made to harvest, haulage, roading, earthworks and silvicultural contractors by plantation managers, and payments made to plantation managers or to other processors for fibre inputs used by wood and paper processors.

Source: BDO EconSearch analysis

3.1.3. Gross regional and state product

Measures of the forest industry's contribution to GRP can be thought of as the value-added by the industry to the economy, or the value left once non-wage expenditure is subtracted from revenue. This means GRP represents the value contributed to the economy in the form of returns to business/resource owners (in the form of profits), workers (in the form of wages and salaries), and taxes to governments. Using GRP as a measure of economic impact avoids the problem of double counting that may arise from using value of output for this purpose.

In total, in 2019-20, the forest industry contributed $278.8 million in direct GSP in WA. This included $56.5 million generated in Great Southern & Esperance, $179.3 million in South West, $1.0 million in the Wheatbelt, $40.7 million in Perth & Peel and $1.3 million in the Other WA (Table 3-5). By resource type the native forest industry contributed $47.7 million to GSP, softwood plantation dependent activities contributed $124.8 million, and hardwood plantation dependent activities contributed $106.3 million (Table 3-6).

Table 3-5 Direct contribution to GRP/GSP ($m) by the WA forest industry in different regions, by supply chain stage, 2019-20

Supply chain stage	Great Southern & Esperance	South West	Wheatbelt	Perth & Peel	Other WA	Total State
Growing	15.7	38.1	0.0	4.0	0.6	58.4
Silviculture	4.4	5.3	0.9	0.0	0.3	10.9
Harvest & haulage	15.6	36.7	0.0	1.9	0.4	54.6
Processing	20.8	89.5	0.1	33.2	0.0	143.6
Firewood	0.0	1.7	0.0	1.2	0.0	2.9
Other	0.0	7.9	0.0	0.4	0.0	8.3
Total	**56.5**	**179.3**	**1.0**	**40.7**	**1.3**	**278.8**

Source: BDO EconSearch analysis

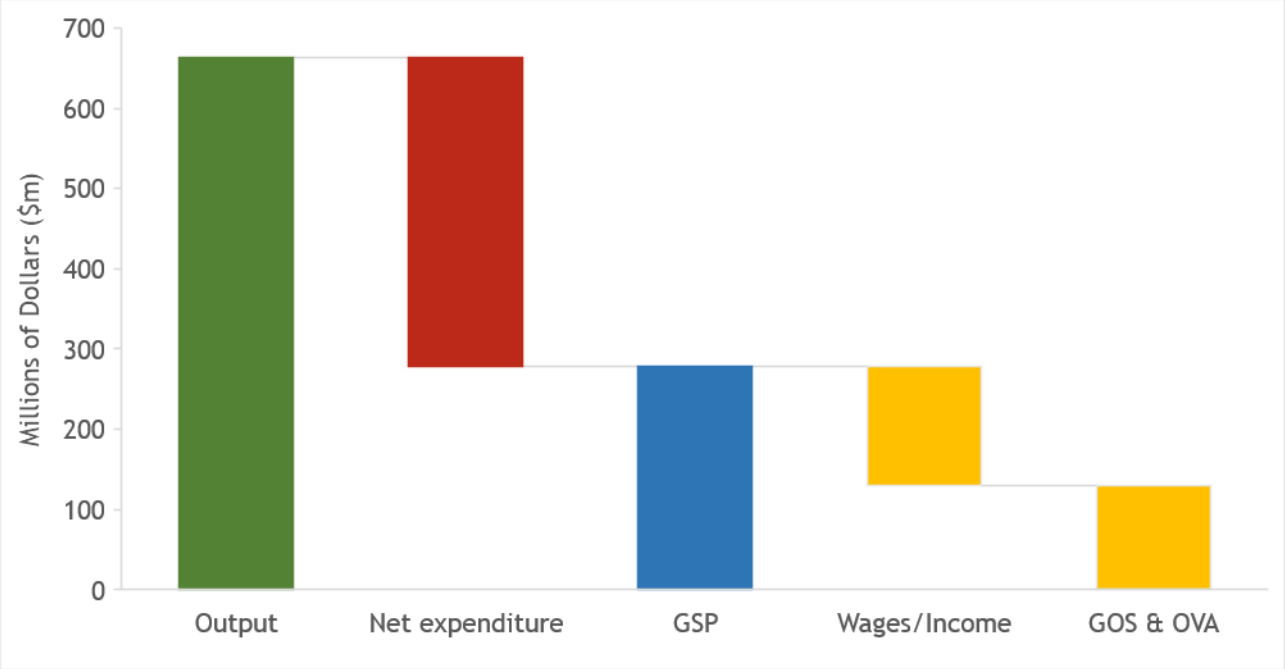
Table 3-6 Direct contribution to GRP/GSP ($m) by the WA forest industry, by resource type, by supply chain stage, 2019-20

Supply chain stage	Native	Softwood	Hardwood	Total State
Growing	5.5	28.2	24.8	58.4
Silviculture	1.1	4.9	4.9	10.9
Harvest & haulage	8.6	15.4	30.6	54.6
Processing	28.5	73.8	41.3	143.6
Firewood	2.9	0.0	0.0	2.9
Other	1.1	2.5	4.7	8.3
Total	**47.7**	**124.8**	**106.3**	**278.8**

Source: BDO EconSearch analysis

Figure 3-1 shows the derivation of direct contribution to GSP by the forest industry in WA. The figure shows that GSP (blue) is what remains once non-wage net expenditure (red) is subtracted from value of output (green). The orange bars show that most of the direct contribution to GRP was wages, followed by gross operating surplus (GOS, before-tax business profit) and a small amount of Other Value Added (OVA, in this case annuities and donations).

Figure 3-1 Calculation and decomposition of direct contribution to GSP, WA, all parts of the industry



Source: BDO EconSearch analysis

3.1.4. Household income

Household income, a component of GRP, and is a useful indicator of the welfare of households. In total, in 2019-20, the forest industry contributed $149.1 million to household income in WA. This included $30.0 million generated in Great Southern & Esperance, $96.9 million in South West, $0.5 million in the Wheatbelt, $20.8 million in Perth & Peel and $0.9 million in Other WA (Table 3-7). By resource type the native forest industry contributed $27.4 million to household income, softwood plantation dependent activities contributed $69.4 million, and hardwood plantation dependent activities contributed $52.3 million (Table 3-8).

