Reducing the reliance of New Zealand livestock systems on internationally produced feed

AgFirst Waikato

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Funded by:

Our Land and Water Contestable Fund

Presentation overview

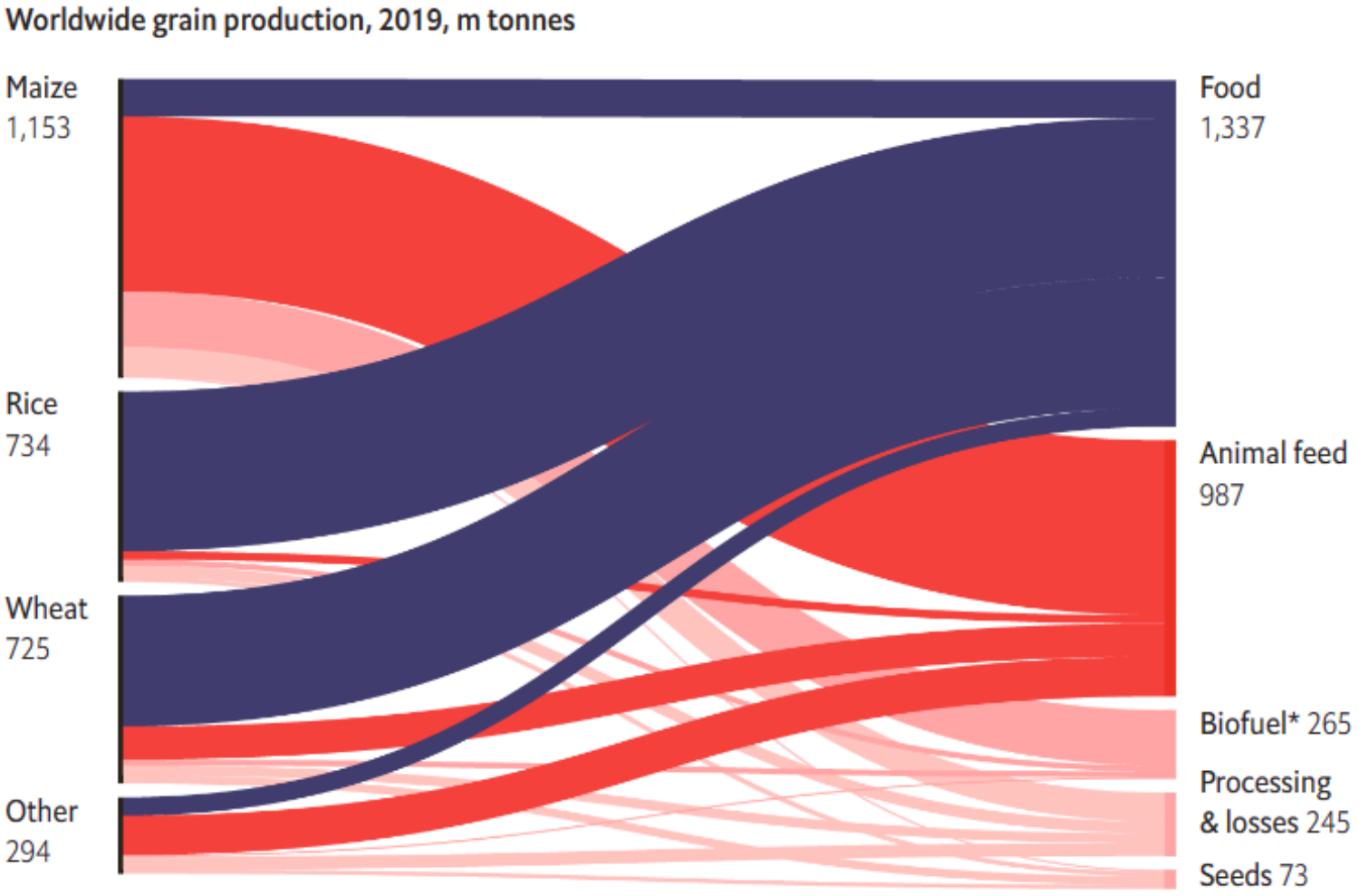
- Global grain production overview
- New Zealand grain and feed production.
- Imports of grain and feed into New Zealand.
- Potential consequences of a shortage of internationally produced feed (IPF).
- Growing more grain.
- Reducing dairy industry reliance on IPF
- Summary

1. Global grain production overview.

Global grain production

- 2.8-2.9 billion tonnes of grain (wheat, maize, barley, sorghum, oats, rye and rice) produced annually.
- Top grains by tonnage harvested are maize (43%), wheat (29%), rice (19%) and barley (6%)
- 57% of all grain used for human consumption and the balance for livestock feed and biofuel.
- Significant differences in the end use profiles of the varying grains.

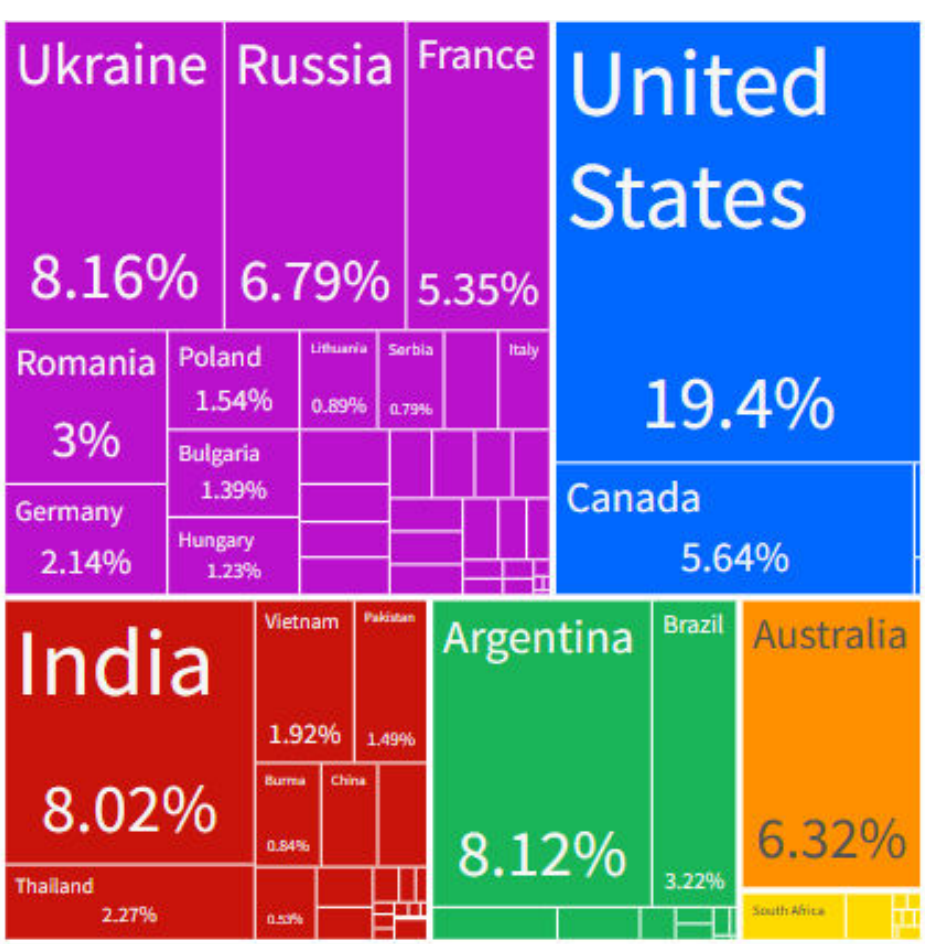
Worldwide grain production and end use



Imports and exports

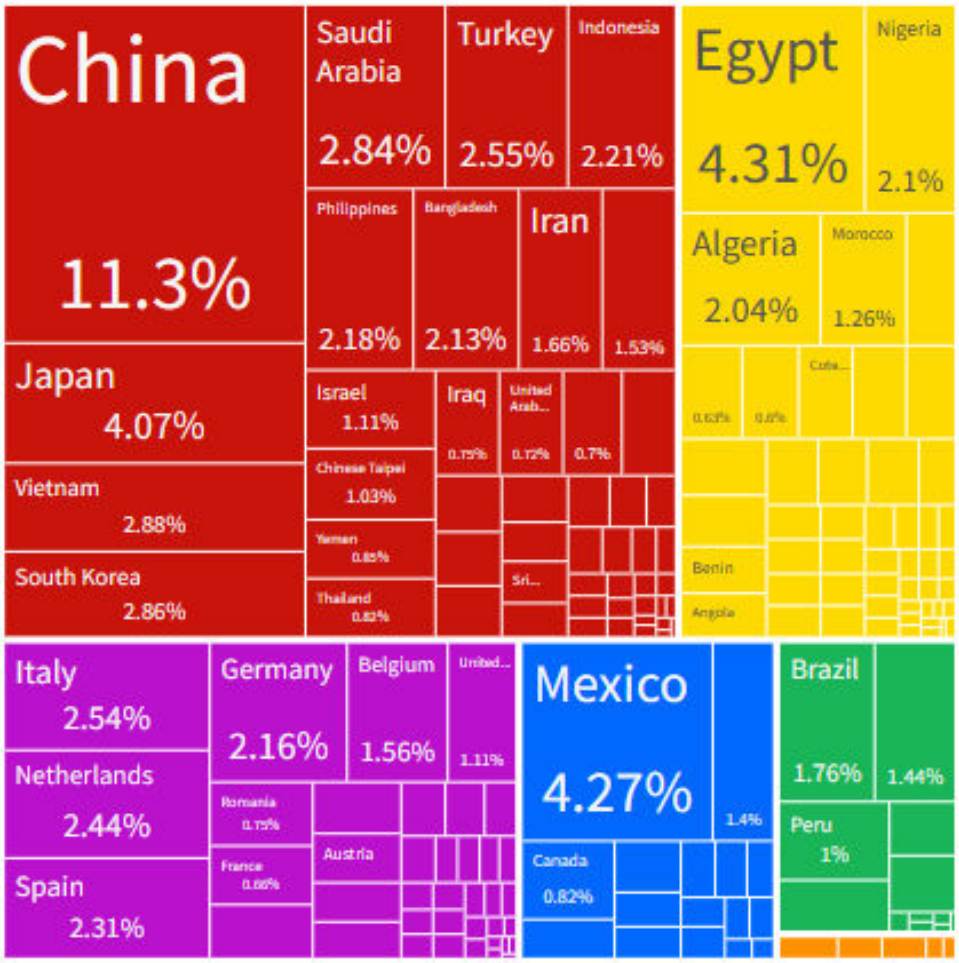
- Only 17% of grain production is exported with single commodity proportions ranging from 9% (rice) to 25% (wheat).
- Europe and North America are the main net exporters while Africa and Asia are the main importers.
- In 2021 the top exporters were USA (19.4%), Ukraine (8.2%, Argentina (8.1%), India (8.0%) and Russia (6.8%)
- China was the largest importer (11.3%) followed by Egypt (4.3%), Mexico (4.3%), Japan (4.1%) and Vietnam (2.9%).

