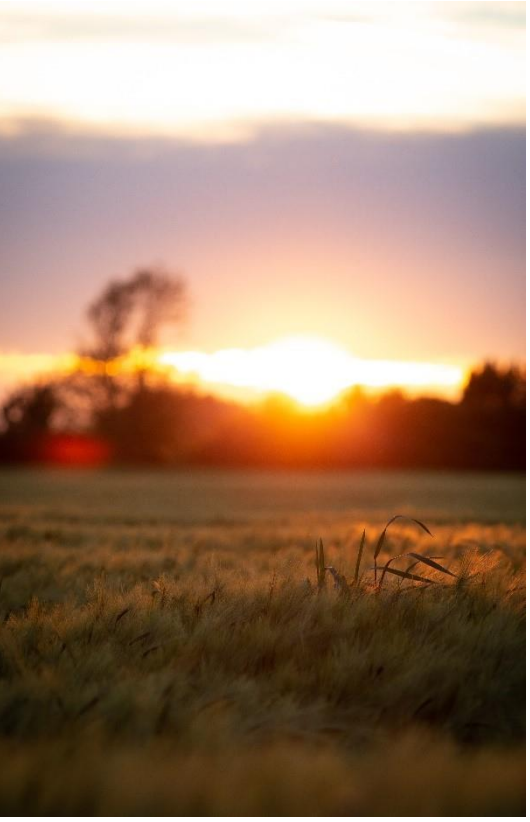





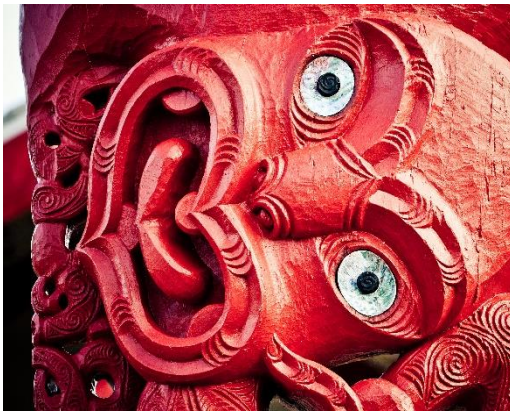

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Making sense of the numbers

Arable Production 2018

Economic impact assessment

Hōngongoi 2019

www.berl.co.nz

Authors: Nick Robertson and Konrad Hurren

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Making sense of the numbers

Agriculture is a significant contributor to the New Zealand economy and arable production is a major part of this. Arable production includes everything that is grown and harvested as a crop. This includes all grains, seeds and other plant such as cereals and maize for silage and seeds of other crops such as fodder crops. Historically grain was the main crop in New Zealand and was a major export good. However, as the livestock industry grew arable production was diverted to feed on farms.

Arable production puts food on the table, both in terms of employment and in terms of the variety of products it is used in the production of. Arable production is a significant input into the livestock and food and drink industries. This is especially true for intensive dairy, poultry and pig meat production.

This report covers arable production in the 2018/19 season and provides a comparison to reports on arable production produced by Business and Economic Research Limited (BERL) in 2011, 2013 and 2015.

104,000 hectares of grain crops were harvested in 2018. Maize grown for silage was almost 42,000 hectares. Just over 33,000 hectares of seed crops were entered for certification in 2018. Total production from this land was 1.72 million tonnes. This is made up of 1.6 million tonnes of grain plus maize grown for silage and 85,000 tonnes of seeds. 780,000 tonnes of grain sold ex the farm. Of this, 210,000 was sold to other farmers, and 570,000 tonnes (63 percent) was sold to industry. All 850,000 tonnes of maize silage was sold to other farmers. Total tonnes of grain ex farm in 2018 was down 12 percent on 2015 levels, maize silage was down 25 percent.

Certified seeds made up the majority of seeds produced in 2018 with 47,000 tonnes. The majority of certified seeds produced were grasses that made up 35,000 tonnes. The share of certified seeds produced in 2018 is far above what it was in 2015.

The value of total direct sales of arable production in 2018 was $781 million. When indirect expenditure by suppliers to the industry and induced expenditure by employees of producers and suppliers is taken into consideration. Arable production supported $2.09 billion of expenditure.

The sales of arable production and the indirect and induced spending the industry generated contributed $863 million to New Zealand's Gross Domestic Product (GDP). Equal to 0.3 percent of national GDP. Arable production was directly responsible for $275 million of this GDP impact.

Despite the total volume of arable production in 2018 falling from 2.1 million tonnes in 2015 to 1.72 million, the GDP contribution of the arable sector has experienced a slight increase on 2015 when it was $755 million. This increase has been on the back of increased prices.

11,310 full time equivalent employees (FTEs) are estimated to be supported by production in the arable sector. Of these 4770 FTEs are working directly in the production of seeds and grains.

New Zealand exported 43,700 tonnes of arable goods with a total value of $214 million in 2018. This is equal to 0.4 percent of New Zealand's total exports by value.

The downstream benefits supported by arable seed production, although not calculated in this report, include benefits from the dairy sector, the meat sector, and brewing of beer. Other downstream industries also continue to benefit from the seeds and grains grown by the arable industry in New Zealand. This includes horticulture, such as market gardening, restaurants, supermarkets, fast food outlets and the exporters of vegetables.

Contents

Tables

Figures

1 Summary

The arable sector grows crops under cultivation to supply to industries that process these crops for use in other industries. This includes preparation of foods for human consumption and livestock feed. Grain crops and seeds make up arable production. Grain crops also include wheat and maize as well as maize grown for silage.

As a nation that is heavily reliant on primary industries, arable production is important to the New Zealand economy. The industry itself is a significant contributor to the national economy.

In 2018 arable production contributed $863 million to the national economy, 0.3 percent of total GDP. This was made up of direct, indirect and induced impacts. Grain production contributed 62 percent ($533 million) of this economic benefit. Seed production made up the remaining 38 percent ($329 million).

In this report comparisons are made to findings for earlier years. Comparisons of figures with earlier years for employment and production tonnage are valid indicators of growth in activity in the sector. However, comparisons of dollar value measures across years (e.g. for gross output and gross domestic product) have not been inflation adjusted and so reflect a combination of changes in activity and changes in prices.

New Zealand exported 43,700 tonnes of arable goods with a total value of $214 million in 2018. This is equal to 0.4 percent of New Zealand's total exports. Exports were dominated by seeds. Ryegrass seeds, clover seeds, and vegetable seeds accounted for over 70 percent of the total volume of seeds exported in 2018. Cereals made up seven percent of export volumes, with the remaining 13 percent made up of other arable exports.

Table 1.1 Summary of arable production economic impacts 2018

		2018			2015	2013
	Tonnes	Total value	With indirect impacts	With total impacts	With total impacts	With total impacts
Gross output ($M)						
Grain production	1,632,500	483	1,021	1,292	1,282	1,816
Seeds	85,400	298	630	798	545	653
Total	**1,717,900**	**781**	**1,652**	**2,089**	**1,827**	**2,469**
GDP ($M)						
Grain production		170	400	533	530	750
Seeds		105	247	329	225	270
Total		**275**	**647**	**863**	**755**	**1,020**
Employment (FTEs)						
Grain production		2,950	5,710	7,000	6,950	9,830
Seeds		1,820	3,530	4,320	2,950	3,540
Total		**4,770**	**9,240**	**11,310**	**9,890**	**13,370**
Arable exports				**2018**	**2015**	
Total ($M)				**214**	**189**	

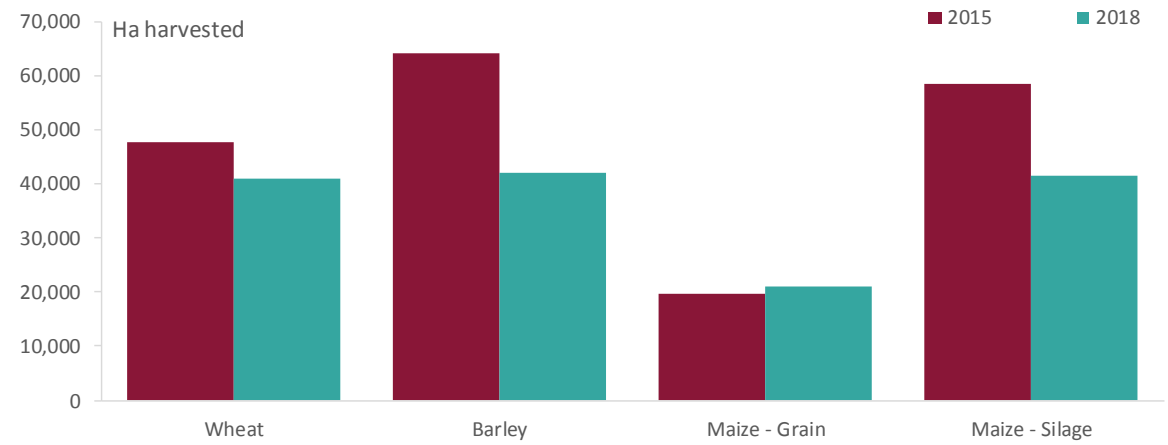
1.1 Grain crops in 2018

1.1.1 Hectares harvested

104,000 hectares of grain crops were harvested in 2018; to this, wheat and barley each contributed around 42,000 hectares, the remainder (21,000 hectares) is accounted for by maize. In 2018, maize grown for silage was also almost 42,000 hectares.