Table 3-7 Direct contribution to household income ($m) by the WA forest industry in different regions, by supply chain stage, 2019-20

Supply chain stage	Great Southern & Esperance	South West	Wheatbelt	Perth & Peel	Other WA	Total State
Growing	12.0	23.5	0.0	3.2	0.5	39.2
Silviculture	1.6	2.1	0.4	0.0	0.1	4.2
Harvest & haulage	11.9	28.6	0.0	1.6	0.3	42.3
Processing	4.6	39.0	0.1	15.4	0.0	59.1
Firewood	0.0	0.6	0.0	0.4	0.0	1.0
Other	0.0	3.2	0.0	0.2	0.0	3.4
Total	**30.0**	**96.9**	**0.5**	**20.8**	**0.9**	**149.1**

Source: BDO EconSearch analysis

Table 3-8 Direct contribution to household income ($m) by the WA forest industry, by resource type, by supply chain stage, 2019-20

Supply chain stage	Native	Softwood	Hardwood	Total State
Growing	4.3	21.6	13.2	39.2
Silviculture	0.5	1.9	1.8	4.2
Harvest & haulage	6.5	11.8	24.0	42.3
Processing	14.7	33.1	11.4	59.1
Firewood	1.0	0.0	0.0	1.0
Other	0.5	1.0	1.9	3.4
Total	**27.4**	**69.4**	**52.3**	**149.1**

Source: BDO EconSearch analysis

3.1.5. Employment fte

The forest industry generated 1,960 fte direct jobs in 2019-20. 'Direct' jobs include jobs that depend on the presence of the industry, and include employment generated in nurseries, silvicultural contracting, harvest and haulage of logs to processors, and primary processing of logs. They do not include jobs generated in mechanical services, fuel supply, or supply of other goods and services to the industry, which are included in flow-on employment.

Across WA forestry regions, 358 fte jobs were generated in Great Southern & Esperance, 1,313 fte in South West, 14 fte in the Wheatbelt, 263 fte in Perth & Peel and 12 fte in Other WA (Table 3-9). By resource type the native forest industry generated 527 fte jobs in WA, softwood plantation dependent activities generated 827 fte jobs, and hardwood plantation dependent activities generated 606 fte jobs (Table 3-10).

Table 3-9 Direct contribution to employment (fte) by the WA forest industry in different regions, by supply chain stage, 2019-20

Supply chain stage	Great Southern & Esperance	South West	Wheatbelt	Perth & Peel	Other WA	Total State
Growing	101	235	0	33	5	375
Silviculture	43	56	11	0	3	113
Harvest & haulage	167	414	0	23	4	607
Processing	47	562	4	198	0	810
Firewood	0	14	0	5	0	20
Other	0	32	0	3	0	35
Total	**358**	**1,313**	**14**	**263**	**12**	**1,960**

Source: BDO EconSearch analysis

Table 3-10 Direct contribution to employment (fte) by the WA forest industry, by resource type, by supply chain stage, 2019-20

Supply chain stage	Native	Softwood	Hardwood	Total State
Growing	45	224	106	375
Silviculture	12	51	50	113
Harvest & haulage	96	152	359	607
Processing	348	389	73	810
Firewood	20	0	0	20
Other	6	10	19	35
Total	**527**	**827**	**606**	**1,960**

Source: BDO EconSearch analysis

3.1.6. Employment total jobs

The forest industry generated 2,134 direct jobs in 2019-20. Across WA forestry regions, 395 jobs were generated in Great Southern & Esperance, 1,422 jobs in South West, 21 jobs in the Wheatbelt, 281 jobs in Perth & Peel and 15 jobs in Other WA (Table 3-11). By resource type the native forest industry generated 556 jobs in WA, softwood plantation dependent activities generated 923 jobs, and hardwood plantation dependent activities generated 655 jobs (Table 3-12).

Table 3-11 Direct contribution to employment (total jobs) by the WA forest industry in different regions, by supply chain stage, 2019-20

Supply chain stage	Great Southern & Esperance	South West	Wheatbelt	Perth & Peel	Other WA	Total State
Growing	117	296	0	43	7	463
Silviculture	65	84	16	0	4	170
Harvest & haulage	164	412	0	23	3	603
Processing	49	581	5	205	0	840
Firewood	0	15	0	6	0	20
Other	0	34	0	3	0	38
Total	**395**	**1,422**	**21**	**281**	**15**	**2,134**

Source: BDO EconSearch analysis

Table 3-12 Direct contribution to employment (total jobs) by the WA forest industry, by resource type, by supply chain stage, 2019-20

Supply chain stage	Native	Softwood	Hardwood	Total State
Growing	55	284	124	463
Silviculture	18	77	74	170
Harvest & haulage	94	152	357	603
Processing	361	399	79	840
Firewood	20	0	0	20
Other	7	11	20	38
Total	**556**	**923**	**655**	**2,134**

Source: BDO EconSearch analysis

3.2. Total Economic Contribution Including Both Direct and Flow-on Effects

The direct expenditure of any industry generates further flow-on effects: expenditure by one industry generates economic activity in other parts of the economy, and therefore generates further jobs and economic activity beyond that occurring directly within the first industry. This flow-on activity can be production-induced, meaning it is generated as a result of the purchase of goods and services by the industry (e.g. purchasing fuel, mechanical services, accounting or financial services, to name a few), or consumption-induced, meaning it is generated as a result of workers in the industry and service industries spending their wages/salaries. 'Total' economic value refers to the total value an industry contributes to the economy when both direct and flow-on effects are included.

3.2.1. Economic contribution by region

When these flow-on effects are taken into account (see Table 3-13 and Appendix 1 for detailed data) and examined by region:

- The total value of output contributed by the industry in 2019-20 was $1,331.2 million in WA for the industry as a whole, including $219.3 million in the Great Southern & Esperance, $627.7 million in South West, $3.1 million in the Wheatbelt, $200.0 million in Perth and Peel, and $4.0 million in Other WA.
- The total contribution to the value of GRP was $654.7 million in WA for the industry as a whole, including $100.1 million in the Great Southern & Esperance, $292.8 million in the South West, $1.7 million in the Wheatbelt, $99.2 million in Perth and Peel, and $1.9 million in Other WA.
- The total contribution to the household income, a component of GRP, was $364.7 million in WA for the industry as a whole, including $53.8 million in the Great Southern and Esperance, $157.7 million in South West, $0.8 million in the Wheatbelt, $54.4 million in Perth and Peel, and $1.2 million in Other WA.
- For the industry as a whole, forestry contributed 4,657 fte jobs to employment in WA, including 666 fte in the Great Southern & Esperance, 2,127 fte in the South West, 19 fte in the Wheatbelt, 679 fte in Perth and Peel, and 17 fte in Other WA.
- For the industry as a whole, forestry contributed 4,941 jobs to employment in WA, including 711 jobs in the Great Southern & Esperance, 2,270 jobs in the South West, 26 jobs in the Wheatbelt, 714 fte in Perth and Peel, and 20 fte in Other WA.