Exporters and importers



EXPORTERS

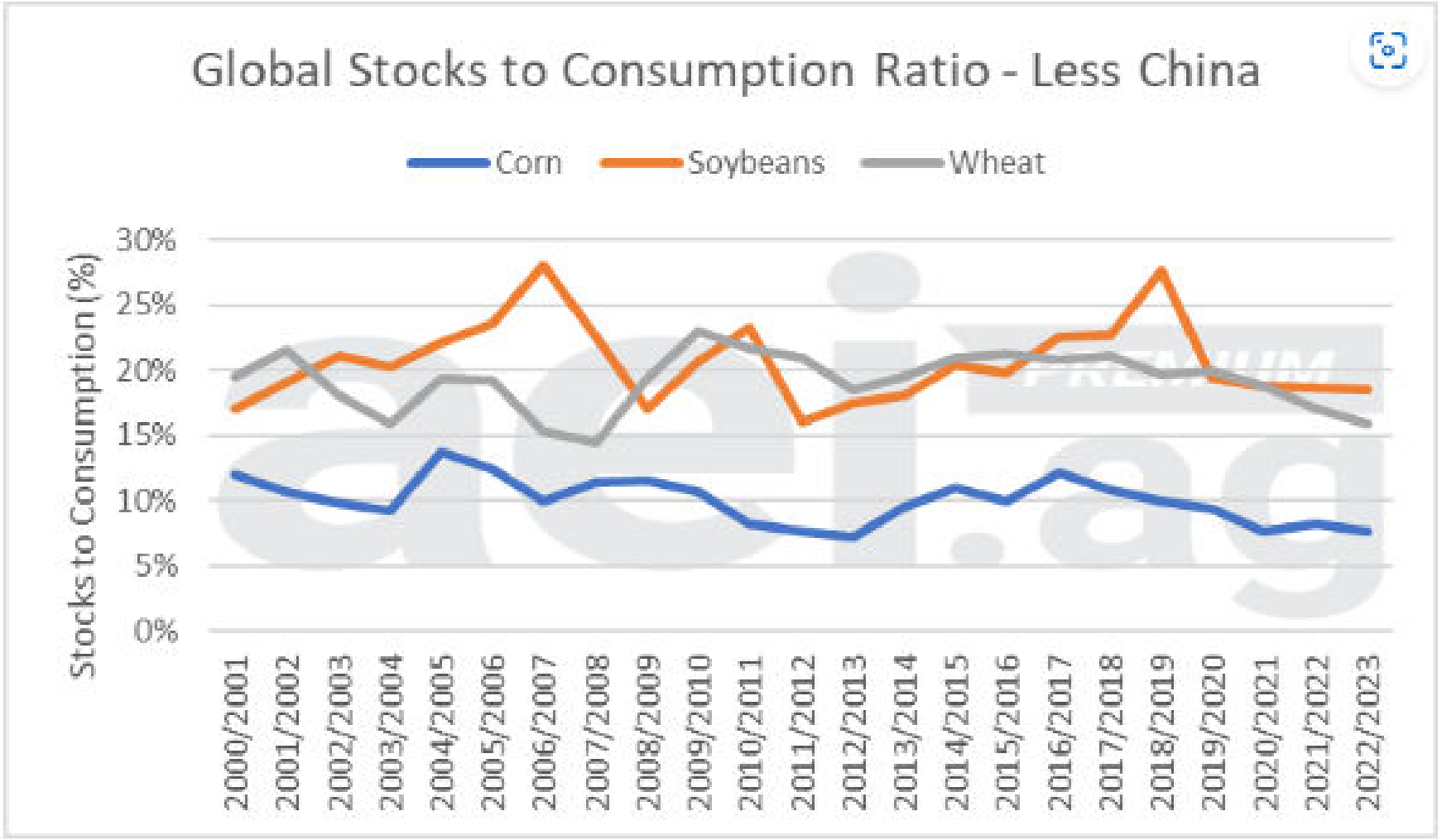
IMPORTERS



Stocks to use rations (S/U)

- The S/U ratio indicates the level of carryover stock (end stock) for any given commodity as a percentage of the total global use of that commodity.
- Stocks-to-use is typically around 30-35% for wheat and 20-25% for maize.
- In 2022-23 China held 70% of global maize stocks,32% of soybean and 54% of wheat.
- If we deduct Chinese stocks, we get a more accurate picture of grain available for global trade.

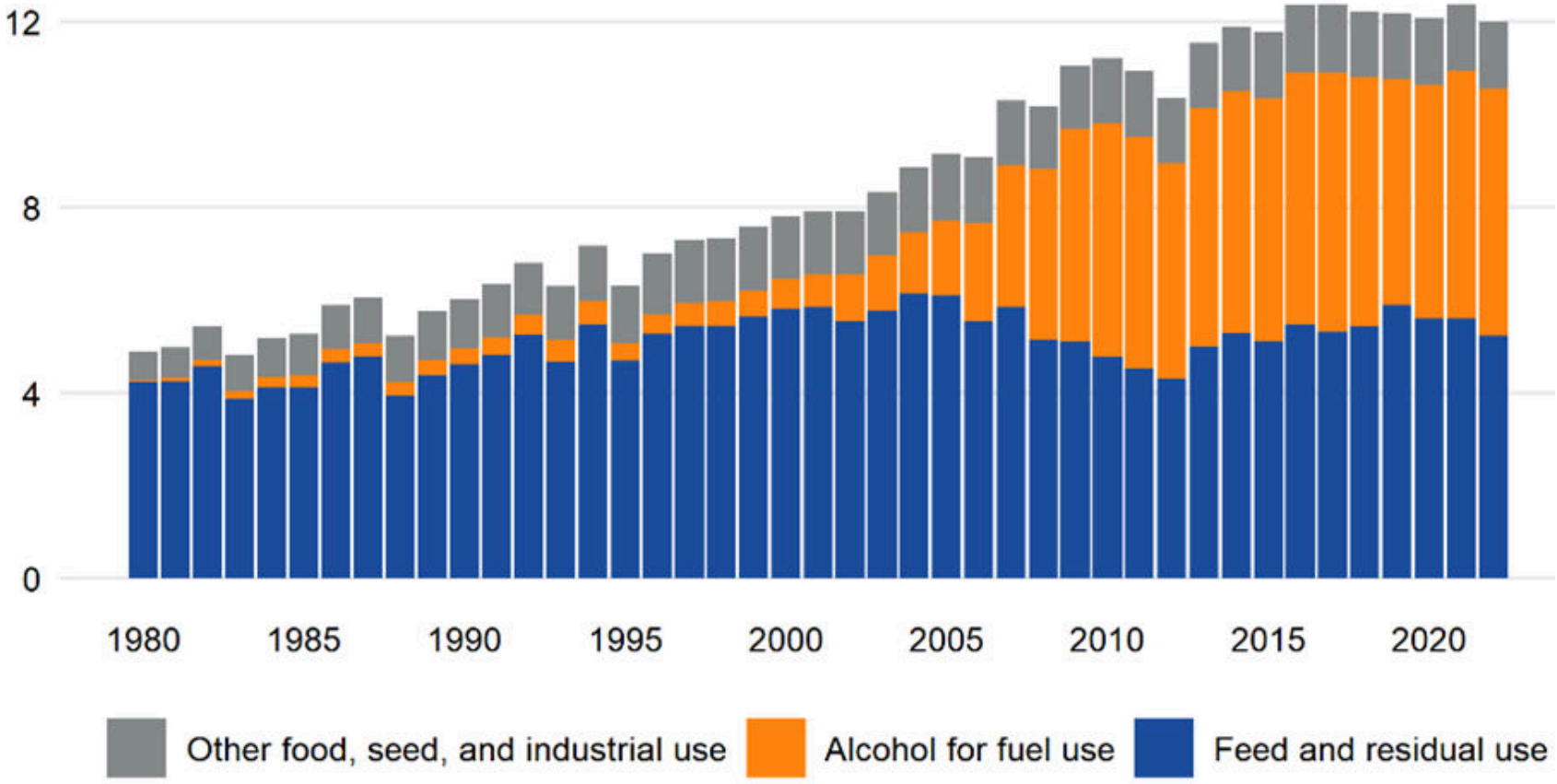
Global grain stocks less China



Biofuel production from grain

- Ethanol production rise six-fold in past two decades
- USA (55%) and Brazil (27%) largest producers
- Ethanol is mainly made from maize (60%) and sugar cane (25%).
- USA Renewable Fuel Standards – rising minimum percentage of renewable fuel in all transportation fuel.
- Maize in USA government mandated low of 60.2m acres in 1982 to 90 million since 2018.
- Ethanol uses 45% of USA maize.