Total grain crop hectares harvested in 2018 were 21 percent lower than in 2015, a year which saw 131,000 hectares of grain harvested.

Figure 1.1 Hectares of grain crops harvested 2015 and 2018



Source: Statistics New Zealand; FAR; BERL calculations

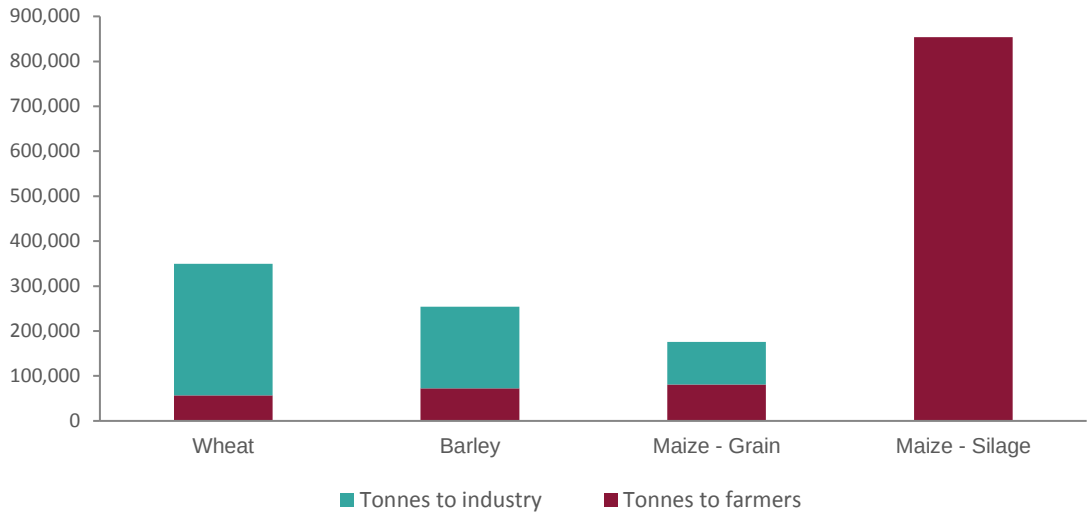
1.1.2 Tonnes ex the farm

In 2018 there were 779,000 tonnes of grain sold ex the farm. Of this, 211,000 (27 percent) was sold to other farmers, and 568,000 tonnes (63 percent) was sold to industry.

All 850,000 tonnes of maize silage was sold to other farmers.

Total tonnes of grain ex farm in 2018 was down 12 percent on 2015 levels, maize silage was down 25 percent.

Figure 1.2 Grain and maize silage sold to farmers and industry 2018

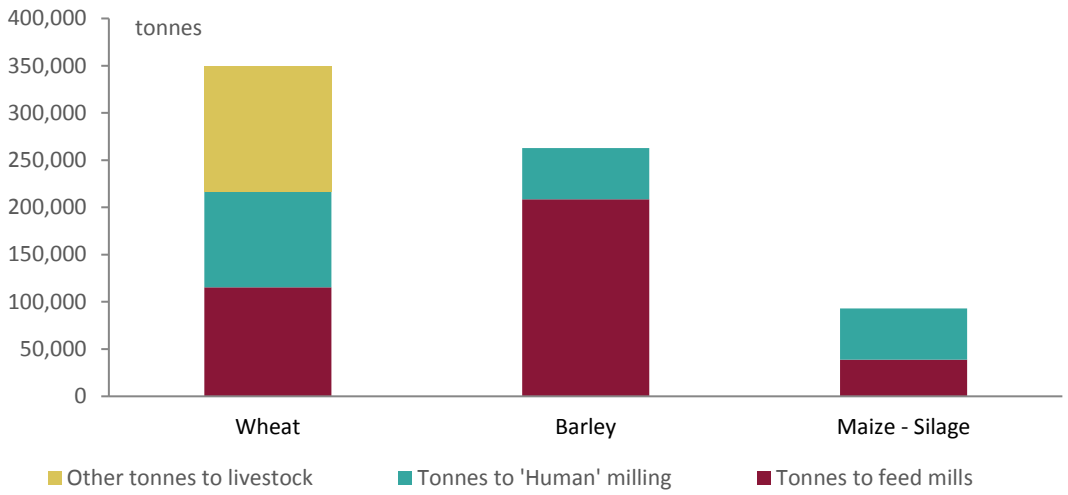


Source: FAR, Arable Industry Marking Initiative (AIMI), BERL calculations

1.1.3 Grain and maize silage flows

In 2018, 612,000 tonnes of wheat and barley was sold. 115,000 tonnes of barley and 209,000 tonnes of wheat went to animal feed mills. 133,000 tonnes of wheat went to livestock. 155,000 tonnes was sold to flour and malt mills to eventually be turned into goods like beer and bread for human consumption. Of this 65 percent was wheat and the remainder barley. 93,000 tonnes of maize grain was sold with almost all going to animal feed mills.

Figure 1.3 Production grain flows 2018

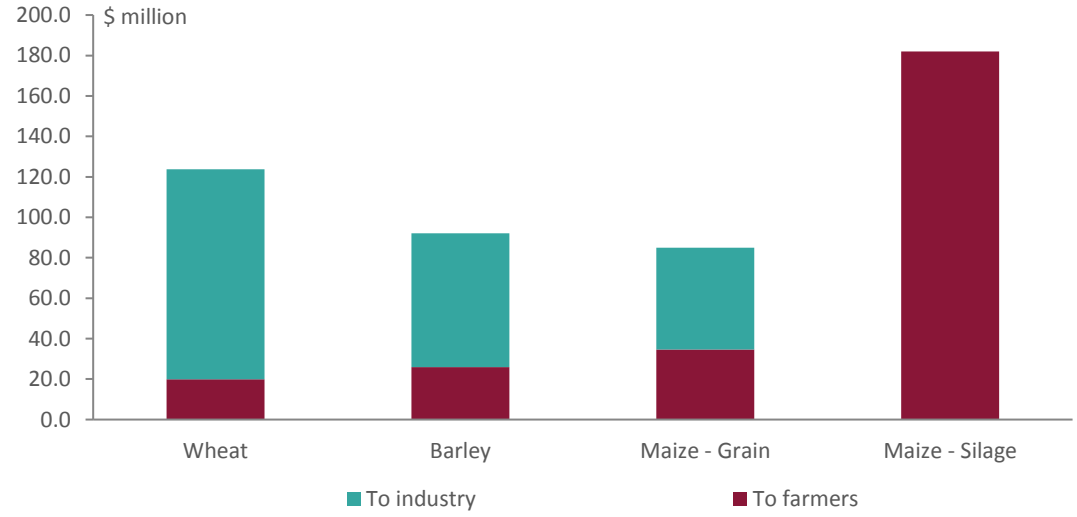


Source: FAR, AIMI, AsureQuality (AQ), FAR, BERL

1.1.4 Value of sales of grain and maize silage

Around $301 million of grain was sold in 2018. Of this, $80 million (27 percent) was sold to farmers and $221 million was sold to industry. Maize silage sales totalled around $182 million, all maize for silage was sold to farmers.

Figure 1.4 Value of grain and maize silage 2018



Source: FAR, various, BERL calculations

1.1.5 Direct and upstream impact of grain and maize silage

The value of grain and maize silage in 2018 of $483 million is multiplied up to $1.29 billion when the indirect impacts on upstream suppliers and associated impacts on household expenditure are taken into account. This is very slightly higher than in 2015 when the total gross value was multiplied to $1.28 billion and is still below levels seen in 2013 ($1.77 billion).

This $483 million direct sales generated $170 million value added in 2018. When we factor in upstream impacts we find that the GDP generated is $533 million.

Around 2950 FTEs were directly employed in grain and maize silage production in 2018. When we factor in the upstream impacts we find that 7000 FTEs were employed as a result of grain production in 2018.

Table 1.2 Direct and upstream economic impact of grains and maize silage 2018

	2018			2015	2013
	Total value	With indirect impacts	With total impacts	With total impacts	With total impacts
Gross output ($M)	483	1,021	1,292	1,282	1,769
GDP ($M)	170	400	533	530	730
Employment (FTEs)	2,950	5,710	7,000	6,950	9,830

1.1.6 Downstream economic impact

BERL believes that the economic impact of the downstream industries in arable production such as brewing, baking and livestock farming are large. Though quantifying these impacts is beyond the scope of this report.

Arable production puts food on the table, both in terms of employment and also in terms of the variety of products arable production is used to produce. Downstream from the employment supported by arable production discussed above there are people employed in producing food for livestock as well as food for humans. This employment sustains communities across New Zealand.

The grains produced by the arable sector are used to produce beer, bread, cakes and biscuits among many other goods we enjoy.

Maize silage produced by the arable sector and grains sold to livestock farmers go in to producing milk, eggs and pork.

We continue to see an increase in the production of niche and specialty products like ancient grain cereals and bread products.

1.2 Seeds in 2018

The arable sector is engaged in two broad activities: production of grains and maize silage, and production of seeds. This latter activity serves two markets: the first is certified seeds, which are ‘certified’ to be purely a single species and are purchased by farmers aiming to multiply the volume for sale to other producers. The second type of seed produced we term ‘production’ seed, it is sold generally as a seed of a single species or cultivar, but may have some seeds of another in it. It is perfectly suitable for general use in production.