Table 3-13 Economic impacts of the WA forest industry, by region – all parts of the industry

Economic indicator	Great Southern & Esperance	South West	Wheatbelt	Perth & Peel	Other WA	Total State
Output ($m)						
Direct	140.2	422.3	1.9	95.8	2.8	663.0
Production Induced	45.2	107.0	0.6	56.5	0.6	345.1
Consumption induced	33.9	98.4	0.5	47.8	0.5	323.1
Total	**219.3**	**627.7**	**3.1**	**200.0**	**4.0**	**1,331.2**
GRP/GSP ($m)						
Direct	56.5	179.3	1.0	40.7	1.3	278.8
Production Induced	22.2	51.8	0.3	29.1	0.3	179.0
Consumption induced	21.4	61.7	0.3	29.4	0.3	196.9
Total	**100.1**	**292.8**	**1.7**	**99.2**	**1.9**	**654.7**
Household income *($m)*						
Direct	30.0	96.9	0.5	20.8	0.9	149.1
Production Induced	14.4	33.6	0.2	19.1	0.2	117.9
Consumption induced	9.4	27.2	0.2	14.5	0.1	97.6
Total	**53.8**	**157.7**	**0.8**	**54.4**	**1.2**	**364.7**
Employment (fte)						
Direct	358	1,313	14	263	12	1,960
Production Induced	173	406	3	219	3	1,355
Consumption induced	135	407	2	197	2	1,342
Total	**666**	**2,127**	**19**	**679**	**17**	**4,657**
Employment (total)						
Direct	395	1,422	21	281	15	2,134
Production Induced	167	393	3	217	3	1,331
Consumption induced	148	455	2	217	2	1,476
Total	**711**	**2,270**	**26**	**714**	**20**	**4,941**

Source: BDO EconSearch analysis

3.2.2. Economic contribution by resource type

The contribution of the industry to the economy of WA is larger than that to sum of the five regions of Great Southern & Esperance, South West, the Wheatbelt, Perth & Peel and Other WA because some of the direct and indirect expenditure by the industry occurs outside of these regions.

When examined by resource type up to and including the point of primary processing (see also Appendix 1):

- The total value of output contributed by the industry in 2019-20 was $1,331.2 million in WA for the industry as a whole, including $235.0 million dependent on native forests, $542.7 million dependent on softwood plantation and $553.4 million dependent on hardwood plantations
- The total contribution to the value of GRP was $654.7 million in WA for the industry as a whole, including $115.5 million dependent on native forests, $278.1 million dependent on softwood plantation and $261.0 million dependent on hardwood plantations
- The total contribution to the household income, a component of GRP, was $364.7 million in WA for the industry as a whole, including $66.4 million dependent on native forests, $156.1 million dependent on softwood plantation and $142.2 million dependent on hardwood plantations.
- For the industry as a whole, forestry contributed 4,657 fte jobs to employment in WA, including 1,015 fte dependent on native forests, 1,916 fte dependent on softwood plantation and 1,727 fte dependent on hardwood plantations.
- In terms of total number of jobs, the industry as a whole contributed to 4,941 jobs in WA, including 1,062 dependent on native forests, 2,059 jobs dependent on softwood plantation and 1,820 jobs dependent on hardwood plantations.

Table 3-14 Economic impacts of the WA forest industry, by resource type – all parts of the industry

Economic indicator	Native	Softwood	Hardwood	Total State
Output ($m)				
Direct	114.0	271.7	277.3	663.0
Production Induced	62.2	132.7	150.2	345.1
Consumption induced	58.8	138.3	126.0	323.1
Total	**235.0**	**542.7**	**553.4**	**1,331.2**
GRP/GSP ($m)				
Direct	47.7	124.8	106.3	278.8
Production Induced	32.0	69.0	78.0	179.0
Consumption induced	35.8	84.3	76.8	196.9
Total	**115.5**	**278.1**	**261.0**	**654.7**
Household income *($m)*				
Direct	27.4	69.4	52.3	149.1
Production Induced	21.2	44.9	51.9	117.9
Consumption induced	17.8	41.8	38.1	97.6
Total	**66.4**	**156.1**	**142.2**	**364.7**
Employment (fte)				
Direct	527	827	606	1,960
Production Induced	244	514	597	1,355
Consumption induced	244	575	523	1,342
Total	**1,015**	**1,916**	**1,727**	**4,657**
Employment (total)				
Direct	556	923	655	2,134
Production Induced	237	504	589	1,331
Consumption induced	269	632	576	1,476
Total	**1,062**	**2,059**	**1,820**	**4,941**

Source: BDO EconSearch analysis

REFERENCES

Schirmer, J., Mylek, M, Magnusson, A., Yabsley, B., Morison, J., 2017, *Socio-economic impacts of the forest industry, Western Australia*, report prepared for Forest & Wood Products Australia, Canberra, December.

Gavran, M, 2020, *Australian forest and wood products statistics datasets 2020*, ABARES technical report, Canberra, November, CC BY 4.0. https://doi.org/10.25814/8vah-r089

APPENDIX 1 Detailed Results Tables

Appendix Table 1-1 Economic impacts of the WA forest industry up to and including primary processing, by sector, on the Great Southern and Esperance region, 2019-20

Economic indicator	Sector						
	Growing	Silviculture	Harvest and Haulage	Processing	Firewood	Other	Whole industry
Output ($m)							
Direct	57.1	6.5	43.2	33.3	0.0	0.0	140.2
Production Induced	20.2	0.9	13.5	10.7	0.0	0.0	45.2
Consumption induced	14.2	1.4	12.3	5.9	0.0	0.0	33.9
Total	**91.5**	**8.9**	**69.0**	**49.9**	**0.0**	**0.0**	**219.3**
GRP ($m)							
Direct	15.7	4.4	15.6	20.8	0.0	0.0	56.5
Production Induced	10.1	0.5	6.6	5.1	0.0	0.0	22.2
Consumption induced	9.0	0.9	7.8	3.7	0.0	0.0	21.4
Total	**34.8**	**5.8**	**29.9**	**29.6**	**0.0**	**0.0**	**100.1**
Household income *($m)*							
Direct	12.0	1.6	11.9	4.6	0.0	0.0	30.0
Production Induced	6.6	0.3	4.3	3.1	0.0	0.0	14.4
Consumption induced	3.9	0.4	3.4	1.6	0.0	0.0	9.4
Total	**22.5**	**2.3**	**19.6**	**9.4**	**0.0**	**0.0**	**53.8**
Employment (fte)							
Direct	101	43	167	47	0	0	358
Production Induced	79	4	53	37	0	0	173
Consumption induced	57	6	49	24	0	0	135
Total	**237**	**53**	**269**	**107**	**0**	**0**	**666**
Employment (total)							
Direct	117	65	164	49	0	0	395
Production Induced	78	4	52	33	0	0	167
Consumption induced	62	6	54	26	0	0	148
Total	**257**	**75**	**270**	**109**	**0**	**0**	**711**

Source: BDO EconSearch analysis

Appendix Table 1-2 Economic impacts of the WA forest industry up to and including primary processing, by sector, on the South West region, 2019-20