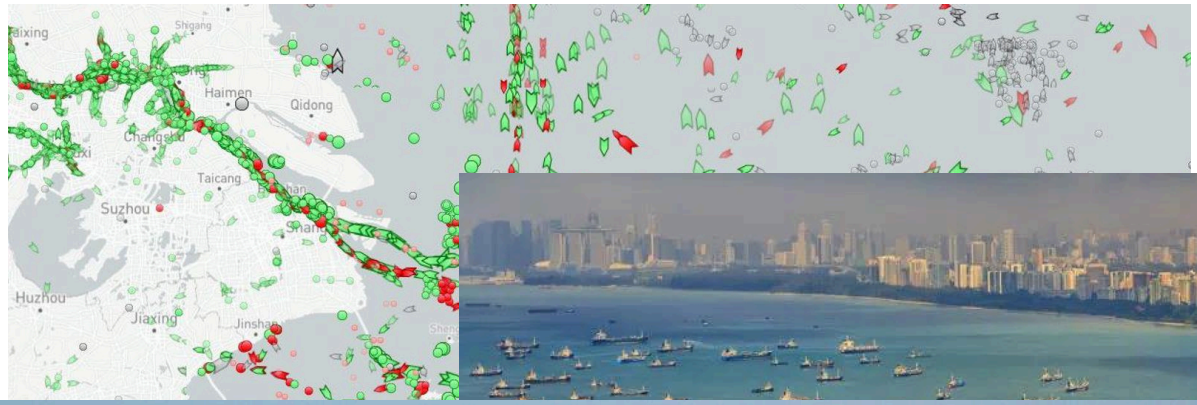
USA domestic maize use



Global COVID pandemic

- Surge in consumers purchasing food for quarantine.
- Temporary sanctions on the export of grain (Russia, Ukraine, India and Vietnam).
- Oil prices dropped so shipping should have been cheaper but….
- Baltic Dry Index, a benchmark for sea freight rose due to increased shipping demand, Chinese port congestion.

Chinese port congestion

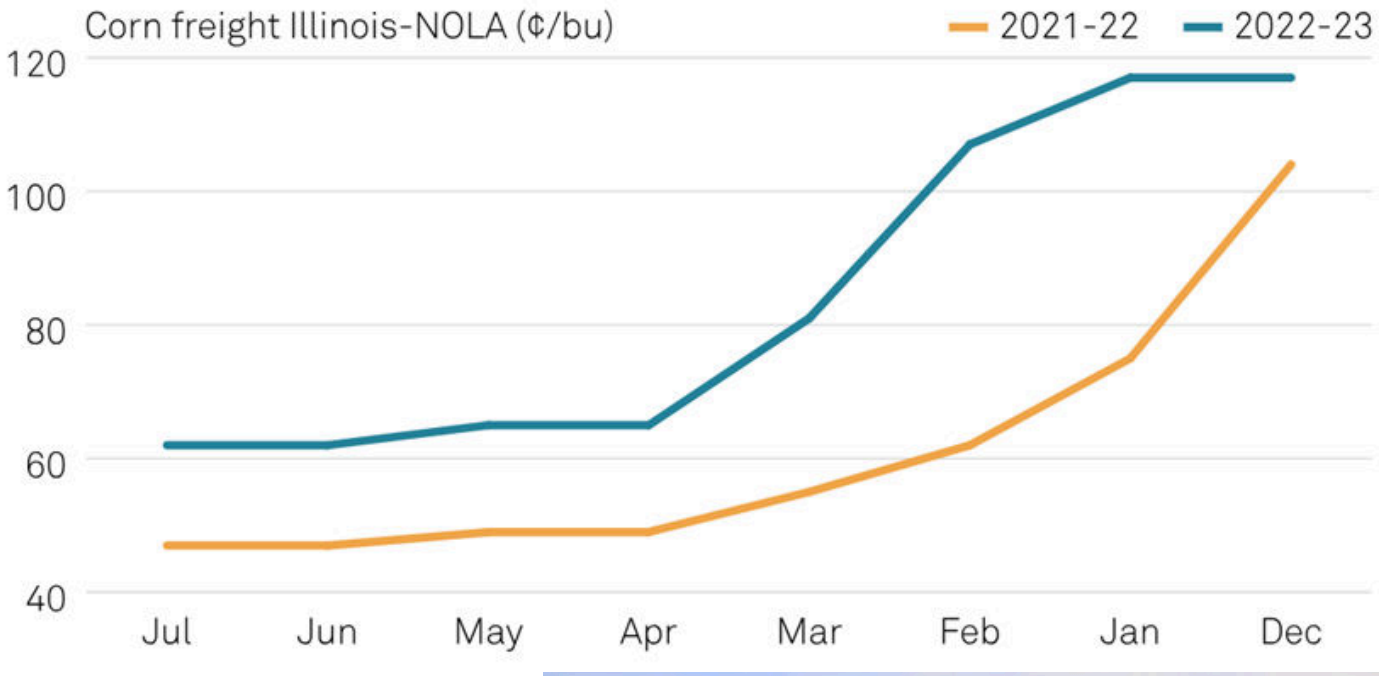


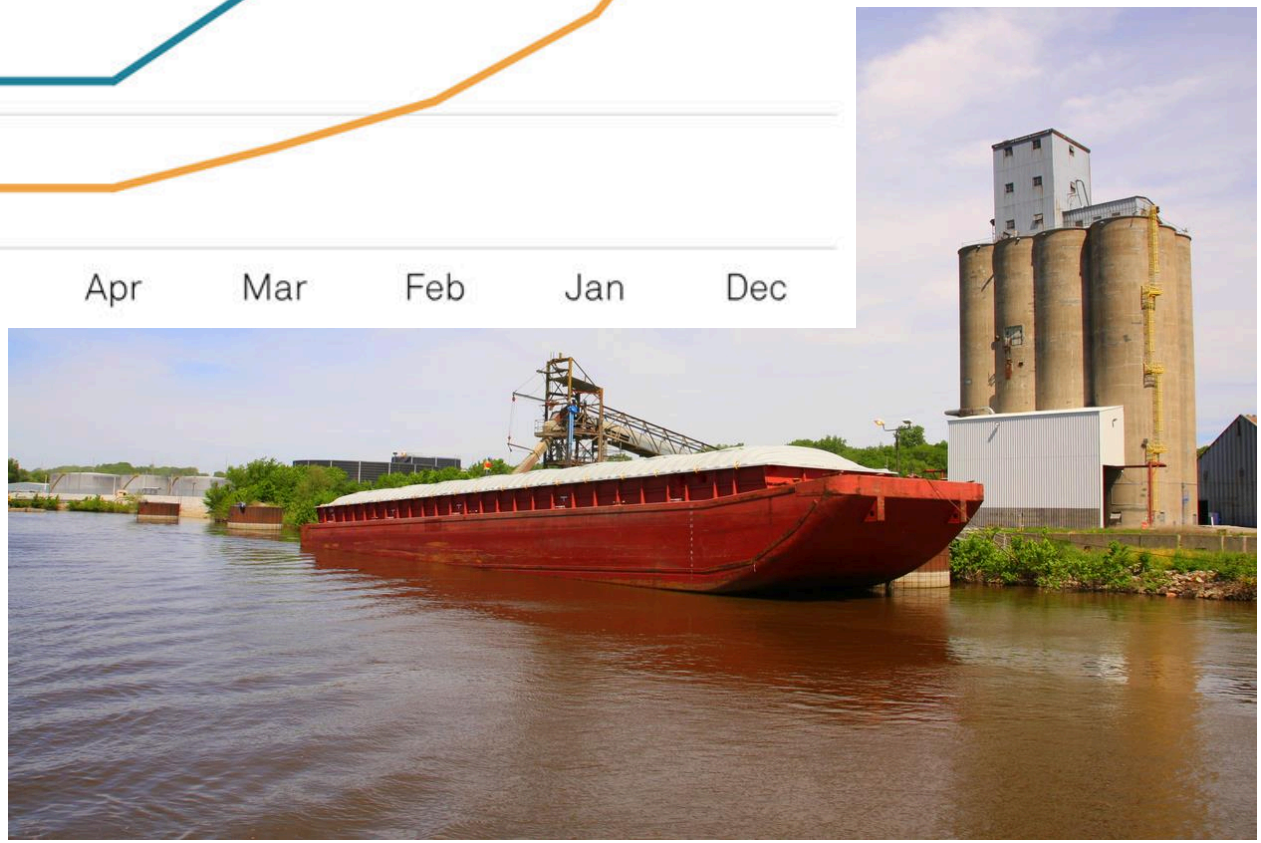
Baltic dry index

Climatic factors

- Extreme heat and drought in Europe diminished maize yields in Spain, Southern France, Italy, and the Balkans. Yields 18% lower than the 5-year average.
- In the USA, drought across parts of the western Corn Belt and Great Plains resulted in increased abandoned (unharvested) areas.
- Nebraska, Kansas and Colorado showed significant declines in both yield and harvested area.
- The USDA estimated that total maize production in 2022 was 9% lower than for 2021.
- Low Mississippi levels increased barge freight cost.