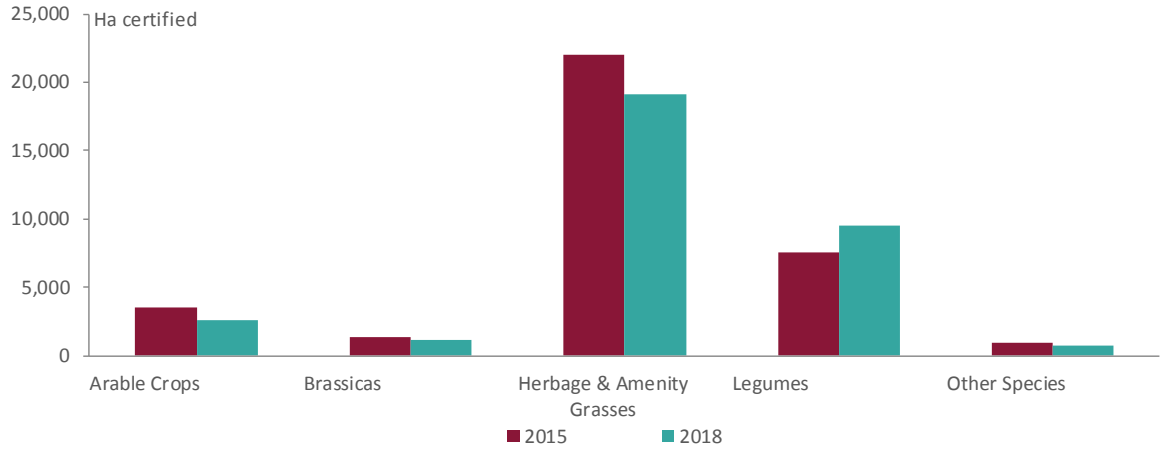
Traditionally the seed sector was all about grasses, in 2018 we see a sector developing a wide variety of seeds for certification and production. This includes sales of $108 million of grasses, but also white clover sales of $41 million and $103 million in sales of other vegetables, increasing amounts of carrot and radish.

1.2.1 Certified seed

Just over 33,000 hectares of seed crops were entered for certification in 2018. 58 percent (19,000 hectares) of this was herbage and amenity grasses. These were composed mostly of perennial (11,000 hectares), Italian (3300 hectares), and hybrid (1900 hectares) ryegrass. However, cocksfoot hectares entered for certification grew to 1200 hectares in 2018 from 600 in 2015.

Overall, the trend is downward for certified seed hectares, from 35,300 hectares in 2015 to 33,100 in 2018.

Figure 1.5 Area entered for certification of seed 2018



Source: AsureQuality; BERL calculations

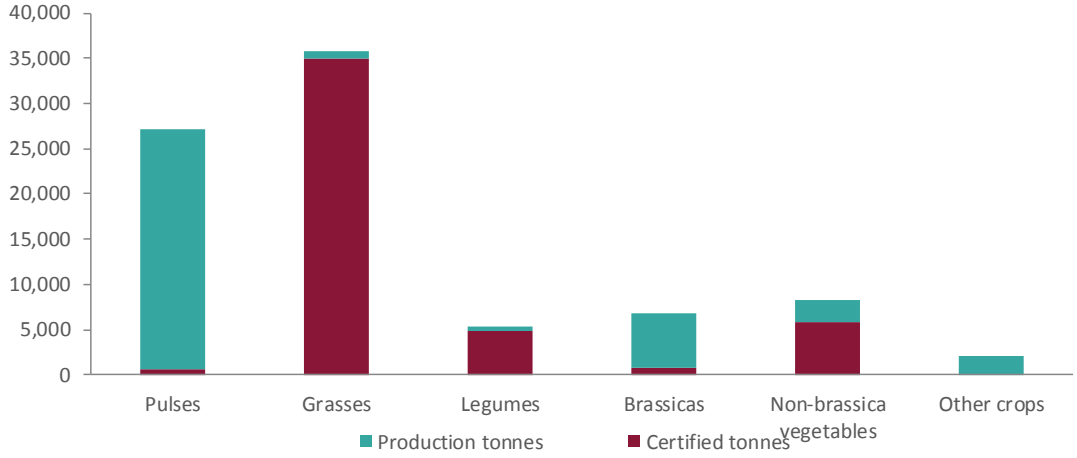
1.2.2 Seed production

In 2018 there were 83,000 tonnes of seed ex farm, down 9.5 percent on 2015 (93,000 tonnes).

Certified seeds made up the majority of seeds produced in 2018; making up 56 percent (47,000 out of the total 83,000). The majority of certified seeds produced were grasses which made up 74 percent (35,000 tonnes).

The share of certified seeds produced in 2018 is far above what it was in 2015 (22 percent). We believe this has been driven by the large increase in certified grass seeds produced.

Figure 1.6 Certified seed and production seed produced 2018

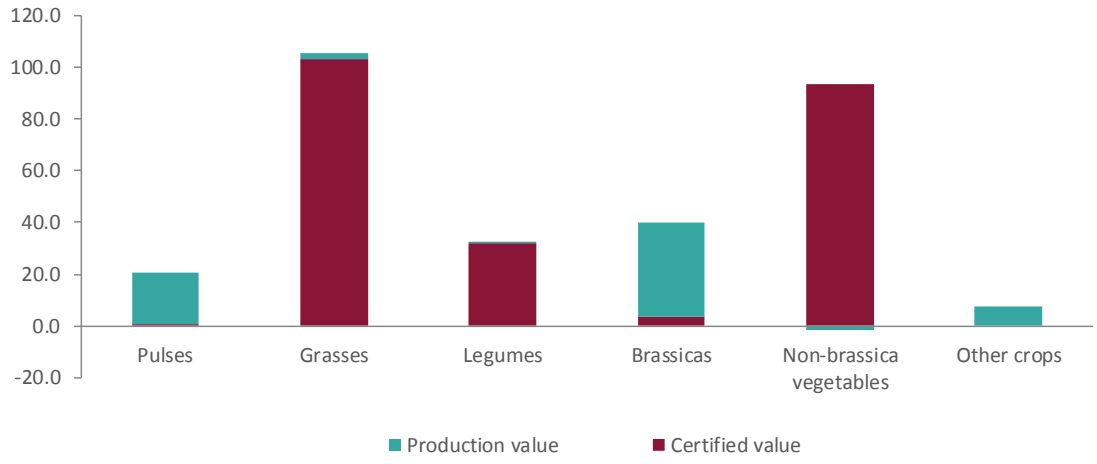


Source: FAR, AsureQuality, Statistics New Zealand, BERL calculations

1.2.3 Value of seed production sales

In total, the value of seed sales in 2018 was $298 million this is an increase of 47 percent on 2015 ($203 million). This was driven by the greater weighting of certified seeds to production seeds. And by the large increase in the (more valuable) non brassica vegetables such as radish and carrot.

Figure 1.7 Value of seed production 2018



Source: FAR, AsureQuality, BERL calculations

1.2.4 Direct and upstream economic impact of seed production

The direct output value of seeds produced in 2018 of $298 million is multiplied up to $798 million when we take into account the upstream effects and increased household expenditure. This is 46 percent higher than in 2015 when it was $545 million.

This $298 million in sales generated $105 million in value added directly. When we take into account the indirect effects this is multiplied to $329 million, a 46 percent increase on $225 million in 2015.

Producing seeds employed 1820 FTEs directly in 2018. When we take into account the indirect employment effects and upstream effects we find that total employment supported by this sector was 4320 FTEs in 2018.

Table 1.3 Direct and upstream impact of seeds production 2018

	2018			2015	2013
	Total Value	With Indirect Impacts	With total impacts	With total impacts	With total impacts
Gross output ($M)	298	630	798	545	653
GDP ($M)	105	247	329	225	270
Employment (FTEs)	1,820	3,530	4,320	2,950	3,540

1.2.5 Downstream economic impact

While we do not quantify the downstream economic impact of seed production in this report we believe that the downstream impact of seed production on the economy is very large.

Firstly, forage brassicas are used as supplementary feed for livestock, an industry contributing $7.1 billion GDP in 2018. This industry supports almost 61,000 FTEs.

Other downstream users of this seed are the horticulture and market garden industries. The benefits of increased seed production then accrue to retailers, exporters and processors of vegetable crops. The consumer comes out on top, gaining the fruits of production of all these industries, including fresh vegetables, milk and meat.

2 Structure and scope

This report has been prepared for the Arable Food Industry Council (AFIC), a Council which combines the interests of a number of groups serving the arable industry. It provides a comprehensive overview of the diverse arable production activities in New Zealand in 2018 and the associated direct and 'upstream' impact to the New Zealand economy.

This report is an update of the *'Economic Impact Assessment of Arable Production'* report that BERL completed for AFIC in 2016. The 2016 BERL report provided an economic assessment of arable production in New Zealand in 2015. Where practical, 2015 (and 2013) levels and estimates are provided for comparative purposes.[1]

2.1 Objective

The objective of this study is to define the core of the arable industry in terms of the arable producers and through to the mills and export. The analysis of this consistent production data set can then estimate the upstream impact of the arable production on the economy through the suppliers of goods and services to the arable producers.