Economic indicator	Sector						
	Growing	Silviculture	Harvest and Haulage	Processing	Firewood	Other	Whole industry
Output ($m)							
Direct	121.3	8.1	105.3	173.6	3.1	10.9	422.3
Production Induced	29.8	1.0	27.0	46.2	1.4	1.6	107.0
Consumption induced	24.9	1.8	28.0	39.9	0.8	2.9	98.4
Total	**176.0**	**10.9**	**160.4**	**259.7**	**5.3**	**15.4**	**627.7**
GRP ($m)							
Direct	38.1	5.3	36.7	89.5	1.7	7.9	179.3
Production Induced	15.2	0.5	13.0	21.7	0.7	0.8	51.8
Consumption induced	15.6	1.1	17.6	25.0	0.5	1.8	61.7
Total	**68.9**	**7.0**	**67.3**	**136.2**	**2.9**	**10.5**	**292.8**
Household income *($m)*							
Direct	23.5	2.1	28.6	39.0	0.6	3.2	96.9
Production Induced	9.6	0.3	8.6	13.9	0.5	0.6	33.6
Consumption induced	6.9	0.5	7.8	11.0	0.2	0.8	27.2
Total	**40.0**	**2.9**	**44.9**	**64.0**	**1.3**	**4.6**	**157.7**
Employment (fte)							
Direct	235	56	414	562	14	32	1,313
Production Induced	119	4	107	163	6	8	406
Consumption induced	103	8	116	165	3	12	407
Total	**457**	**68**	**636**	**890**	**23**	**52**	**2,127**
Employment (total)							
Direct	296	84	412	581	15	34	1,422
Production Induced	117	4	105	153	5	8	393
Consumption induced	115	8	130	185	4	13	455
Total	**528**	**97**	**647**	**918**	**23**	**56**	**2,270**

Source: BDO EconSearch analysis

Appendix Table 1-3 Economic impacts of the WA forest industry up to and including primary processing, by sector, on the Wheatbelt region, 2019-20

Economic indicator	Sector						
	Growing	Silviculture	Harvest and Haulage	Processing	Firewood	Other	Whole industry
Output ($m)							
Direct	0.0	1.5	0.0	0.5	0.0	0.0	1.9
Production Induced	0.0	0.3	0.0	0.3	0.0	0.0	0.6
Consumption induced	0.0	0.4	0.0	0.1	0.0	0.0	0.5
Total	**0.0**	**2.1**	**0.0**	**0.9**	**0.0**	**0.0**	**3.1**
GRP ($m)							
Direct	0.0	0.9	0.0	0.1	0.0	0.0	1.0
Production Induced	0.0	0.2	0.0	0.2	0.0	0.0	0.3
Consumption induced	0.0	0.2	0.0	0.1	0.0	0.0	0.3
Total	**0.0**	**1.3**	**0.0**	**0.3**	**0.0**	**0.0**	**1.7**
Household income *($m)*							
Direct	0.0	0.4	0.0	0.1	0.0	0.0	0.5
Production Induced	0.0	0.1	0.0	0.1	0.0	0.0	0.2
Consumption induced	0.0	0.1	0.0	0.0	0.0	0.0	0.2
Total	**0.0**	**0.6**	**0.0**	**0.2**	**0.0**	**0.0**	**0.8**
Employment (fte)							
Direct	0	11	0	4	0	0	14
Production Induced	0	1	0	2	0	0	3
Consumption induced	0	2	0	1	0	0	2
Total	**0**	**13**	**0**	**6**	**0**	**0**	**19**
Employment (total)							
Direct	0	16	0	5	0	0	21
Production Induced	0	1	0	2	0	0	3
Consumption induced	0	2	0	1	0	0	2
Total	**0**	**19**	**0**	**7**	**0**	**0**	**26**

Source: BDO EconSearch analysis

Appendix Table 1-4 Economic impacts of the WA forest industry up to and including primary processing, by sector, on the Perth & Peel region, 2019-20

Economic indicator	Sector						
	Growing	Silviculture	Harvest and Haulage	Processing	Firewood	Other	Whole industry
Output ($m)							
Direct	9.8	0.0	6.5	76.7	2.1	0.5	95.8
Production Induced	5.3	0.0	4.3	45.4	1.3	0.1	56.5
Consumption induced	6.2	0.0	3.6	36.6	1.1	0.3	47.8
Total	**21.4**	**0.0**	**14.5**	**158.8**	**4.5**	**0.9**	**200.0**
GRP ($m)							
Direct	4.0	0.0	1.9	33.2	1.2	0.4	40.7
Production Induced	2.9	0.0	2.2	23.4	0.7	0.0	29.1
Consumption induced	3.8	0.0	2.2	22.5	0.6	0.2	29.4
Total	**10.7**	**0.0**	**6.3**	**79.1**	**2.5**	**0.6**	**99.2**
Household income *($m)*							
Direct	3.2	0.0	1.6	15.4	0.4	0.2	20.8
Production Induced	1.9	0.0	1.4	15.1	0.5	0.0	19.1
Consumption induced	1.9	0.0	1.1	11.1	0.3	0.1	14.5
Total	**7.0**	**0.0**	**4.1**	**41.7**	**1.2**	**0.3**	**54.4**
Employment (fte)							
Direct	33	0	23	198	5	3	263
Production Induced	21	0	16	176	6	0	219
Consumption induced	26	0	15	151	4	1	197
Total	**80**	**0**	**55**	**525**	**15**	**5**	**679**
Employment (total)							
Direct	43	0	23	205	6	3	281
Production Induced	21	0	16	174	5	0	217
Consumption induced	28	0	16	166	5	1	217
Total	**92**	**0**	**56**	**545**	**16**	**5**	**714**

Source: BDO EconSearch analysis

Appendix Table 1-5 Economic impacts of the WA forest industry up to and including primary processing, by sector, on the Other WA region, 2019-20

Economic indicator	Sector						
	Growing	Silviculture	Harvest and Haulage	Processing	Firewood	Other	Whole industry
Output ($m)							
Direct	1.5	0.4	0.9	0.0	0.0	0.0	2.8
Production Induced	0.3	0.0	0.2	0.0	0.0	0.0	0.6
Consumption induced	0.3	0.1	0.2	0.0	0.0	0.0	0.5
Total	**2.1**	**0.5**	**1.3**	**0.0**	**0.0**	**0.0**	**4.0**
GRP ($m)							
Direct	0.6	0.3	0.4	0.0	0.0	0.0	1.3
Production Induced	0.2	0.0	0.1	0.0	0.0	0.0	0.3
Consumption induced	0.2	0.0	0.1	0.0	0.0	0.0	0.3
Total	**1.0**	**0.4**	**0.6**	**0.0**	**0.0**	**0.0**	**1.9**
Household income *($m)*							
Direct	0.5	0.1	0.3	0.0	0.0	0.0	0.9
Production Induced	0.1	0.0	0.1	0.0	0.0	0.0	0.2
Consumption induced	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total	**0.7**	**0.1**	**0.4**	**0.0**	**0.0**	**0.0**	**1.2**
Employment (fte)							
Direct	5	3	4	0	0	0	12
Production Induced	2	0	1	0	0	0	3
Consumption induced	1	0	1	0	0	0	2
Total	**8**	**3**	**5**	**0**	**0**	**0**	**17**
Employment (total)							
Direct	7	4	3	0	0	0	15
Production Induced	2	0	1	0	0	0	3
Consumption induced	1	0	1	0	0	0	2
Total	**10**	**5**	**6**	**0**	**0**	**0**	**20**