Low Mississippi levels

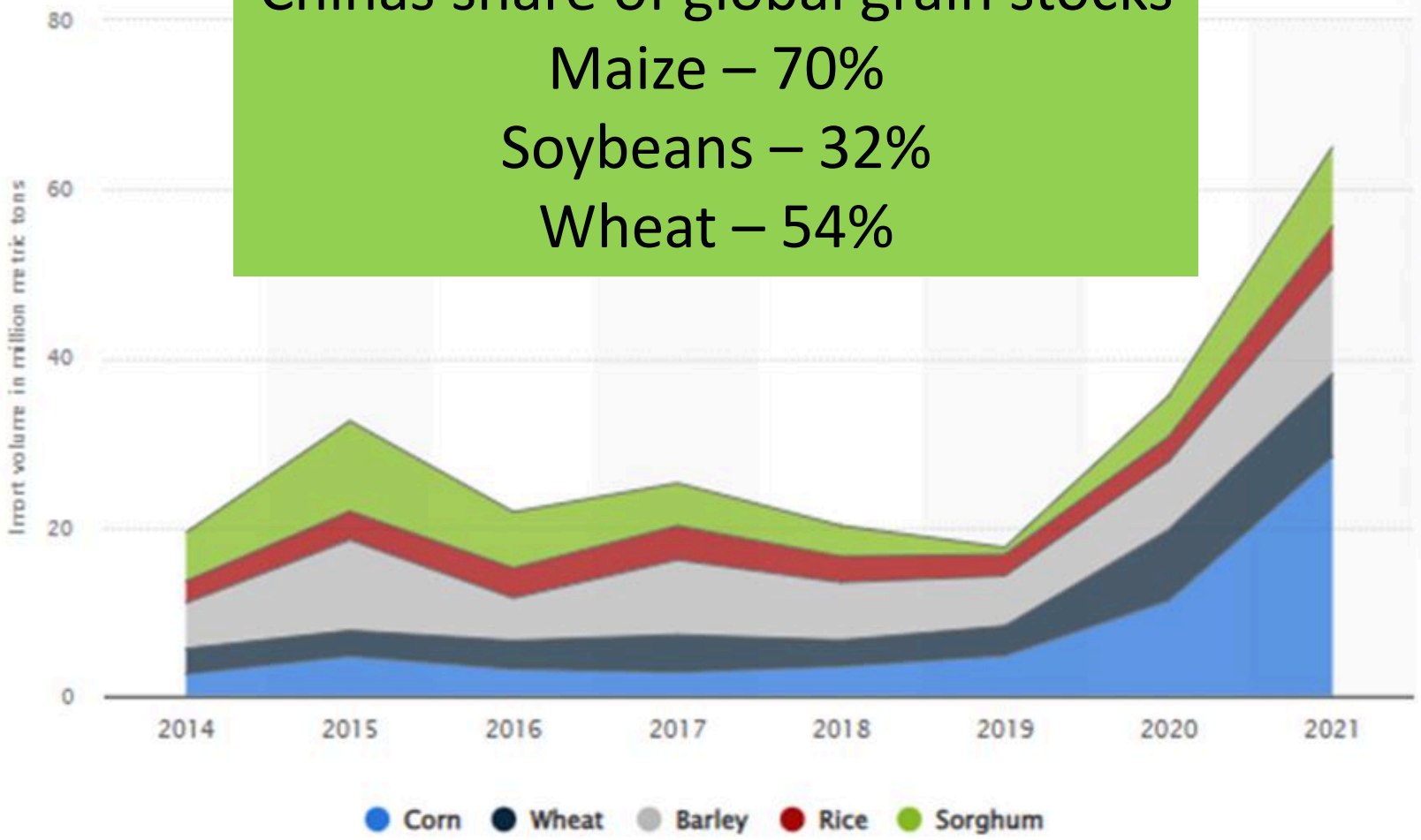




Chinese arable land

Chinese grain import volume

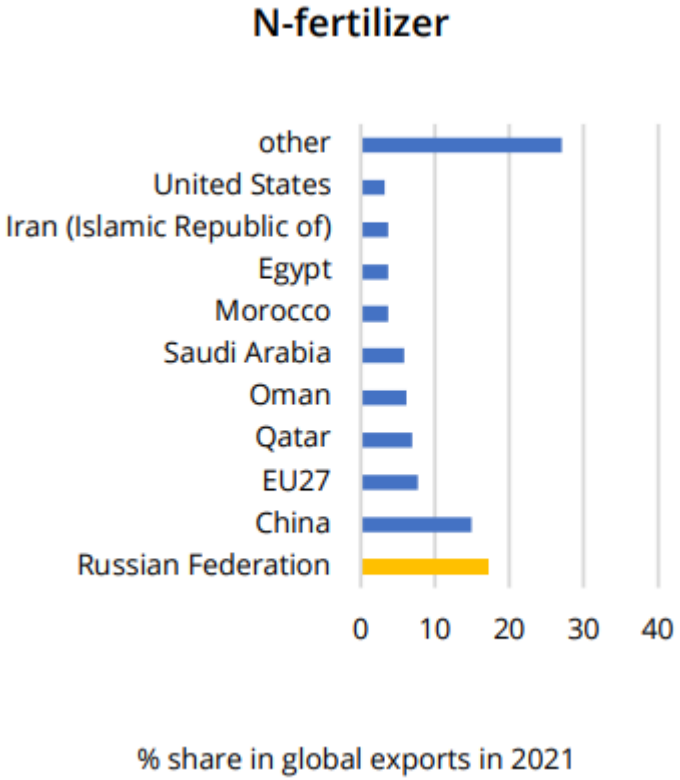
Chinas share of global grain stocks
Maize – 70%
Soybeans – 32%
Wheat – 54%

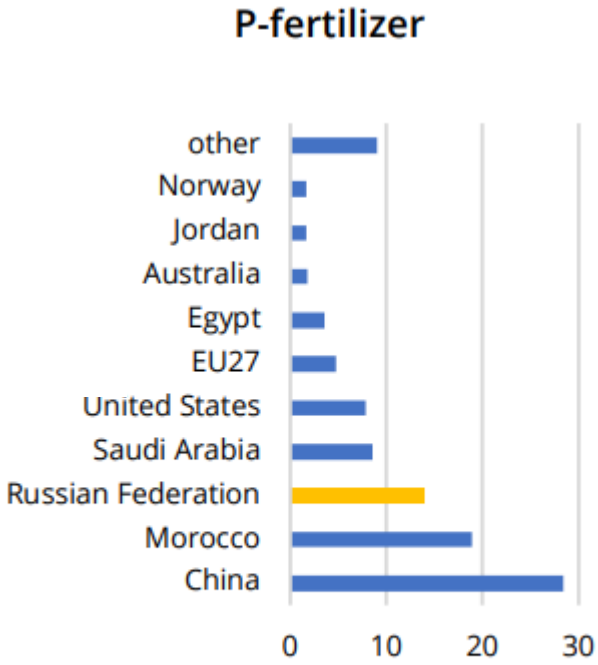


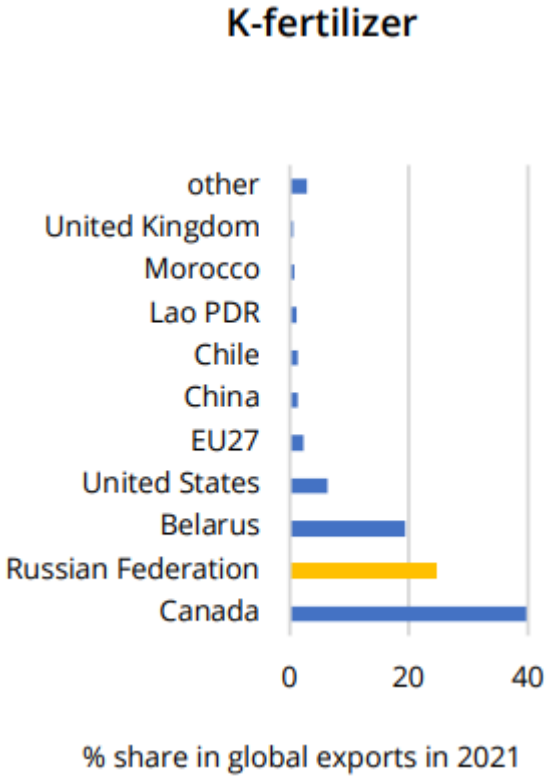
Russian-Ukraine war

- Russia and the Ukraine both major players in global grain trade.
- Russia the largest exporter of N, P and K fertiliser.
- Combination of conflict, sanctions and the severing of the Nordic Stream pipeline resulted in supply concerns for:
  - Grain
  - Oil
  - Fertiliser
  - Agochemicals