2.2 Scope of the report

In the report the arable production industry is taken to be the industry that grows crops under cultivation to supply to those that process these crops for use in other industries such as livestock production or for human food preparation. There is a range of information available from a number of sources on different parts of the industry, and the data generated by these sources are not always consistent with each other.

Using the definition of arable production, existing data sources are used to estimate the direct and upstream impact of arable production. Upstream impacts captured are those through the supply of goods and services to arable producers. As was the case in the economic analysis that BERL provided AFIC of 2011, 2013, and 2015 arable production, the economic impact of the downstream users of arable products are not included. Downstream industries that rely on arable production are varied and range from beer production and retail (barley) to the fast food industry that uses pork and poultry fed on, for example, wheat. The downstream economic impact of arable production is out of the scope of this report to enable comparability with the earlier economic analysis of 2015 arable production.

BERL notes that it is possible to capture the economic impact of the downstream users of arable products and is keen to work with AFIC on this as we believe the downstream economic impacts of arable production to be large. We believe that this would require research into industry structures of animal feed producers, grain millers and processors and of animal production and human food industries that they supply.

[1] 2013 figures presented in this report may differ from those presented in the BERL (2012) *'Economic Impact Assessment of Arable Production'* report. The 2012 report drew on data from a wide range of sources, many of which have since been revised.

2.3 Source of information used

Key information on various aspects of arable production in New Zealand used in this report is sourced from the following organisations:

- **Statistics New Zealand (Stats NZ)** collects information on a range of aspects of arable production in New Zealand through various surveys and Censuses of agricultural production. Stats NZ have estimates of area and tonnages harvested for main crops. Stats NZ also provide the detailed export information on quantities and values of exports from New Zealand. For seeds the certified and uncertified seed types are recorded separately. This information enables estimates of average export prices per kilogram at FOB for a detailed range of grain and seeds.
- The **Foundation for Arable Research (FAR)** is a levy-funded research organisation. As part of its levy-collection function FAR collects detailed information on the volume of sales and value of all grain and seed. The levy on these values is collected at first point of sale, either to industry, or to another grower. This information on volume and value also enables an estimate of average prices per kilogram or tonne at each point of sale.
- **AsureQuality** is responsible for operating the Seed Certification scheme in New Zealand. They therefore have information for each cultivar of each species on the number of sites entered for seed certification, the total area in hectares, and the weight of certified seed dressed, coming from the sites entered in the scheme. Taken with the total production information from the FAR levy data, this enables separation into certified and uncertified production.
- **Arable Industry Marketing Initiative (AIMI)** collects a range of information on the main grains, including the areas, production, stocks on hand, and marketing channels including feed grains and milling grains.
- The **New Zealand Feed Manufacturing Association (NZFMA)** collects detailed information on use of local product and imports for compound animal feed manufacture in both the North Island and South Island. The NZFMA includes most of the major players in the industry, and so provides an accurate estimate of the volumes of grains going into compound feed manufacture.

Following feedback from the industry and AFIC, we have based our analyses on the levy information from FAR for the 2018 year, and used other sources to estimate volumes and value going to different uses as shown in later sections

2.4 Report structure

This report has two key sections:

- Section 3 provides an outline of arable production in 2018
- Section 4 uses information from Section 3 to estimate the direct and upstream economic impact of 2018 arable production in New Zealand.

3 Arable production in New Zealand

Arable production, by definition is anything that is grown and harvested as a crop. This includes all grains, all seeds and certain other plants which are grown as crops such as fodder crops and high value leafy greens for human consumption.

Historically grain was the main crop in New Zealand. This was used as sustenance for the people living and working in New Zealand and as a source of export revenue to fund the importation of articles unable to be produced here.

In more recent years arable production has been used to supplement livestock. And as at 2018 we see more high value arable production taking place with an emphasis on producing new “ancient grain” cereals and breads, as well as leafy greens for consumers.

3.1 Grain crops

In 2018 there were 104,000 hectares of grain harvested. There was a relatively even spread between barley and wheat hectares harvested. Silage maize accounted for a further 41,000 hectares. The total hectares of grain harvested is down 21 percent on 2015s 132,000 hectares harvested.

The 104,000 hectares harvested in 2018 produced 971,000 tonnes of grain. Compared to 2015 when there was 1.08 million tonnes of grain, 2018 production is down 10 percent.

In 2018 we calculate that each hectare yielded nine tonnes of grain. In 2015 the yield per hectare was eight tonnes of grain harvested per hectare. The average yield of grain per hectare figure’s increase is partially explained by fewer hectares of barley (which has the lowest yield of grains in our data) being harvested in 2018.

Table 3.1 Hectares and tonnes of arable grains and maize silage produced 2013, 2015 and 2018

	Hectares			Tonnes harvested			Tonnes ex farm		
	2013	2015	2018	2013	2015	2018	2013	2015	2018
Wheat	**47,200**	**47,700**	**41,100**	**440,100**	**413,500**	**405,200**	**448,200**	**355,400**	**349,600**
Milling	0	0	0	0	0	0	120,800	93,300	100,900
Feed	0	0	0	0	0	0	327,400	262,100	248,700
Barley	**58,700**	**64,200**	**42,000**	**407,900**	**437,100**	**297,600**	**353,200**	**302,200**	**253,800**
Malting	0	0	0	0	0	**0**	49,800	42,900	45,200
Feed	0	0	0	0	0	0	303,400	259,300	208,600
Oats	**5,600**	**0**	**0**	**30,700**	**0**	**0**	**24,600**	**0**	**0**
Maize	**72,900**	**78,300**	**62,400**	**1,408,100**	**0**	**0**	**0**	**0**	**0**
Grain	18,100	19,800	21,000	201,600	226,300	268,500	201,600	226,300	175,600
Silage	54,800	58,500	41,400	1,206,500	1,141,700	853,600	1,206,500	1,141,700	853,600
Other cereal grains	**1,400**	**0**	**0**	**8,800**	**0**	**0**	**14,500**	**0**	**0**
Total grains & silage	**185,800**	**190,200**	**145,500**	**2,295,600**	**2,218,600**	**1,824,900**	**2,248,500**	**2,025,600**	**1,632,500**

Source: Statistics New Zealand; FAR; AIMI; BERL calculations

3.1.1 Utilisation of grain crops

As with previous analyses in 2011, 2013 and 2015 we have found that a significant step change occurred in the structure of grain traded from arable farmers to farmers using grain as animal feed. In this current analysis we update our findings for 2018.

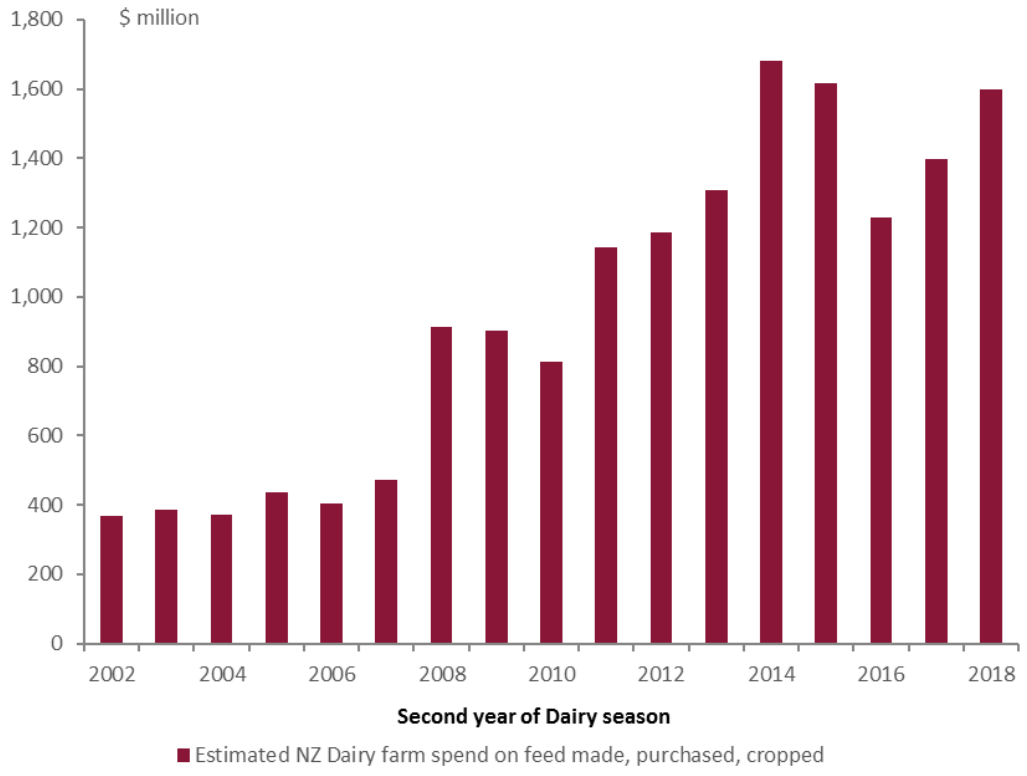
3.1.2 Changing structure of grain flows

As in our 2016 analysis and report, we employ data from *DairyNZ Economic Survey* and *New Zealand Dairy Statistics* to estimate how much was spent by dairy farmers on feed in New Zealand.