Source: BDO EconSearch analysis

Appendix Table 1-6 Economic impacts of the WA forest industry up to and including primary processing, by sector, on all of WA, 2019-20

Economic indicator	Sector						
	Growing	Silviculture	Harvest and Haulage	Processing	Firewood	Other	Whole industry
Output ($m)							
Direct	189.7	16.6	156.0	284.1	5.2	11.4	663.0
Production Induced	118.9	4.3	79.8	136.3	3.2	2.6	345.1
Consumption induced	99.3	7.0	84.1	124.7	2.6	5.3	323.1
Total	**407.9**	**27.9**	**319.9**	**545.1**	**11.0**	**19.3**	**1,331.2**
GSP ($m)P							
Direct	58.4	10.9	54.6	143.6	2.9	8.3	278.8
Production Induced	64.2	2.4	40.0	69.6	1.6	1.3	179.0
Consumption induced	60.5	4.3	51.2	76.0	1.6	3.2	196.9
Total	**183.1**	**17.6**	**145.8**	**289.2**	**6.2**	**12.8**	**654.7**
Household income *($m)*							
Direct	39.2	4.2	42.3	59.1	1.0	3.4	149.1
Production Induced	42.9	1.6	27.2	44.0	1.2	1.0	117.9
Consumption induced	30.0	2.1	25.4	37.7	0.8	1.6	97.6
Total	**112.1**	**7.9**	**94.9**	**140.8**	**3.0**	**6.0**	**364.7**
Employment (fte)							
Direct	375	113	607	810	20	35	1,960
Production Induced	483	18	321	508	14	12	1,355
Consumption induced	413	29	349	518	11	22	1,342
Total	**1,270**	**160**	**1,278**	**1,836**	**44**	**69**	**4,657**
Employment (total)							
Direct	463	170	603	840	20	38	2,134
Production Induced	477	19	319	492	12	12	1,331
Consumption induced	454	32	384	570	12	24	1,476
Total	**1,394**	**220**	**1,307**	**1,902**	**44**	**74**	**4,941**

Source: BDO EconSearch analysis

Appendix Table 1-7 Economic impacts of the WA native forestry industry up to and including primary processing, by sector, on all of WA, 2019-20

Economic indicator	Sector						
	Growing	Silviculture	Harvest and Haulage	Processing	Firewood	Other	Whole industry
Output ($m)							
Direct	19.3	1.8	20.9	65.3	5.2	1.5	114.0
Production Induced	11.9	0.5	9.6	36.7	3.2	0.3	62.2
Consumption induced	10.5	0.8	11.8	32.2	2.6	0.8	58.8
Total	**41.7**	**3.0**	**42.3**	**134.2**	**11.0**	**2.7**	**235.0**
GSP ($m)P							
Direct	5.5	1.1	8.6	28.5	2.9	1.1	47.7
Production Induced	6.4	0.3	4.8	18.7	1.6	0.2	32.0
Consumption induced	6.4	0.5	7.2	19.7	1.6	0.5	35.8
Total	**18.3**	**1.9**	**20.6**	**66.8**	**6.2**	**1.8**	**115.5**
Household income *($m)*							
Direct	4.3	0.5	6.5	14.7	1.0	0.5	27.4
Production Induced	4.4	0.2	3.3	12.0	1.2	0.1	21.2
Consumption induced	3.2	0.2	3.6	9.7	0.8	0.2	17.8
Total	**11.9**	**0.9**	**13.3**	**36.4**	**3.0**	**0.9**	**66.4**
Employment (fte)							
Direct	45	12	96	348	20	6	527
Production Induced	49	2	38	139	14	2	244
Consumption induced	44	3	49	134	11	3	244
Total	**138**	**17**	**184**	**621**	**44**	**11**	**1,015**
Employment (total)							
Direct	55	18	94	361	20	7	556
Production Induced	49	2	38	134	12	2	237
Consumption induced	48	4	54	147	12	4	269
Total	**152**	**24**	**187**	**643**	**44**	**12**	**1,062**

Source: BDO EconSearch analysis

Appendix Table 1-8 Economic impacts of the WA softwood plantation forestry industry up to and including primary processing, by sector, on all of WA, 2019-20

Economic indicator	Sector						
	Growing	Silviculture	Harvest and Haulage	Processing	Firewood	Other	Whole industry
Output ($m)							
Direct	76.5	7.4	43.4	140.9	0.0	3.5	271.7
Production Induced	43.2	2.0	22.1	64.7	0.0	0.8	132.7
Consumption induced	44.8	3.2	23.4	65.3	0.0	1.6	138.3
Total	**164.5**	**12.6**	**88.8**	**270.9**	**0.0**	**5.9**	**542.7**
GSP ($m)P							
Direct	28.2	4.9	15.4	73.8	0.0	2.5	124.8
Production Induced	23.4	1.1	11.1	33.1	0.0	0.4	69.0
Consumption induced	27.3	2.0	14.2	39.8	0.0	1.0	84.3
Total	**78.9**	**7.9**	**40.7**	**146.7**	**0.0**	**3.9**	**278.1**
Household income *($m)*							
Direct	21.6	1.9	11.8	33.1	0.0	1.0	69.4
Production Induced	15.4	0.7	7.5	20.9	0.0	0.3	44.9
Consumption induced	13.5	1.0	7.1	19.7	0.0	0.5	41.8
Total	**50.6**	**3.6**	**26.4**	**73.7**	**0.0**	**1.8**	**156.1**
Employment (fte)							
Direct	224	51	152	389	0	10	827
Production Induced	173	8	89	241	0	4	514
Consumption induced	186	13	97	271	0	7	575
Total	**583**	**73**	**338**	**901**	**0**	**21**	**1,916**
Employment (total)							
Direct	284	77	152	399	0	11	923
Production Induced	171	8	88	233	0	4	504
Consumption induced	205	15	107	298	0	7	632
Total	**660**	**100**	**347**	**930**	**0**	**22**	**2,059**

Source: BDO EconSearch analysis

Appendix Table 1-9 Economic impacts of the WA hardwood plantation forestry industry up to and including primary processing, by sector, on all of WA, 2019-20

Economic indicator	Sector						
	Growing	Silviculture	Harvest and Haulage	Processing	Firewood	Other	Whole industry
Output ($m)							
Direct	94.0	7.4	91.6	77.9	0.0	6.4	277.3
Production Induced	63.8	1.9	48.2	34.9	0.0	1.4	150.2
Consumption induced	43.9	3.0	48.9	27.2	0.0	2.9	126.0
Total	**201.7**	**12.3**	**188.7**	**139.9**	**0.0**	**10.8**	**553.4**
GSP ($m)P							
Direct	24.8	4.9	30.6	41.3	0.0	4.7	106.3
Production Induced	34.3	1.0	24.1	17.8	0.0	0.7	78.0
Consumption induced	26.8	1.8	29.8	16.6	0.0	1.8	76.8
Total	**85.8**	**7.8**	**84.5**	**75.7**	**0.0**	**7.1**	**261.0**
Household income *($m)*							
Direct	13.2	1.8	24.0	11.4	0.0	1.9	52.3
Production Induced	23.1	0.7	16.4	11.1	0.0	0.6	51.9
Consumption induced	13.3	0.9	14.8	8.2	0.0	0.9	38.1
Total	**49.6**	**3.4**	**55.2**	**30.7**	**0.0**	**3.3**	**142.2**
Employment (fte)							
Direct	106	50	359	73	0	19	606
Production Induced	260	8	194	128	0	7	597
Consumption induced	182	13	203	113	0	12	523
Total	**549**	**70**	**756**	**314**	**0**	**38**	**1,727**
Employment (total)							
Direct	124	74	357	79	0	20	655
Production Induced	257	8	193	125	0	7	589
Consumption induced	201	14	223	124	0	13	576
Total	**582**	**96**	**774**	**328**	**0**	**40**	**1,820**