Russia – fertiliser exports

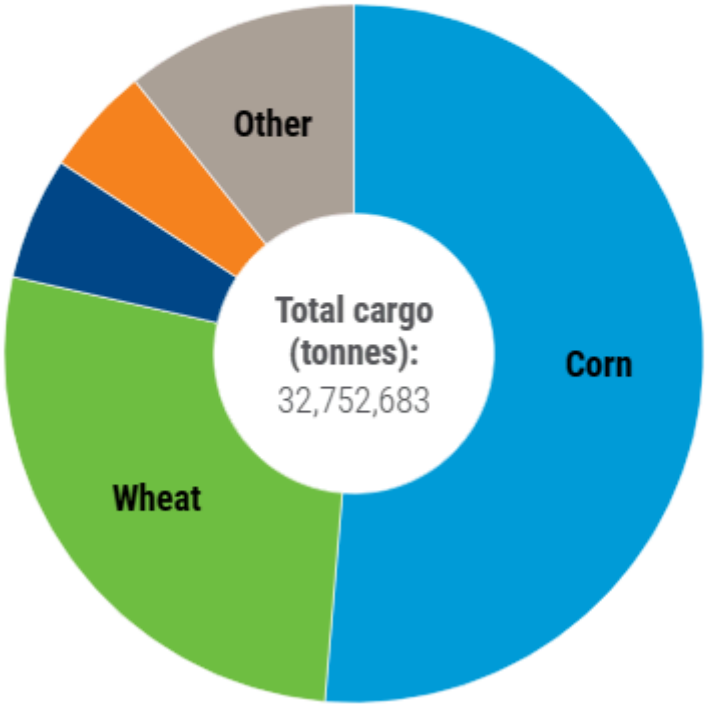




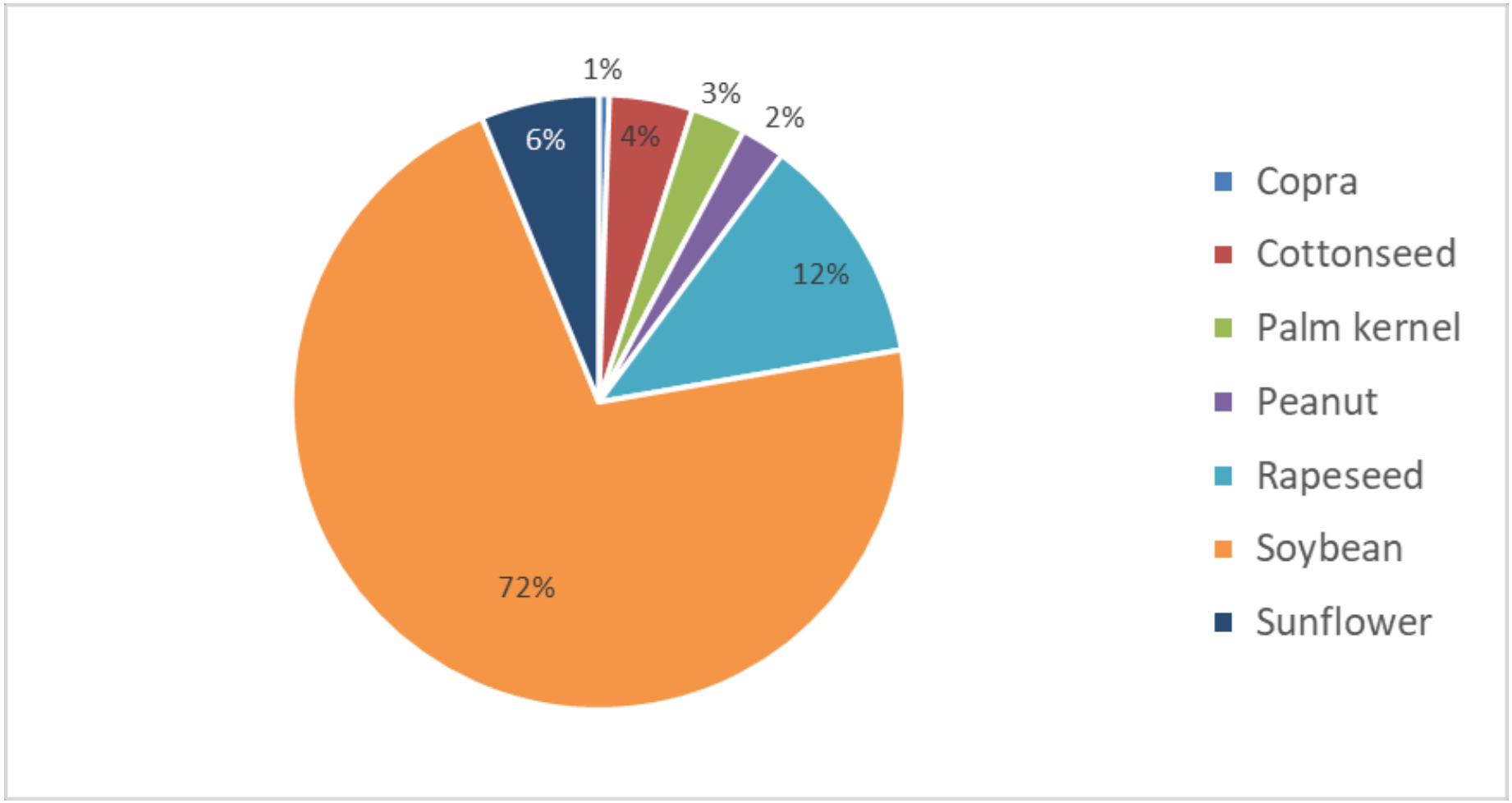


What has been shipped?

- **Corn** (51%)
- **Wheat** (27%)
- **Sunflower meal** (6%)
- **Sunflower oil** (5%)
- **Other** (11%)



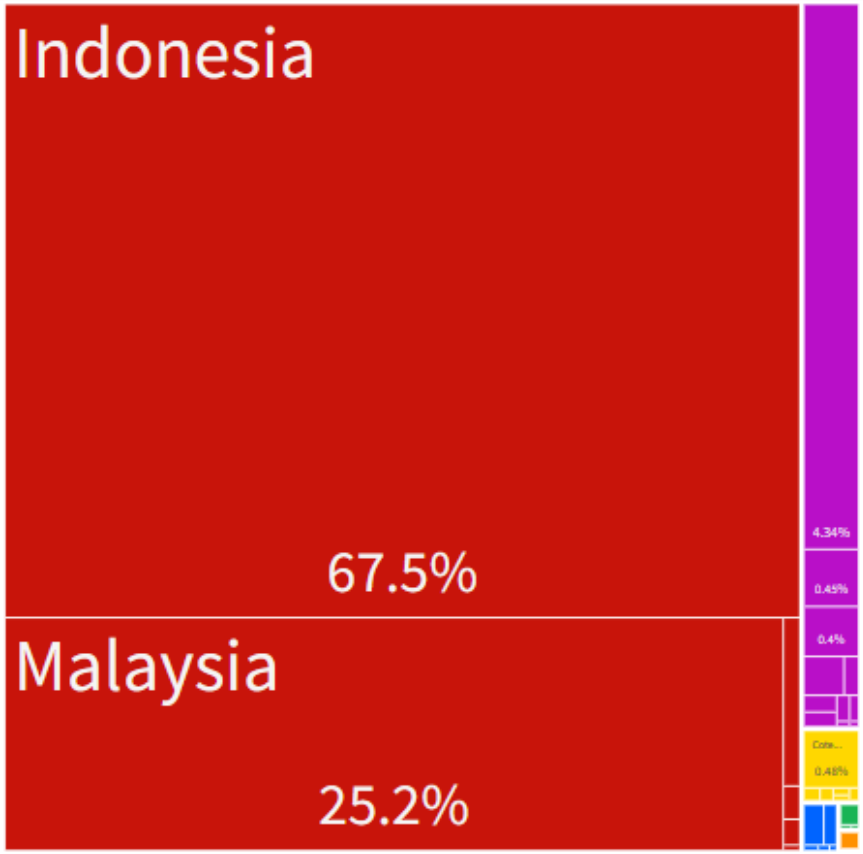
Plant protein production

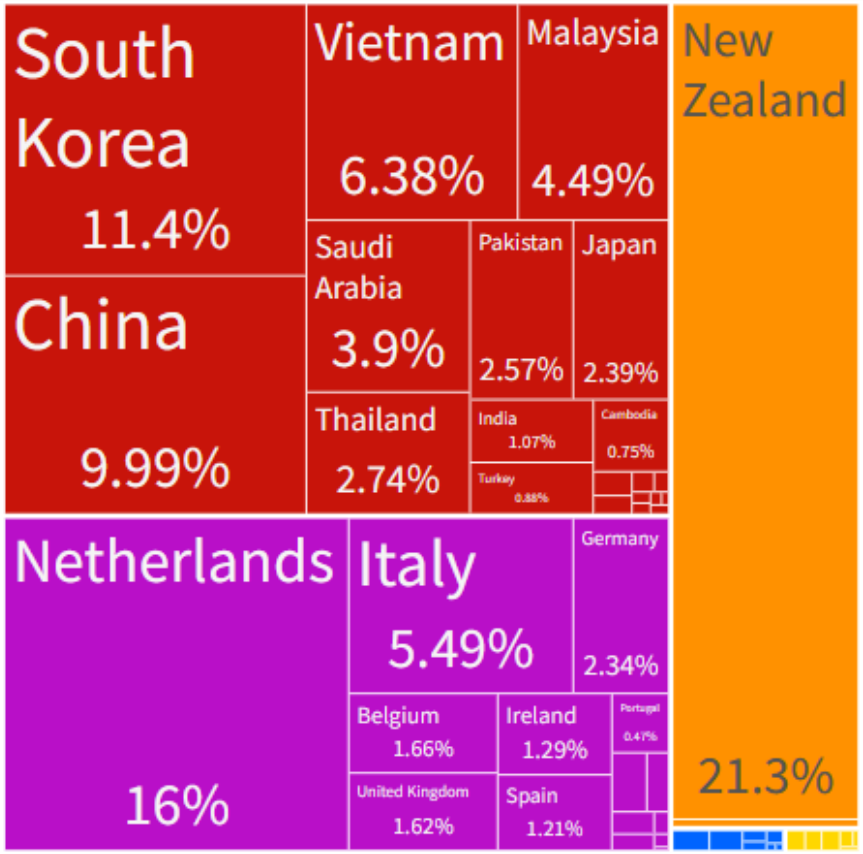


Palm kernel extract (PKE)