We found that in the seasons after 2008 dairy farmers began to spend much more on feed. This has continued to grow up until a peak in 2014 of $1,681 million. The spend on grain for feed by dairy farmers has remained high ever since and in 2018 we estimate that it was $1,598 million in total.

This data provides further evidence confirming our hypothesis of a structural shift in the arable and feed industries.

Figure 3.1 Estimated spending on feed in New Zealand dairy farms 2001-2018



Source: DairyNZ, LIC, BERL Estimates

We have been able to source data on grain flows from arable farmers to other farmers in the FAR levy data separate from grain sold to industry. This means we can calculate grain sold for animal feed and grain sold for further processing for human or animal consumption.

In Table 3.2 we summarise the available data and calculate the flows of grain to industry and to farmers. We found that of the 175,600 tonnes of maize grain sold 46 percent (81,100 tonnes) was sold to farmers and the remaining 54 percent (94,500 tonnes) was sold to industry.

In total, the proportion of all grain and maize silage sold to farmers has decreased to 65 percent (from 68 percent in 2015) and the proportion to industry has increased to 35 percent (from 32 percent in 2015).

Table 3.2 Grain and maize silage sold to farmers and industry 2015 and 2018

	Tonnes ex farm			Tonnes to farmers			Tonnes to industry		
	2013	2015	2018	2013	2015	2018	2013	2015	2018
Wheat	448,200	355,400	349,600	56,100	63,100	57,000	392,100	292,300	292,500
Milling	120,800	93,300	100,900	600	100	1,200	120,200	93,200	99,700
Feed	327,400	262,100	248,700	55,500	63,000	55,900	271,900	199,100	192,800
Barley	353,200	302,200	253,800	76,100	81,800	72,500	277,100	220,400	181,200
Malting	49,800	42,900	45,200	400	200	0	49,400	42,700	45,200
Feed	303,400	259,300	208,600	75,700	81,500	72,500	227,600	177,700	136,100
Maize Grain	201,600	226,300	175,600	139,400	88,700	81,100	62,200	137,600	94,500
Maize Silage	1,206,500	1,141,700	853,600	1,206,500	1,141,700	853,600	0	0	0
Total grains and silage	**2,248,500**	**2,025,600**	**1,632,500**	**1,482,300**	**1,377,800**	**1,066,400**	**766,300**	**647,700**	**566,100**

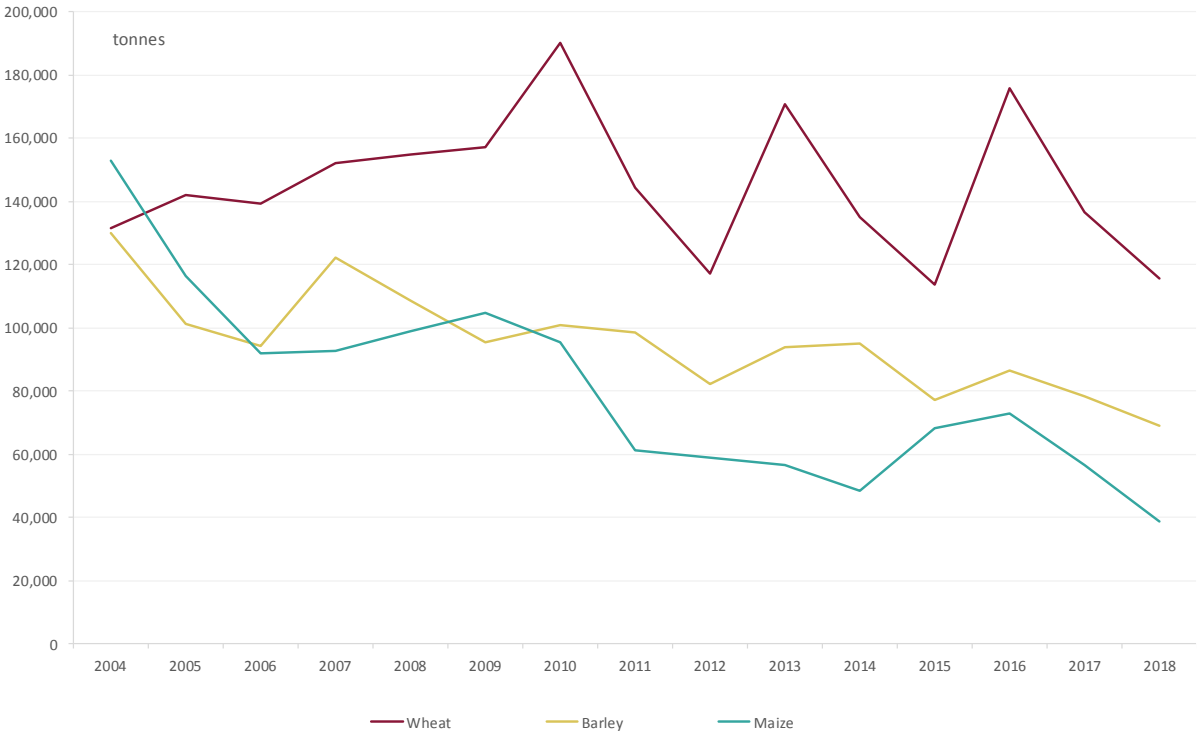
Source: FAR; AIMI; BERL calculations

3.1.3 Use of grains in feed and food mills

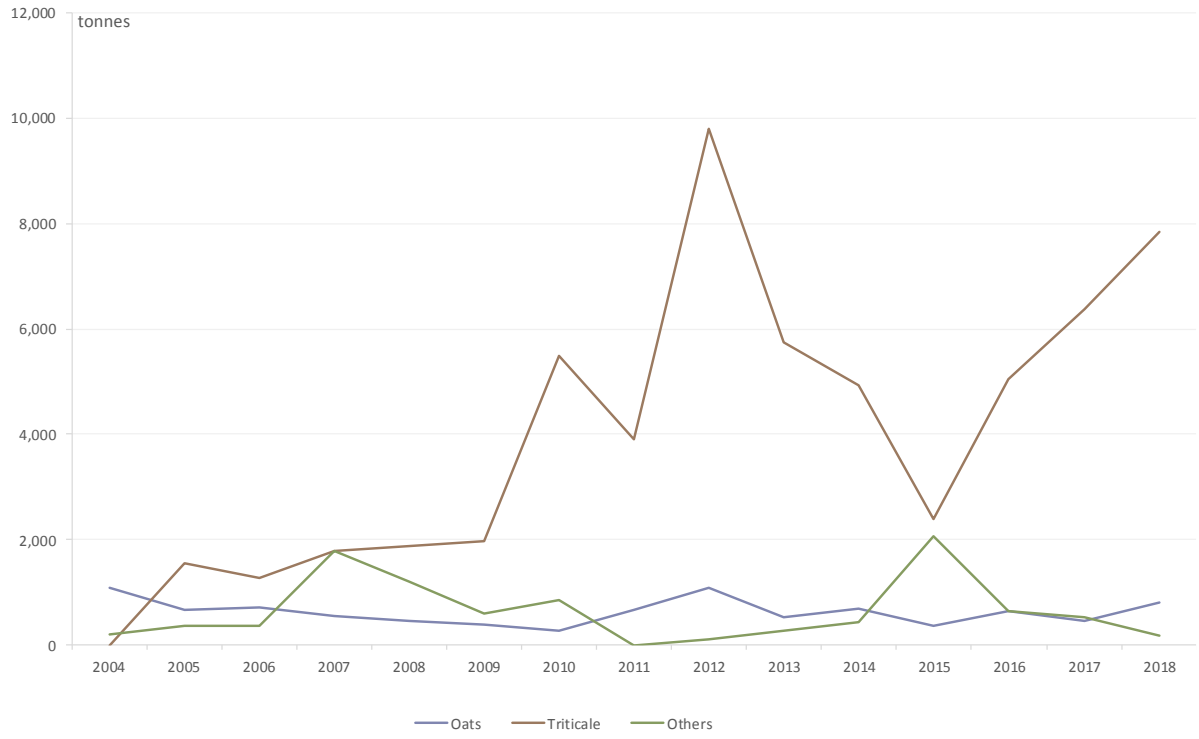
Next we needed to adjust the figures for the certified seed grains not going to milling. To do so we deducted the certified seed tonnes data provided by AsureQuality from the tonnes provided to industry. This results in an estimate of 'production tonnes' of grains that go to milling.

Below, in Figure 3.2 we summarise NZFMA data on grains that are sent to feed mills. We observe a decline in barley and maize for feed milling while wheat continues to display an alternating pattern. Triticale which is a hybrid of wheat and rye appears to be trending up in use as a milled feed grain.

Figure 3.2 NZFMA usage of grains for feed 2004 to 2018



Source: NZFMA; BERL calculations



Source: NZFMA; BERL calculations

Finally we deduct the detailed information from the NZFMA on the tonnes of production grains that go to feed milling to estimate tonnes of production that go to human milling (for flour and malt mainly).

We summarise the results of this process in Table 3.3

We found that of the 696,000 production tonnes of grain produced in 2018, 428,000 (61 percent) went to animal feed mills and the remaining 268,000 (39 percent) went to flour and malt mills and other uses.