Source: BDO EconSearch analysis

APPENDIX 2 An Overview of Economic Impact Analysis Using the Input-Output Method

Economic impact analysis based on an I-O model provides a comprehensive economic framework that is extremely useful in the resource planning process. Broadly, there are two ways in which the I-O method can be used.

First, the I-O model provides a numerical picture of the size and shape of an economy and its essential features. The I-O model can be used to describe some of the important features of an economy, the interrelationships between sectors and the relative importance of the individual sectors.

Second, I-O model is used to calculate industry multipliers that can then be applied to various development or change scenarios.

The input-output database

I-O analysis, as an accounting system of inter-industry transactions, is based on the notion that no industry exists in isolation. This assumes, within any economy, each firm depends on the existence of other firms to purchase inputs from, or sell products to, for further processing. The firms also depend on final consumers of the product and labour inputs to production. An I-O database is a convenient way to illustrate the purchases and sales of goods and services taking place in an economy at a given point in time.

As noted above, I-O models provide a numerical picture of the size and shape of the economy. Products produced in the economy are aggregated into a number of groups of industries and the transactions between them recorded in the transaction table. The rows and columns of the I-O table can be interpreted in the following way:

- The rows of the I-O table illustrate sales for intermediate usage (i.e. to other firms in the region) and for final demand (e.g. household consumption, exports or capital formation).
- The columns of the I-O table illustrate purchases of intermediate inputs (i.e. from other firms in the region), imported goods and services and purchases of primary inputs (i.e. labour, land and capital).
- Each item is shown as a purchase by one sector and a sale by another, thus constructing two sides of a double accounting schedule.

In summary, the I-O model can be used to describe some of the important features of a state or regional economy, the interrelationships between sectors and the relative importance of the individual sectors. The model is also used for the calculation of sector multipliers and the estimation of economic impacts arising from some change in the economy.

Using input-output analysis for estimation of economic impacts

The I-O model conceives the economy of the region as being divided up into a number of sectors and this allows the analyst to trace expenditure flows. To illustrate this, consider the example of a vineyard that, in the course of its operation, purchases goods and services from other sectors. These goods and services would include fertiliser, chemicals, transport services, and, of course, labour. The direct employment created by the vineyard is regarded in the model as an expenditure flow into the household sector, which is one of several non-industrial sections recognised in the I-O model.

Upon receiving expenditure by the vineyard, the other sectors in the regional economy engage in their own expenditures. For example, as a consequence of winning a contract for work with the vineyard, a spraying contractor buys materials from its suppliers and labour from its own employees. Suppliers and employees in

turn engage in further expenditure, and so on. These indirect and induced (or flow-on) effects, as they are called, are part of the impact of the vineyard on the regional economy. They must be added to the direct effects (which are expenditures made in immediate support of the vineyard itself) in order to arrive at a measure of the total impact of the vineyard.

It may be thought that these flow-on effects (or impacts) go on indefinitely and that their amount adds up without limit. The presence of leakages, however, prevents this from occurring. In the contact of the impact on a regional economy, an important leakage is expenditure on imports, that is, products or services that originate from outside the region, state or country (e.g. machinery).

Thus, some of the expenditure by the vineyard (i.e. expenditure on imports to the region) is lost to the regional economy. Consequently, the flow-on effects get smaller and smaller in successive expenditure rounds due to this and other leakages. Hence the total expenditure created in the regional economy is limited in amount, and so (in principle) it can be measured.

Using I-O analysis or estimation of regional economy impacts requires a great deal of information. The analyst needs to know the magnitude of various expenditures and where they occur. Also needed is information on how the sectors receiving this expenditure share their expenditure amount the various sectors from whom they buy, and so on, for the further expenditure rounds.

In applying the I-O model to economic impact analysis, the standard procedure is to determine the direct or first-round expenditure in subsequent expenditures only. No attempt is made to pursue such inquires on expenditure in subsequent rounds, not even, for example, to trace the effects in the regional economy on household expenditures by vineyard employees on food, clothing, entertainment and so on, as it is impartible to measure these effects for an individual case, here the vineyard.

The I-O model is instead based on a set of assumptions about constant and uniform proportions of expenditure. If households in general in the regional economy spend, for example, 13.3 per cent of their income on food and non-alcoholic beverages, it is assumed that those working in vineyards do likewise. Indeed, the effects of all expenditure rounds after the first are calculated by using such standard propositions (i.e. multiplier calculations). Once a transaction table has been complied, simple mathematical procedures can be applied to derive multipliers for each sector in the economy.

Input-output multipliers

I-O multipliers are an indication of the strength of the linkages between a particular sector and the rest of the state or regional economy. As well, they can be used to estimate the impact of a change in that particular sector on the rest of the economy.

Detailed explanations on calculating I-O multipliers, including the underlying assumptions, are provided in any regional economics or I-O analysis textbook (see, for example, Jensen and West 1986). They are calculated through a routine set of mathematical operations based on coefficients derived from the I-O transactions model, as outlined below.

The transactions table may be represented by a series of equations thus:

$$X_1 = X_{11} + X_{12} + \ldots\ldots\ldots\ldots + X_{1n} + Y_1$$

$$X_2 = X_{21} + X_{22} + \ldots\ldots\ldots\ldots + X_{2n} + Y_2$$

$$X_n = X_{n1} + X_{n2} + \ldots\ldots\ldots\ldots + X_{nn} + Y_n$$

Where: X_i = total output of intermediate sector *i* (row totals);

X_{ij} = output of sector *i* purchased by sector *j* (elements of the intermediate quadrant); and

Y_j = total final demand for the output of sector *i*.

It is possible, by dividing the elements of the columns of the transactions table by the respective column totals to derive coefficients, which represent more clearly the purchasing pattern of each sector. These coefficients, termed 'direct' or 'I-O' coefficients, are normally denoted as a_{ij}, and represent the direct or first round requirements from the output of each sector following an increase in output of any sector.