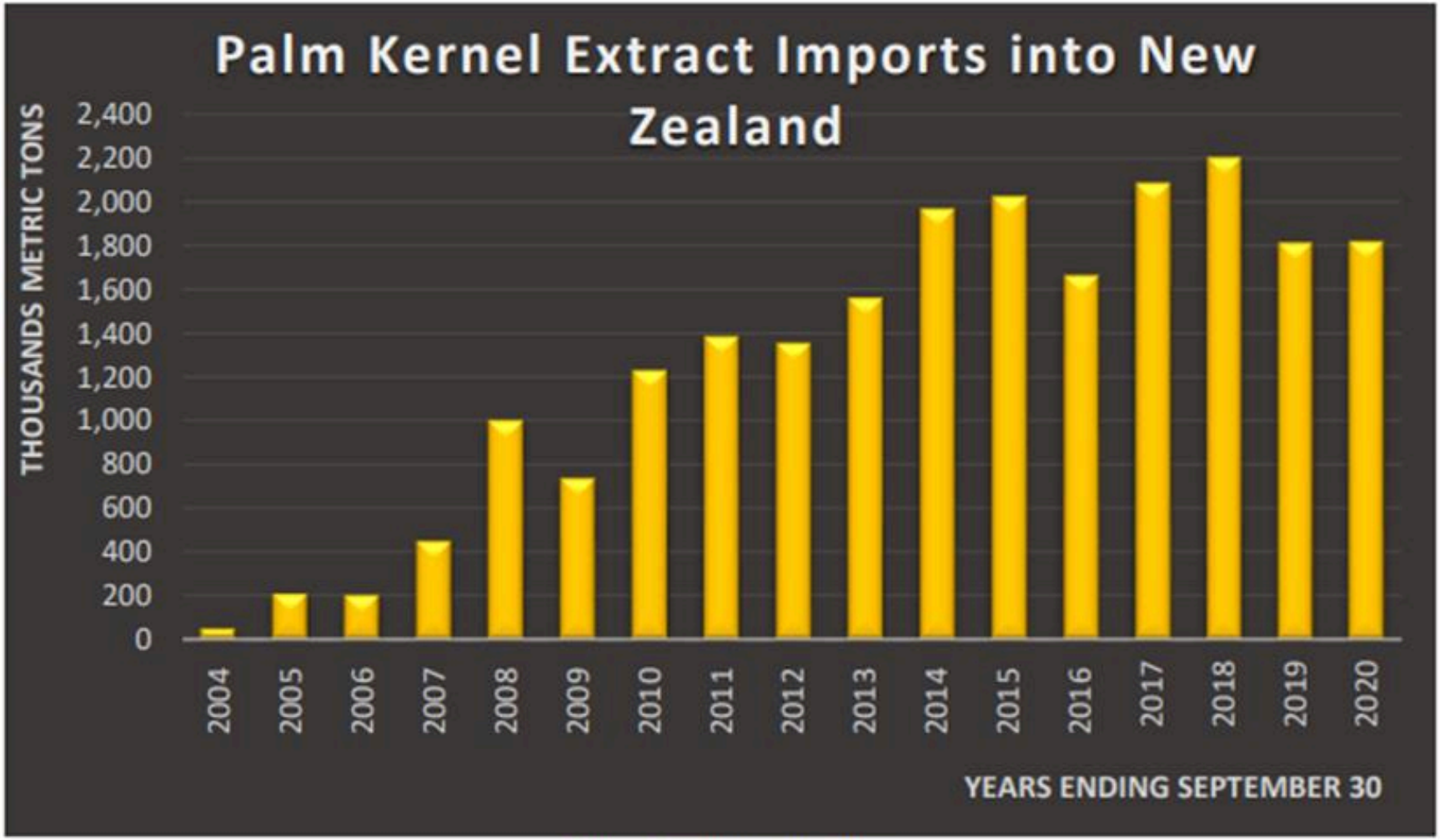
- Palm kernel extract is a byproduct of mechanical extraction of palm oil.
- Used globally for stock feed, pet food and biofuel
- Indonesia and Malaysia produce 80% of the worlds total palm oil.
- Global oil production stable at 70-75 million tonnes per annum since 2017-18
- New Zealand is the top importer of palm oil extraction residues.

PKE exporters (left) and importers (right)





NZ PKE imports



Source: trade data monitor

2. Grain and feed production in New Zealand

NZ grain production

- In 2022, NZ arable farmers produced 900,000 tonnes of grain off 107,000 ha.
- Our favourable growing conditions mean average crop yields are some of the highest in the world.
- Cost of production is high due to small scale agriculture and high input costs.
- Particularly high cost to get grain from the South Island to the North Island

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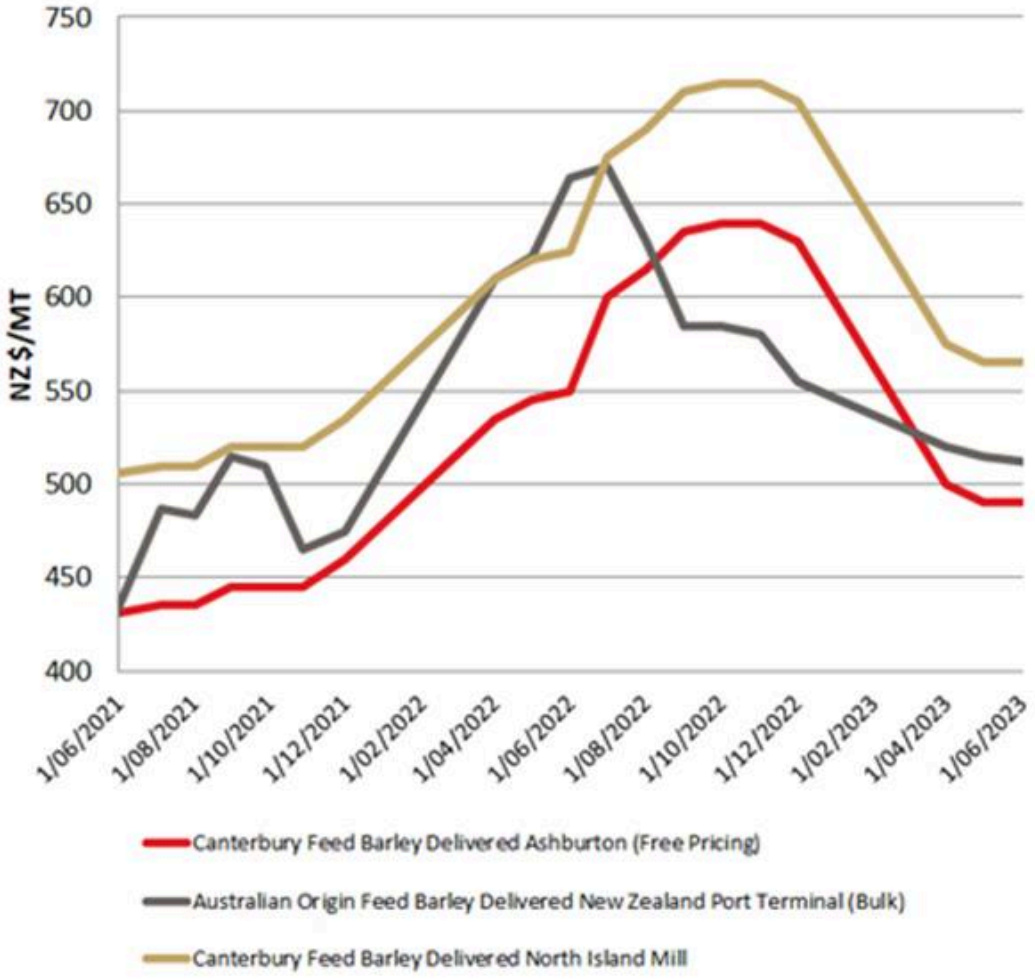
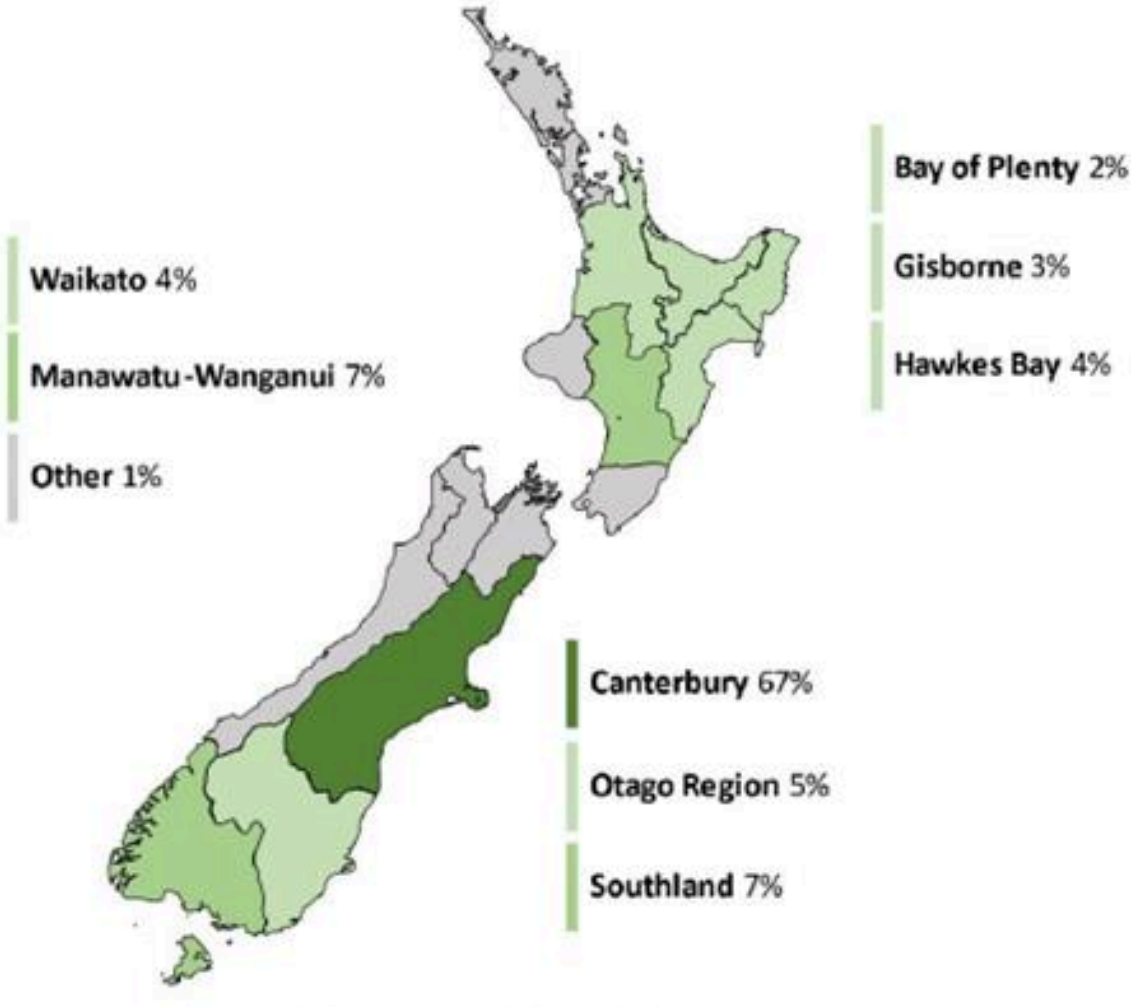
Wheat production costs