Table 3.3 Grain and maize silage flows to farms and mills 2013, 2015 and 2018

	Tonnes ex farm			Tonnes to farmers			Tonnes to industry		
	2013	2015	2018	2013	2015	2018	2013	2015	2018
Wheat	**448,200**	**355,400**	**349,600**	**56,100**	**63,100**	**57,000**	**392,100**	**292,300**	**292,500**
Milling	120,800	93,300	100,900	600	100	1,200	120,200	93,200	99,700
Feed	327,400	262,100	248,700	55,500	63,000	55,900	271,900	199,100	192,800
Barley	**353,200**	**302,200**	**253,800**	**76,100**	**81,800**	**72,500**	**277,100**	**220,400**	**181,200**
Malting	49,800	42,900	45,200	400	200	0	49,400	42,700	45,200
Feed	303,400	259,300	208,600	75,700	81,500	72,500	227,600	177,700	136,100
Maize	**1,408,100**	**1,368,000**	**1,029,200**						**94,500**
Grain	201,600	226,300	175,600	139,400	88,700	81,100	62,200	137,600	94,500
Silage	1,206,500	1,141,700	853,600	1,206,500	1,141,700	853,600			0
Total grains and silage	**2,209,500**	**2,064,600**	**1,632,500**	**1,482,300**	**1,377,800**	**1,066,400**	**766,300**	**664,000**	**567,600**

Table 3.3 continued

	Certified tonnes			Uncertified tonnes			Tonnes to feed mill			Tonnes to 'Human' milling			Other tonnes to livestock	
	2013	2015	2018	2013	2015	2018	2013	2015	2018	2013	2015	2018	2015	2018
Wheat	**3,000**	**2,700**	**4,300**	**389,100**	**292,300**	**349,600**	**170,700**	**113,500**	**115,500**	**130,000**	**100,000**	**100,900**	**78,800**	**133,200**
Milling														
Feed														
Barley	**5,000**	**5,200**	**6,600**	**272,000**	**220,400**	**253,800**	**93,700**	**77,000**	**208,600**	**178,300**	**215,200**	**54,100**		
Malting														
Feed														
Maize														
Grain	200	0	1,600	62,000	137,600	92,900	56,600	68,100	38,800	5,400	69,500	54,100		
Silage														
Total grains and silage	**10,600**	**7,900**	**12,500**	**757,300**	**549,600**	**696,300**	**327,600**	**258,500**	**362,900**	**341,300**	**384,700**	**209,100**	**78,800**	**133,200**

Source: FAR; AIMI; NZFMA; AsureQuality; BERL calculations

3.1.4 Value of grains and maize silage

Having summarised the general flow of grains and maize silage from New Zealand farms we can estimate their value at first point of sale; that is at sale to other farmers or to industry. Price data comes from FAR levy information.

We found that sales of grain and maize silage totalled $483 million in 2018. This is composed of $262 million to farmers, and $220 million to industry. This is 22 percent down on 2015.

Table 3.4 Value of sales of grain and maize silage 2015 and 2018

	2018				2015	2013
	Price Weighted average ($/tonne)	Sales ($Million)		Total Sales ($Million)	Total Sales ($Million)	Total Sales ($Million)
		To farmers	To industry			
Wheat						
Milling	369	0	37	37	41	51
Feed	347	19	67	86	104	125
Barley						
Malting	393	0	18	18	19	22
Feed	356	26	48	74	101	113
Maize						
Grain	484	35	50	85	111	93
Silage	213	182	0	182	243	257
Total grains and silage	**0**	**262**	**220**	**483**	**620**	**661**

Source: FAR; various; BERL estimates

3.2 Seeds crops

The arable sector in New Zealand grows crops for final production and also with the intention to produce seed.

The variety of seeds grown commercially in New Zealand is surprising. We count 44 different species in the official data. These include traditional species like grasses and legumes that are mostly used as fodder, as well as higher value vegetable seeds such as radish or carrot.

We define certified and production seed as follows for the remainder of the report:

- **Certified seed**: seed is grown so that it is certified to be only of the species and cultivar designated. The process of certification is administered and operated by AsureQuality, a 100 percent government-owned commercial entity, related to the Ministry of Primary Industries.

- **Production seed**: seed grown is harvested from crops which may or may not contain some seeds from other cultivars, but is nevertheless perfectly suitable for general use in production.

3.2.1 Scope of seed certification in New Zealand

AsureQuality is a commercial entity owned and operated by the New Zealand government, it operates a seed certification service and handles at least 44 species of seed.

We summarise the data on hectares of certified seed entered into certification in 2013, 2015, and 2018 in Table 3.5.

In total, 33,000 hectares were entered for certification. This is down again on the 37,000 hectares entered in 2013.

Table 3.5 Area entered for certification of seed 2013, 2015, and 2018

Species	Hectares			Species	Hectares		
	2013	2015	2018		2013	2015	2018
Arable Crops				**Herbage & Amenity Grasses**			
Barley	1,120	1,110	990	Brome Grass	30	20	30
Linseed	60	60	130	Browntop	510	680	360
Maize	1,230	1,120	430	Cocksfoot	690	580	1,230
Oat	410	430	340	Crested Dogstail	60	70	40
Pea	40	100	100	Grazing Brome	30	10	40
Ryecorn	30	20	20	Festulolium spp	870	1,150	650
Triticale	70	40	110	Hybrid Ryegrass	3,130	2,770	1,870
Wheat	670	630	480	Italian Ryegrass	3,790	3,990	3,280
Sub-total	**3,620**	**3,510**	**2,600**	Perennial Ryegrass	14,250	12,060	10,560
Brassicas				Phalaris	10	0	0
Rape	940	630	410	Prairie Grass	60	50	140
Kale	410	450	350	Red Fescue	0	0	30
Turnip	190	180	340	Tall Fescue	750	650	720
Swede	30	50	70	Timothy	0	0	40
Sub-total	**1,570**	**1,300**	**1,170**	Upland Brome	0	30	90
Other Species				x Festulolium spp	300	10	20
Chicory	160	180	250	**Sub-total**	**24,470**	**22,070**	**19,090**
Fodder Radish	310	0	80	**Legumes**			
Phacelia	0	420	0	Lotus	10	10	50
Plantain	220	310	450	Lucerne	200	230	200
White Mustard	0	0	0	Red Clover	400	670	1,330
Sub-total	**690**	**900**	**770**	White Clover	6,280	6,620	7,880
				Sub-total	**6,890**	**7,530**	**9,470**
				TOTAL ALL SPECIES	**37,240**	**35,310**	**33,110**

Source: AssureQuality; BERL calculations

3.2.2 Certified and production seeds produced

By combining data from FAR, AsureQuality and Statistics New Zealand we can calculate the amount of certified seed and tonnes of production seed produced. Table 3.7 summarises tonnes of seeds ex the farm sourced from FAR levy data and Statistics New Zealand export data. The amount of certified seeds is sourced from AsureQuality and Statistics New Zealand export data.

The difference between the two gives us an estimate of the amount of production seeds produced.

Overall seed production (ex farm) is down to 85,400 tonnes (from nearly 93,000 tonnes in 2015). This small decrease is accounted for by a large increase in certified seeds, and a large decrease in production seeds.

Certified seed production is up to 47,000 tonnes in 2018 (up from 20,000 in 2015), most of this is grasses at 74 percent (35,000 tonnes). While production seeds (which is the ex farm figure net of certified seeds) are down to 38,000 tonnes from 70,000 tonnes in 2015.

Table 3.6 Certified and production seed 2013, 2015, and 2018

	Tonnes ex farm			Certified tonnes			Production tonnes		
	2013	2015	2018	2013	2015	2018	2013	2015	2018
Beans	2,430	320	550	0	0	0	2,430	320	550
Peas	22,970	27,970	22,410	10	210	310	22,960	27,770	22,100
Linseed	3,190	2,940	3,940	70	70	330	3,120	2,870	3,610
Other pulses	480	120	230	0	0	0	480	120	230
Pulses	**29,080**	**31,360**	**27,130**	**80**	**280**	**640**	**29,000**	**31,070**	**26,490**
Cocksfoot	620	550	1,110	280	400	1,070	340	150	40
Fescue	570	370	770	560	210	1,240	10	170	-480
Ryegrasses	34,920	30,800	32,910	29,930	14,160	32,620	5,000	16,650	290
Other grass	3,150	660	1,060	0	0	0	3,150	660	1,060
Grasses	**39,260**	**32,390**	**35,840**	**30,770**	**14,770**	**34,940**	**8,500**	**17,620**	**910**
White clover	4,840	3,670	4,220	2,900	2,640	4,630	1,940	1,030	-400
Red clover	250	300	430	110	130	190	150	170	250
Other legumes	970	90	620	30	30	50	940	60	570
Legumes	**6,070**	**4,060**	**5,280**	**3,030**	**2,800**	**4,870**	**3,030**	**1,260**	**410**
Rape	5,830	15,140	1,290	1,200	0	0	4,630	15,140	1,290
Kale	760	780	660	80	70	100	680	710	550
Turnip	390	350	530	50	450	620	340	-90	-90
Swede	50	220	60	50	0	20	0	220	30
Cabbage (Ethiopian)	830	810	1,310	10	0	60	820	810	1,250
Cabbage			290			0			290
Other forage brassica			300			0			300
Asian Brassicas			2,430			0			2,430
Brassicas	**7,863**	**17,316**	**6,860**	**1,390**	**520**	**810**	**6,480**	**16,790**	**6,050**
Beet	130	0	910	0	0	550	130	0	360
Carrots	660	280	650	40	20	650	620	250	0
Radish	3,060	3,890	2,180	250	960	3,750	2,810	2,930	-1,560
Plantain	350	730	910	350	730	910	0	0	0
Other vegetables	2,500	2,750	3,000	0	0	0	2,500	2,750	3,000
Spinach	0	0	610			0			610
Non-brassica vegetables	**6,690**	**7,650**	**8,280**	**630**	**1,720**	**5,860**	**3,560**	**3,180**	**2,410**
Other crops			**2,000**			**0**			**2,000**
Total Seeds	**88,959**	**92,765**	**85,400**	**35,900**	**20,090**	**47,120**	**50,560**	**69,930**	**38,280**

Source: FAR; AsureQuality; Statistics New Zealand; BERL calculations

3.2.3 Value of seeds

In 2018 the total value of seeds sold was $298 million. This is a 46 percent increase on 2015. This sector is an exciting part of the industry. We can see in the data that grasses and legume sales have increased markedly, we suspect this reflects more use in fodder.