In equation terms the model becomes:

$$X_1 = a_{11}X_1 + a_{12}X_2 + \ldots\ldots\ldots\ldots + a_{1n}X_n + Y_1$$

$$X_2 = a_{21}X_1 + a_{22}X_2 + \ldots\ldots\ldots\ldots + a_{2n}X_n + Y_2$$

$$X_n = a_{n1}X_1 + a_{n2}X_2 + \ldots\ldots\ldots\ldots + a_{nn}X_n + Y_n$$

where a_{ij} (the direct coeffiennt) = X_{ij}/X_j. this may be represented in matrix terms:

$X = AX + Y$

where $A = [a_{ij}]$, the matrix of direct coefficients.

The previous equation can be extended to:

$(I\text{-}A)X = Y$

where $(I\text{-}A)$ is termed the Leontief matrix,

or $X = (I\text{-}A)^{-1}Y$

where $(I\text{-}A)^{-1}$ is termed the 'general solution', the 'Leontief inverse' or simply the inverse of the open model.

The general solution is often represented by:

$Z = (I\text{-}A)^{-1} = [z_{ij}]$

The I-O table can be 'closed' with respect to certain elements of the table. Closure involves the transfer of items from the exogenous portions of the table (final demand and primary input quadrants) to the endogenous section of the table (intermediate quadrant). This implies that the analyst considers that the transferred item is related more to the level of local activity than to external influences. Closure of I-O tables with respect to households is common and has been adopted in this project.

The 'closed' direct coefficients matrix may be referred to as A^*. The inverse of the Leontief matrix formed from A^* is given by:

$Z^* = (I\text{-}A^*)^{-1} = [z^*_{ij}]$

Z^* is referred to as the 'closed inverse' matrix.

A multiplier is essentially a measurement of the impact of an economic stimulus. In the case of I-O multipliers the stimulus is normally assumed to be an increase of one dollar in sales to final demand by a sector. The impact in terms of output, contribution to gross regional product, household income and employment can be identified in the categories discussed below.

(i) The initial impact: refers to the assumed dollar increase in sales. It is the stimulus or the cause of the impacts. It is the unity base of the output multiplier and provides the identity matrix of the Leontief matrix. Associated directly with this dollar increase in output is an own-sector increase in household income (wages and salaries, drawings by owner operators etc.) used in the production of that dollar. This is the household income coefficient h_j. Household income, together with other value added (OVA), provide the total gross regional product from the production of that dollar of

output. The gross regional product coefficient is denoted v_j. Associated also will be an own-sector increase in employment, represented by the size of the employment coefficient. This employment coefficient e_j represents an employment/output ratio and is usually calculated as 'employment per million dollars of output'.

(ii) The first round impact: refers to the effect of the first round of purchases by the sector providing the additional dollar of output. In the case of the output multiplier this is shown by the direct coefficients matrix [a_{ij}]. The disaggregated effects are given by individual a_{ij} coefficients and the total first-round effect by Σa_{ij}. First-round household income effects are calculated by multiplying the first-round output effects by the appropriate household income coefficient (h_j). Similarly, the first-round gross regional product and employment effects are calculated by multiplying the first-round output effects by the appropriate gross regional product (v_j) and employment (e_j) coefficients.

(iii) Industrial-support impacts. This term is applied to 'second and subsequent round' effects as successive waves of output increases occur in the economy to provide industrial support, as a response to the original dollar increase in sales to final demand. The term excludes any increases caused by increased household consumption. Output effects are calculated from the open Z inverse, as a measure of industrial response to the first-round effects. The industrial-support output requirements are calculated as the elements of the columns of the Z inverse, less the initial dollar stimulus and the first-round effects. The industrial support household income, gross regional product and employment effects are defined as the output effects multiplied by the respective household income, gross regional product and employment coefficients. The first-round and industrial-support impacts are together termed the production-induced impacts.

(iv) Consumption-induced impacts: are defined as those induced by increased household income associated with the original dollar stimulus in output. The consumption-induced output effects are calculated in disaggregated form as the difference between the corresponding elements in the open and closed inverse (i.e. $z^*_{ij} - z_{ij}$, and in total as $\Sigma(z^*_{ij} - z_{ij})$. The consumption-induced household income, gross regional product and employment effects are simply the output effects multiplied by the respective household income, gross regional product and employment coefficients.

(v) Flow-on impacts: are calculated as total impact less the initial impact. This allows for the separation of 'cause and effect' factors in the multipliers. The cause of the impact is given by the initial impact (the original dollar increase in sales to final demand), and the effect is represented by the first-round, industrial-support and consumption-induced effects, which together constitute the flow-on effects.

Each of the five impacts are summarised in Appendix Table 2-1. It should be noted that household income, gross regional product and employment multipliers are parallel concepts, differing only by their respective coefficients h_j, v_j and e_j.

The output multipliers are calculated on a 'per unit of initial effect' basis (i.e. output responses to a one-dollar change in output). Household income, gross regional product and employment multipliers, as described above, refer to changes in household income per initial change in output, changes to gross regional product per initial change in output and changes in employment per initial change in output. These multipliers are conventionally converted to ratios, expressing a 'per unit' measurement, and described as Type I and Type II ratios. For example, with respect to employment:

Type I employment ratio = [initial + first round + industrial support]/initial

and

Type II employment ratio = [initial + production induced + consumption induced]/initial

Appendix Table 2-1 The structure of input-output multipliers for sector *i*[a]

Impacts	General formula
Output multipliers ($)	
Initial	1
First-round	$\Sigma_i a_{ij}$
Industrial-support	$\Sigma_i z_{ij}$-1-$\Sigma_i a_{ij}$
Consumption-induced	$\Sigma_i z^*_{ij}$-$\Sigma_i z_{ij}$
Total	$\Sigma_i z^*_{ij}$
Flow-on	$\Sigma_i z^*_{ij}$-1
Household Income multipliers ($)	
Initial	h_j
First-round	$\Sigma_i a_{ij} h_i$
Industrial-support	$\Sigma_i z_{ij} h_i$- h_j-$\Sigma_i a_{ij} h_i$
Consumption-induced	$\Sigma_i z^*_{ij} h_i$-$\Sigma_i z_{ij} h_i$
Total	$\Sigma_i z^*_{ij} h_i$
Flow-on	$\Sigma_i z^*_{ij} h_i$-h_j
Gross regional product multipliers ($)	
Initial	v_j
First-round	$\Sigma_i a_{ij} v_i$
Industrial-support	$\Sigma_i z_{ij} v_i$- v_j-$\Sigma_i a_{ij} v_i$
Consumption-induced	$\Sigma_i z^*_{ij} v_i$-$\Sigma_i z_{ij} v_i$
Total	$\Sigma_i z^*_{ij} v_i$
Flow-on	$\Sigma_i z^*_{ij} v_i$-v_j
Employment multipliers (full time equivalents)	
Initial	e_j
First-round	$\Sigma_i a_{ij} e_i$

Impacts	General formula
Industrial-support	$\Sigma_i z_{ij} e_i - e_j - \Sigma_i a_{ij} e_i$
Consumption-induced	$\Sigma_i z^*_{ij} e_i - \Sigma_i z_{ij} e_i$
Total	$\Sigma_i z^*_{ij} e_i$
Flow-on	$\Sigma_i z^*_{ij} e_i - e_j$

[a] In a DECON model, Z^* (the 'closed inverse' matrix), includes a population and an unemployed row and column (see below for details).