Cost Item	New Zealand	Australia (< 400 mm rainfall)*	Australia (> 400 mm rainfall)*
Average cost of production per ha (using contractor rates, excluding post-harvest costs)	$3,684	$457	$1,140
Average grain yield (t/ha)	12.7	1.8	4.8
Cost of production (NZ$/tonne)	**$290**	**$253**	**$238**

Comparative feed barley prices

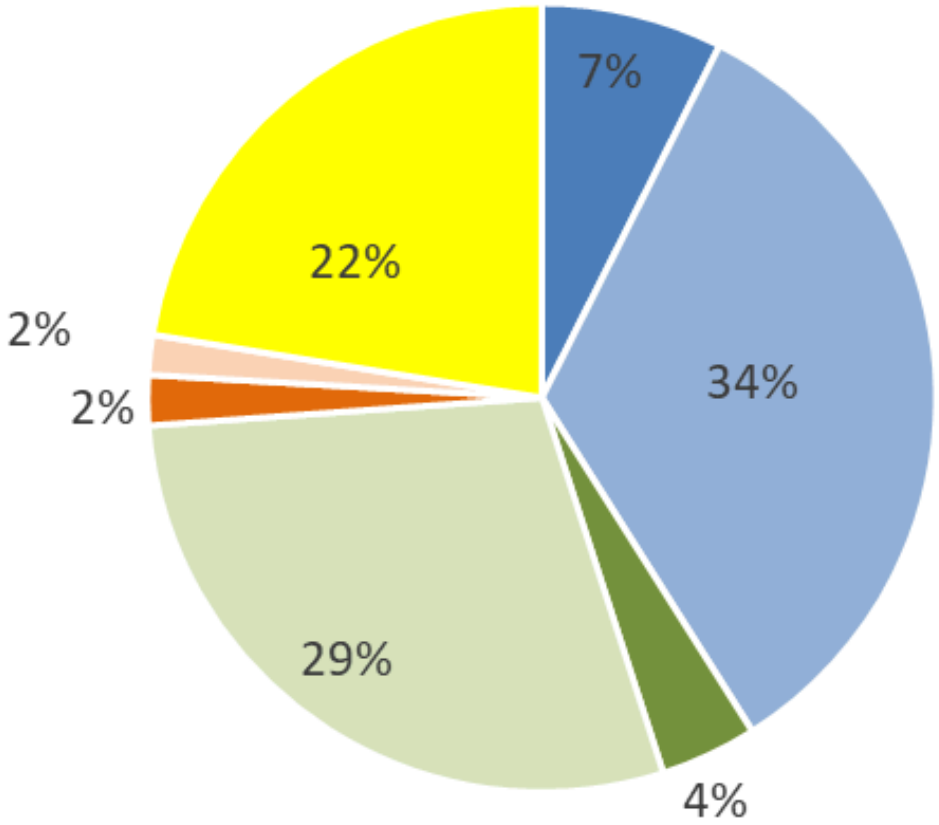


Grain production by region

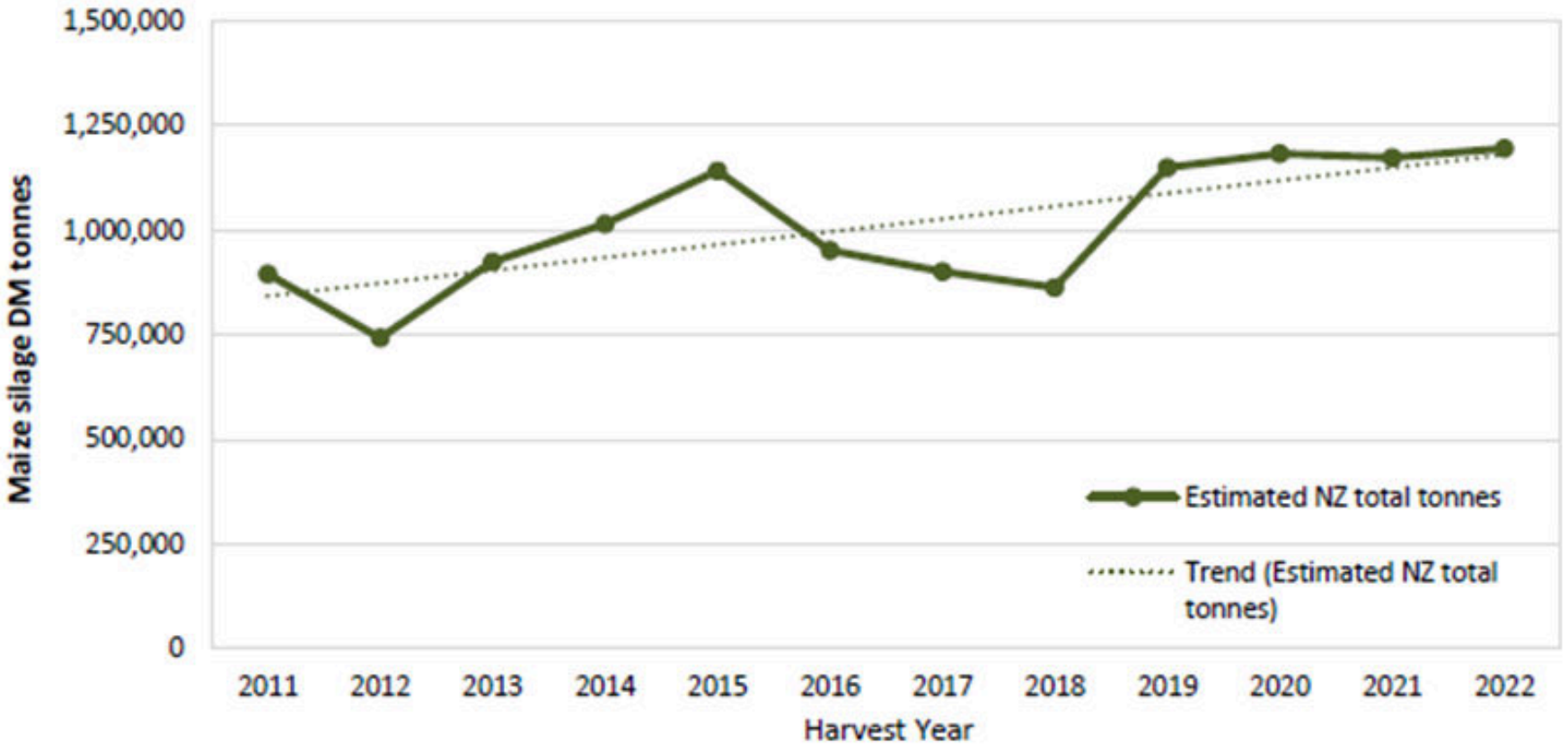


Source: StatsNZ and FAS/Wellington

Grain production by type



Maize silage production



Cropping gross margins

Crop	Yield	Grain price ($/t) or silage price ($/tDM)	Gross margin ($/ha)
Feed wheat (South Island)	12.7	$540	$2,451
Milling wheat (South Island)	10.6	$620	$2,216
Maize grain (North Island)	12.0	$600	$2,797
Maize silage (South Island)	20.5	$250	$1,487
Maize silage (North Island)	22.0	$300	$3,307
Dairy*(Waikato/BOP)	-	-	$5,251
Sheep and beef** (North Island Intensive Finishing)	-	-	$1,053
Sheep and beef** (North Island Easy Hill Country)	-	-	$660