We also found that the total sales of non-brassica vegetables (which are mostly used for human consumption) have increased from $57 million in 2015 to $92 million in 2018.

Table 3.7 Value of seed production 2015 and 2018

	Price		Sales		Total Sales 2018	Total Sales 2015	Total Sales 2013
	Uncertified	Certified	Uncertified	Certified			
	$/tonne		$Million			$Million	
Beans	540	0	0	0	0	0	1
Peas	710	1,350	16	0	16	23	16
Linseed	1,020	1,170	4	0	4	3	3
Other pulses	1,170	0	0	0	0	0	1
Total pulses			**20**	**1**	**21**	**26**	**21**
Cocksfoot	4,350	4,760	0	5	5	2	3
Fescue	4,040	5,170	-2	6	4	2	1
Ryegrasses	1,930	2,820	1	92	92	70	92
Other grass	3,110	3,980	3	0	3	3	10
Total grasses			**2**	**103**	**106**	**78**	**106**
White clover	5,350	6,600	-2	31	28	22	28
Red clover	6,820	7,700	2	1	3	2	2
Other legumes	1,170	5,290	1	0	1	1	3
Total legumes			**0**	**32**	**32**	**25**	**33**
Rape	2,520	na	3	na	3	6	8
Kale	3,820	6,590	2	1	3	4	4
Turnip	2,400	4,030	0	3	2	2	1
Swede	2,660	4,490	0	0	0	1	0
Cabbage (Ethiopian)	5,930	5,930	7	0	8	5	4
Total brassicas			**36**	**4**	**40**	**17**	**18**
Beet	6,390	0	2	0	2	0	1
Carrots	10,820	53,080	0	35	35	15	28
Radish	2,630	10,440	-4	39	35	26	28
Plantain	0	21,750	0	20	20	16	10
Other vegetables	1,100	0	3	0	3	3	3
Non-brassica vegetables			**-2**	**94**	**92**	**57**	**66**
Other crops	3,700		7	0	7		
Total Seeds			**64**	**234**	**298**	**204**	**244**

Source: FAR, Export FOB, and BERL Estimate

3.3 Arable exports

In 2018, New Zealand exported 43,700 tonnes of arable goods with a total value of $214 million. This is equal to 0.4 percent of the total value of New Zealand's goods exports in 2018.

This is a 2300 tonne increase (six percent) on 2015 when 41,400 tonnes of arable goods was exported. The value of exports also increased by $25 million (13 percent) from $189 million in 2015. The average value per tonne of arable good exported was $4890.

The highest volume of exports was ryegrass seed where 20,900 tonnes exported in 2018. Exports of ryegrass seed increased by 20 percent from 2015. The 3500 tonne increase was also the largest volume increase from 2015 across the five arable categories. The value of these exports was $54 million.

'Other arable' had the largest proportional increase in volume between 2015 and 2018. The volume of 'other arable' increased 52 percent (3300 tonnes). Other arable are the arable products that are not captured in the other four categories. Other arable includes exports such as kale seeds (3200 tonnes), oil seeds (1900 tonnes) and fescue seeds (940 tonnes).

Although the volume of vegetable seeds fell 24 percent from 2015 vegetable seed exports had the highest value per tonne and the highest value of exports. Exports of vegetable seeds were valued at $73 million in 2018. This was an increase of $2 million from 2015. The average value per tonne of vegetable seeds was $11,390 in 2018. This is a $3040 per tonne increase form 2015.

Cereals was the only category that had a fall in export volume and value. The total volume of cereal exports fell 46 percent from 2015 to 3200 tonnes. Despite a 72 percent increase in the price per tonne of cereal to $5940, the total value of cereal exports fell by $1 million from 2015.

Table 3.8 Arable export volumes and revenue 2018 and 2015

	2018		2015	
	Tonnes	Total Value ($Millions)	Tonnes	Total Value ($Millions)
Cereals	3,200	19	5,900	20
Clover Seeds	3,300	22	3,000	19
Other Arable	9,800	45	6,500	33
Ryegrass Seeds	20,900	54	17,500	45
Vegetable Seeds	6,400	73	8,500	71
Total	**43,700**	**214**	**41,400**	**189**

Source: Stats NZ

4 Economic impact of arable production

This section estimates the economic impact of arable production in New Zealand. To estimate the economic impact of arable production, the impact of the industry's gross output, the value added or GDP component and employment is calculated using multiplier analysis. The arable industry's output generates three impact effects:

- Direct – initial spending (i.e. from the sales of seeds and grains)
- Indirect – the additional inter-industry spending as a result of the direct impact
- Induced – the impact of additional household expenditure resulting from the direct and indirect impact.

The multipliers capture the impact upstream through the economy, of the output produced by the arable sector. As discussed earlier, this multiplier analysis does not capture the impact of downstream arable production on the downstream impact of arable production to the New Zealand economy.

In this section we make comparisons to findings for earlier years. Comparisons of figures with earlier years for employment and production tonnage are valid indicators of growth in activity in the sector. However, comparisons of dollar value measures across years (e.g. for gross output and GDP) have not been inflation adjusted and so reflect a combination of changes in activity and changes in prices.

4.1 Economic impact of grain and maize silage production

To estimate the economic impact of the grain and maize silage, we take the value of sales as estimated in Section 3, and use multiplier analysis to find the indirect and total impacts from the suppliers to the arable production industry. A component of this gross output is the value added, and value added from each industry goes to make up New Zealand's GDP.

4.1.1 Gross output

The gross output of an industry is the value of sales. The gross output of grain and maize silage was $483 million in 2018. This is a 0.8 percent increase from $479 million in 2015.

Table 4.1 Gross output multipliers for grain production 2018

		2018			2015	2013
	Tonnes	Total Value ($Millions)	With Indirect Impacts	With total impacts	With total impacts	With total impacts
Wheat	**349,600**					
Milling	100,900	37	79	100	109	137
Feed	248,700	86	183	231	211	335
Barley	**253,800**					
Malting	45,200	18	38	48	52	59
Feed	208,600	74	157	199	204	303
Maize	**1,029,200**					
Grain	175,600	85	180	227	95	248
Silage	853,600	182	385	487	611	688
Total grains and silage	**1,632,500**	**483**	**1,021**	**1,292**	**1,282**	**1,769**

Total gross grains and silage produced was down 393 tonnes from 2015. The total value of all arable products with the exception of maize grain were down from 2015 levels. The total values of maize grain almost doubled from 2015. Reduced supply appears to have driven up the price for this product.

When the indirect and induced impacts are included the $483 million of direct impact increases to $1.29 billion of total output generated by arable production. Indirect and induced impacts occuer as a result of the increased output of suppliers and expenditure by households of those working directly in the sector or for suppliers to the sector.

This outcome is very similar to the levels seen in 2015 and is still below the total impact in 2013 that was $1.77 billion.

4.1.2 Gross domestic product (GDP)

GDP is the total of value added to a product in the New Zealand economy. This is obtained as the proportion of value added for each $1 of sales of grains, obtained from industry analyses.

The $483 million of grain and maize silage sales in 2018 generated $170 million of value added. This represents a 1.2 percent increase on 2015. This is an improvement but the impact still falls short of the 2013 results. When total impacts are factored in, the total GDP generated for the New Zealand economy was $534 million.

Table 4.2 GDP multipliers for grain production 2018

		2018			2015	2013
	Tonnes	Total Value ($Millions)	With Indirect Impacts	With total impacts	With total impacts	With total impacts
Wheat	**349,600**					
Milling	100,900	13	31	41	45	56
Feed	248,700	30	72	95	87	138
Barley	**253,800**					
Malting	45,200	6	15	20	21	24
Feed	208,600	26	62	82	84	125
Maize	**1,029,200**					
Grain	175,600	30	70	94	39	102
Silage	853,600	64	151	201	252	284
Total grains and silage	**1,632,500**	**170**	**400**	**533**	**530**	**730**

4.1.3 Employment

Employment is the third economic impact that is generated by the arable industry. This includes the direct employment of those working in the industry as well as those employed indirectly by suppliers and the employment induced by the spending by those employed in the sector and the sectors suppliers. This employment is measured in full time equivalent employees (FTEs). We have not completed a survey of employment across the diverse arable production industry. As a result we have used the national coefficients from the relevant section of the overall agricultural sector to estimate the employment in the arable industry. These coefficients provide the employment estimates based on the sales and GDP estimates above for production in 2018.