Model assumptions

There are a number of important assumptions in the I-O model that are relevant in interpreting the analytical results.

- Industries in the model have a linear production function, which implies constant returns to scale and fixed input proportions.
- Another model assumption is that firms within a sector are homogeneous, which implies they produce a fixed set of products that are not produced by any other sector and that the input structure of the firms are the same. Thus it is preferable to have as many sectors as possible specified in the models and the standard models for this study were compiled with 78 sectors.
- The model is a static model that does not take account of the dynamic processes involved in the adjustment to an external change, such as a permanent change in natural resources management.

Extending the standard economic impact model as a DECON model

Based on work undertaken by BDO EconSearch and consistent with Mangan and Phibbs (1989), the I-O model developed for this project was extended as demographic-economic (DECON) model. The two key characteristics of the DECON model, when compared with a standard economic model, are as follows.

1. The introduction of a population 'sector' (or row and column in the model) makes it possible to estimate the impact on local population levels of employment growth or decline.
2. The introduction of an unemployed 'sector' makes it possible to account for the consumption-induced impact of the unemployed in response to economic growth or decline.

The population 'sector'

The introduction of a population 'sector' to the standard I-O model allows for the calculation of population multipliers. These multipliers measure the flow-on population impact resulting from an initial population change attributable to employment growth or decline in a particular sector of the regional economy.

Calculation of population multipliers is made possible by inclusion of a population row and column in the 'closed' direct coefficients matrix of the I-O model.

Population row: the population coefficient (p_j) for sector j of the DECON model is represented as:

$P_j = -rho_j * e_j * family\ size_j$

where rho_j = the proportion of employees in sector *j* who remain in the region after they lose their job (negative employment impact) or the proportion of new jobs in sector *j* filled by previously unemployed locals (positive employment impact);

e_j = the employment coefficient for sector *j*; and

family size$_j$ = average family size for sector *j*.

Population column: the population column of the DECON model is designed to account for growth or decline in those sectors of the economy that are primarily population-driven (i.e. influenced by the size of the population) rather than market-driven (i.e. dependent upon monetary transactions). Clearly, many of the services provided by the public sector fit this description and, for the purpose of this analysis, it was assumed that the following intermediate sectors were primarily population-driven:

- public administration and defence;
- education;
- health and community services; and
- cultural and recreational services.

Thus, the non-market coefficient for sector j of the DECON model is represented as expenditure on that non-market service (by governments) in $million per head of population.

The population multiplier for sector *j* is represented as: z^*_{pj} / p_{pj}

where z^*_{pj} = coefficient of the 'closed inverse' matrix in the population row for sector *j*; and

p_{pj} = coefficient of the direct coefficients matrix in the population row for sector *j*.

Sources of local data for the population sector of the DECON models used in this project included the following.

- rho: little or no published data are available to assist with estimation of this variable, particularly at a regional level. The DECON models have been constructed to enable the analyst to estimate this variable on the basis of the availability superior data or assumptions.
- Family size: in order to estimate average family size by industry, relevant data were extracted from the Australian Bureau of Statistics 2006 Census of Population and Housing using the TableBuilder database. These data were modified by the consultants in order to ensure consistency with the specification and conventions of the I-O models.

The unemployed 'sector'

As outlined above, the introduction of an unemployed 'sector' to the standard I-O model makes it possible to account for the consumption-induced impact of the unemployed in response to economic growth or decline.

Through the inclusion of an unemployed row and column in the 'closed' direct coefficients matrix of the standard I-O model it is possible to calculate Type III multipliers (for output, gross regional product, household income and employment).

The key point to note is that, in the situation where at least some of the unemployed remain in a region after losing their job (negative employment impact) or some of the new jobs in a region are filled by previously unemployed locals (positive employment impact), Type III multipliers will be smaller than the more frequently used Type II multipliers.

Unemployed row: the unemployed coefficient (u_j) for sector *j* of the DECON model is represented as:

$u_j = -\text{rho}_j * (1-ess_j) * e_j$

where rho_j = the proportion of employees in sector j who remain in the region after they lose their job (negative employment impact) or the proportion of new jobs in sector j filled by previously unemployed locals (positive employment impact);

ess_j = the proportion of employed in sector j who are not eligible for welfare benefits when they lose their job*; and*

e_j = the employment coefficient for sector j.

Unemployed column: the unemployed column of the DECON model is an approximation of total consumption expenditure and the consumption pattern of the unemployed. It is represented as dollars per unemployed person rather than $million for the region as a whole, as is the case for the household expenditure column in a standard I-O model.

Sources of local (i.e. state and regional) data for the unemployed sector of the DECON models used in this study included the following.

- ess: in order to estimate the proportion of employed by industry who are not eligible for welfare benefits when they lose their job, relevant data were extracted from the Australian Bureau of Statistics 2006 Census of Population and Housing using the TableBuilder database. These data were modified by the consultants in order to ensure consistency with the specification and conventions of the I-O models.
- Unemployed consumption: total consumption expenditure by the unemployed was based on an estimate of the Newstart Allowance whilst the pattern of consumption expenditure was derived from household income quintiles in the 2014/15 Household Expenditure Survey (ABS 2017).

Incorporating a tourism demand profile in the I-O model

Tourism expenditure is a measure of the value of sales of goods and services to visitors to the state or region. The following method and data sources were used to estimate tourism expenditure by industry sector for the region.

- The primary data were sourced from Tourism Research Australia (TRA).
- Base datasets included total tourism expenditure by TRA tourism region and average expenditure profiles, by region, across a range of goods and services (e.g. food and drink, fuel, shopping, etc.).
- Estimates were available for domestic day, domestic overnight and international visitor expenditure.
- The first adjustment to the base data was the development of a concordance between the TRA tourism regions and I-O model regions and the allocation of these base data to the relevant I-O model region. These allocations were based, in turn, on an ABS concordance between TRA tourism regions and Statistical Local Areas.
- The second adjustment to the base data was the application of a more detailed expenditure breakdown from the ABS Australian National Accounts: Tourism Satellite Account for both domestic and international visitor expenditure (ABS 2016).
- The third adjustment to the base data was the conversion of tourism expenditure estimates from purchasers to basic prices (i.e. reallocation of net taxes (taxes minus subsidies) and marketing and transport margins) to make the data consistent with accounting conventions used in the national, state and regional I-O models. Purchasers' to basic price ratios for tourism expenditure categories were derived from ABS data.

- The final adjustment to the base data was the allocation of the tourism expenditure data in basic prices to the relevant input-output sectors (intermediate sectors, taxes less subsidies or imports) in which the expenditure occurred, thus compiling a profile of sales to final demand. This process was undertaken for each type of tourism expenditure (domestic day, domestic overnight and international visitor) and the results aggregated to form a single tourism demand profile. Profiles were developed at the state and regional levels.