Table 4.3 Employment multipliers for grain production 2018

		2018			2015	2013
	Tonnes	FTEs	With Indirect Impacts	With total impacts	With total impacts	With total impacts
Wheat	**349,600**					
Milling	100,900	230	440	540	590	740
Feed	248,700	530	1,020	1,250	1,140	1,810
Barley	**253,800**					
Malting	45,200	110	210	260	280	320
Feed	208,600	450	880	1,080	1,110	1,640
Maize	**1,029,200**					
Grain	175,600	520	1,010	1,230	510	1,340
Silage	853,600	1,110	2,150	2,640	3,310	3,730
Total grains and silage	**1,632,500**	**2,950**	**5,710**	**7,000**	**6,950**	**9,830**

Because the total value of sales in 2018 was only slightly above that in 2015 total employment in grain and maize silage was estimated to be 2950 FTEs which is a small increase from 2930 in 2015.

When the employment created by suppliers to the industry and the employment induced from the increased spending is included the total number of FTEs supported by grain and maize silage production is estimated to be 7000.

In summary, the total economic impact of grain production is estimated to be:

- Gross output: $1.29 billion
- GDP: $533 million
- Employment: 7000 FTEs.

4.2 Economic impact of seeds

As we did with grain and maize silage to estimate the economic impact of seeds, we take the value of sales as estimated in Section 3, and use multiplier analysis to find the upstream indirect and total impacts from the suppliers to the arable production industry.

4.2.1 Gross output

The gross output of seeds based on the total sales value in 2018 was estimated at $298 million. This is a $94 million increase on 2015 gross output (which was $204 million). The growth in gross output has occurred because of an increase in the price of seeds, and greater production of higher value non

brassica vegetable seeds. The total volume of seeds produced in 2018 fell to 85,398 tonnes from 92,765 tonnes in 2015.

Table 4.4 Gross output multipliers for seeds production 2018

		2018			2015	2013
	Tonnes	Total Value ($Millions)	With Indirect Impacts	With total impacts	With total impacts	With total impacts
Pulses	27,100	21	44	56	70	56
Grasses	35,800	106	223	282	208	284
Legumes	5,300	32	69	87	68	87
Brassicas	6,900	40	84	107	45	48
Non-brassica vegetables	8,300	92	194	246	153	177
Other crops	2,000	7	16	20		
Total Seeds	**85,400**	**298**	**630**	**798**	**545**	**653**

With the indirect impact on sales of suppliers to seeds production, gross output of seeds in 2018 increases to $630 million, and the total impacts are $798 million when including the induced impacts. The total gross output impact of seeds in 2018 was 46 percent higher than the total gross output impact of $545 million in 2015, and 22 percent higher than the $653 million impact in 2013.

The increase from 2015 has been caused by increasing prices for seeds. With the exception of grasses and non-brassica vegetables the total output value for all seeds increased while volumes fell. Grasses and non-brassica vegetables both had increases in volumes and increase in total value. This flowed through to the total impacts for these seeds.

4.2.2 Gross domestic product (GDP)

On a similar basis as for the grain estimate, the direct sales of $298 million of seeds in 2018 generated a value added of $105 million. Taking into account the total impacts, the seeds industry made a contribution of $329 million to New Zealand's GDP in 2018. This was up from $225 million in 2015, but down from $270 million in 2013.

Table 4.5 GDP multipliers for seeds production 2018

	2018				2015	2013
	Tonnes	Total Value ($Millions)	With Indirect Impacts	With total impacts	With total impacts	With total impacts
Pulses	27,100	7	17	23	29	23
Grasses	35,800	37	87	117	86	117
Legumes	5,300	11	27	36	28	36
Brassicas	6,900	14	33	44	19	20
Non-brassica vegetables	8,300	32	76	102	63	73
Other crops	2,000	3	6	8		
Total Seeds	**85,400**	**105**	**247**	**329**	**225**	**270**

4.2.3 Employment

As with grains and maize silage employment in seeds is estimated from coefficients for the relevant part of the agricultural industry. This indicates that in 2018, seeds led to the direct employment of around 1820 FTEs, and generated total employment of 4320 FTEs. In 2015, around 2950 FTEs were generated by seeds. The 2018 employment estimate is over 780 FTEs greater than the 2013 employment generated by seeds.

Table 4.6 Employment multipliers for seeds production 2018

	2018				2015	2013
	Tonnes	Total FTEs	With Indirect Impacts	With total impacts	With total impacts	With total impacts
Pulses	27,100	130	250	300	380	300
Grasses	35,800	640	1,250	1,530	1,130	1,540
Legumes	5,300	200	380	470	370	470
Brassicas	6,900	240	470	580	250	260
Non-brassica vegetables	8,300	560	1,090	1,330	830	960
Other crops	2,000	50	90	110		
Total Seeds	**85,400**	**1,820**	**3,530**	**4,320**	**2,950**	**3,540**

The employment estimate is likely to be overestimated as a result of the decrease in production volumes. There may be some greater labour requirements of the non-brassica vegetable seeds that offset this tendency for over estimation but we have not attempted to estimate this. For comparative

purposes this estimate is comparable to employment across other sectors of the New Zealand economy when using this methodology.

In summary, the total economic impact of seed production is estimated to be:

- Gross output: $798 million
- GDP: $329 million
- Employment: 4320 FTEs.

4.3 Summary economic impact of the arable industry in 2018

Combining the separate information from the grains and the seeds production to show the full impact of the arable industry, we estimate that the annual value of sales of the arable industry in 2018 was $781 million. This generated a total level of sales in the economy of $2.09 billion.

Table 4.7 Summary of arable production economic impacts 2018

	2018				2015	2013
	Tonnes	Total value	With indirect impacts	With total impacts	With total impacts	With total impacts
Gross output ($M)						
Grain production	1,632,500	483	1,021	1,292	1,282	1,816
Seeds	85,400	298	630	798	545	653
Total	**1,717,900**	**781**	**1,652**	**2,089**	**1,827**	**2,469**
GDP ($M)						
Grain production		170	400	533	530	750
Seeds		105	247	329	225	270
Total		**275**	**647**	**863**	**755**	**1,020**
Employment (FTEs)						
Grain production		2,950	5,710	7,000	6,950	9,830
Seeds		1,820	3,530	4,320	2,950	3,540
Total		**4,770**	**9,240**	**11,310**	**9,890**	**13,370**
Arable Exports				**2018**	**2015**	
Total ($M)				**214**	**189**	

The total contribution of arable production to GDP was $863 million in 2018, up from $755 million in 2015 but down on $1.02 billion in 2013. Arable production also generated an estimated 11,315 FTEs in 2018.

Despite falling volumes for a number of grain and seed types arable production remains a significant contributor to New Zealand's economy.

New Zealand exported 43,700 tonnes of arable goods with a total value of $214 million in 2018. This is equal to 0.4 percent of New Zealand's total value of exports.

4.3.1 Downstream economic impact

Downstream industries that rely on arable production are varied and range from the fast food industry that uses pork and poultry fed on feed formulations including grains like maize to brewing which makes use of barley. BERL believes that the economic impact of arable production on these downstream industries, while not quantified in this report, to be large.

The grain millers and processors are producing specialised value added products including health and exercise bars, muesli bars, and baking products.

Downstream industries also rely heavily on seeds produced in New Zealand. These include those using the outputs of pastoral livestock production where the sheep and cows are fed on grasses and forage brassicas grown from New Zealand seeds.

Other downstream seed users are the horticulture/market gardening industries. Downstream benefits therefore also accrue to retailers, exporters and restaurants/fast food outlets. The greatest winner at the end is the consumer, who gains the produce of all these activities in the form of meat, milk, beer, bread, and cakes, among many other products.

These downstream benefits are not included in our estimates of the impacts of arable seed production.

Appendix A Multiplier analysis

The analysis in this report uses multipliers derived from inter-industry input-output tables for New Zealand. Input-output tables have been derived and updated from the national input-output tables produced by Statistics New Zealand.

Multipliers allow us to identify the direct, indirect and induced effects in terms of expenditure, Gross Domestic Product, and Full-Time Equivalent (FTE) employment.

Measures of economic activity

The three measures used are:

Expenditure: the value of production, which is built up through the national accounts as a measure of gross sales or turnover. This is expressed in $million at constant prices (i.e. removing the effect of inflation), and includes GST.

GDP: the increase in output generated along the production chain, which when aggregated, totals Gross Domestic Product, or GDP. This is the sum of:

- Compensation of employees (i.e. salaries and wages)
- Income from self-employment
- Depreciation
- Profits
- Indirect taxes less subsidies.

Note that expenditure is made up of the above (value added) plus:

- Intermediate purchases of goods (other than stock in trade)
- Intermediate purchases of services.

Employment: the volume of employment is usually expressed as Full-Time Equivalents (FTEs). These are estimated as the number of full-time employees and working proprietors and one-third of the number of part-time employees, converted to an annual basis.

FTEs provide a measure of total labour demand associated with expenditure - e.g. four full-time jobs running for three months or three part time jobs running for a year would be shown as a single FTE.