* Financial Survey 2022 – Waikato/Bay of Plenty Dairy (AgFirst, 2022)

** Beef + Lamb NZ Economic Service – Sheep and Beef Farm Survey 2022

Crop gross margins provided by Foundation of Arable Research

Environmental impact

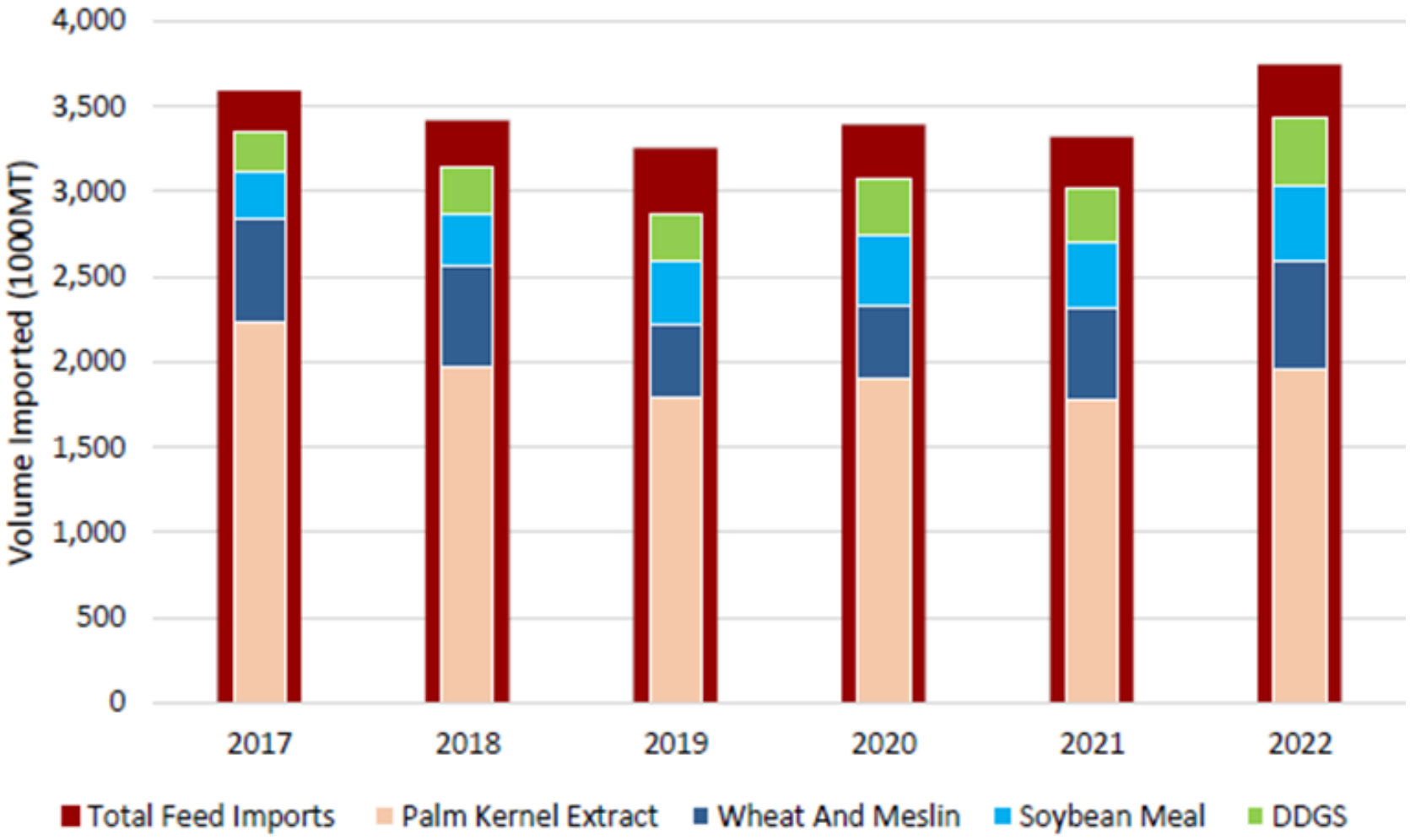
- Variable N losses from cropping systems depending on the crop rotation.
- Cereal rotations can have high N loss especially when they include vegetables or vegetable seed.
- Maize trials have shown low N loss provided a cover crop is planted after maize harvest.
- Greenhouse gas losses of cropping systems (no livestock) typically average around 2 tCO_2e/ha which is lower than sheep and beef (average 3.6 tCO_2e/ha) and dairy (9.6 tCO_2e/ha)

3. NZ grain and concentrate imports

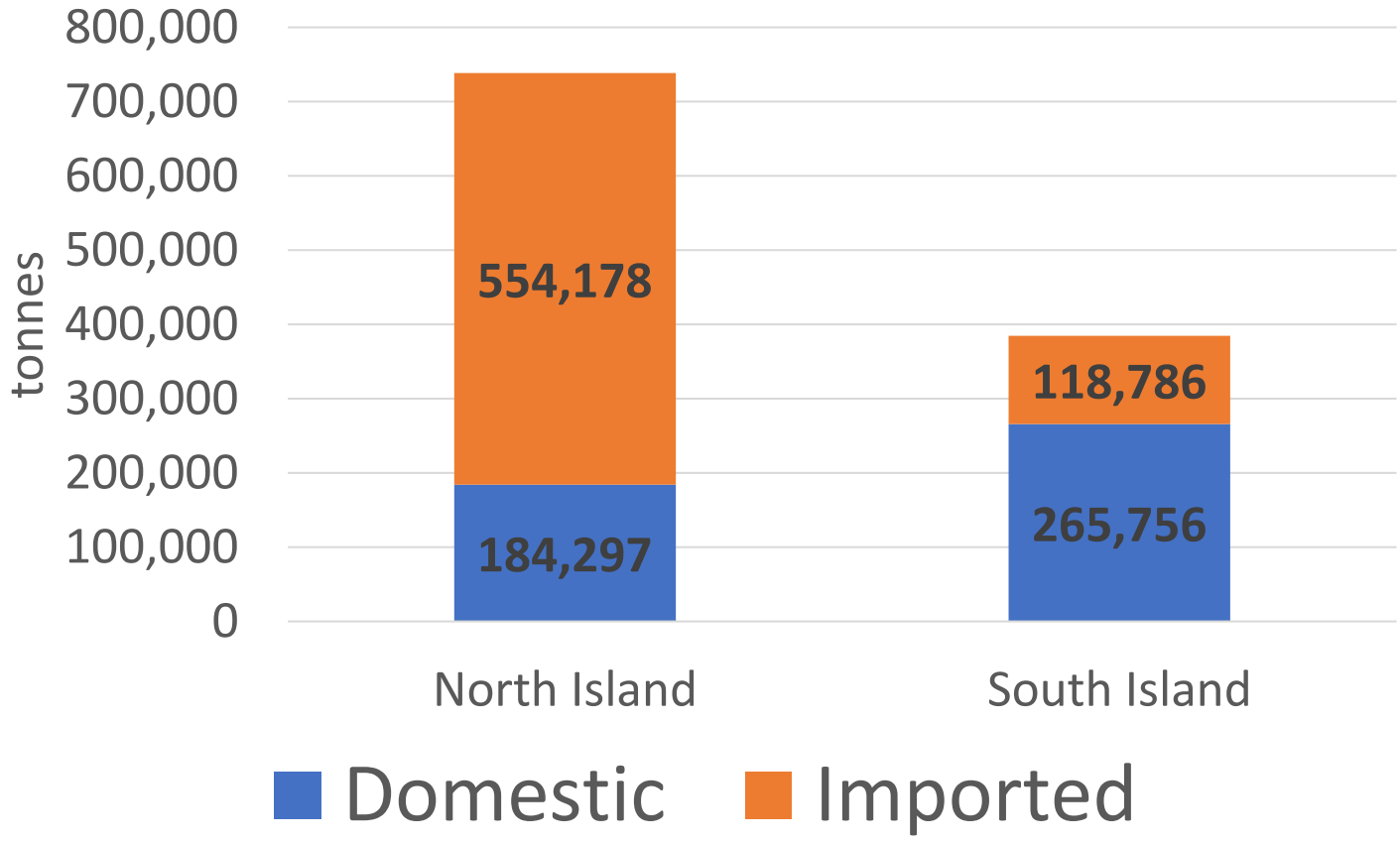
NZ grain and feed imports

- New Zealand is a net importer of grain and concentrates.
- In 2022 New Zealand:
  - consumed 5.8 m tonnes of concentrates
  - grew 2.1 m tonnes of grain
  - imported 3.7 m tonnes of internationally produced feed (IPF).
- PKE is the largest volume import (54% of imports)

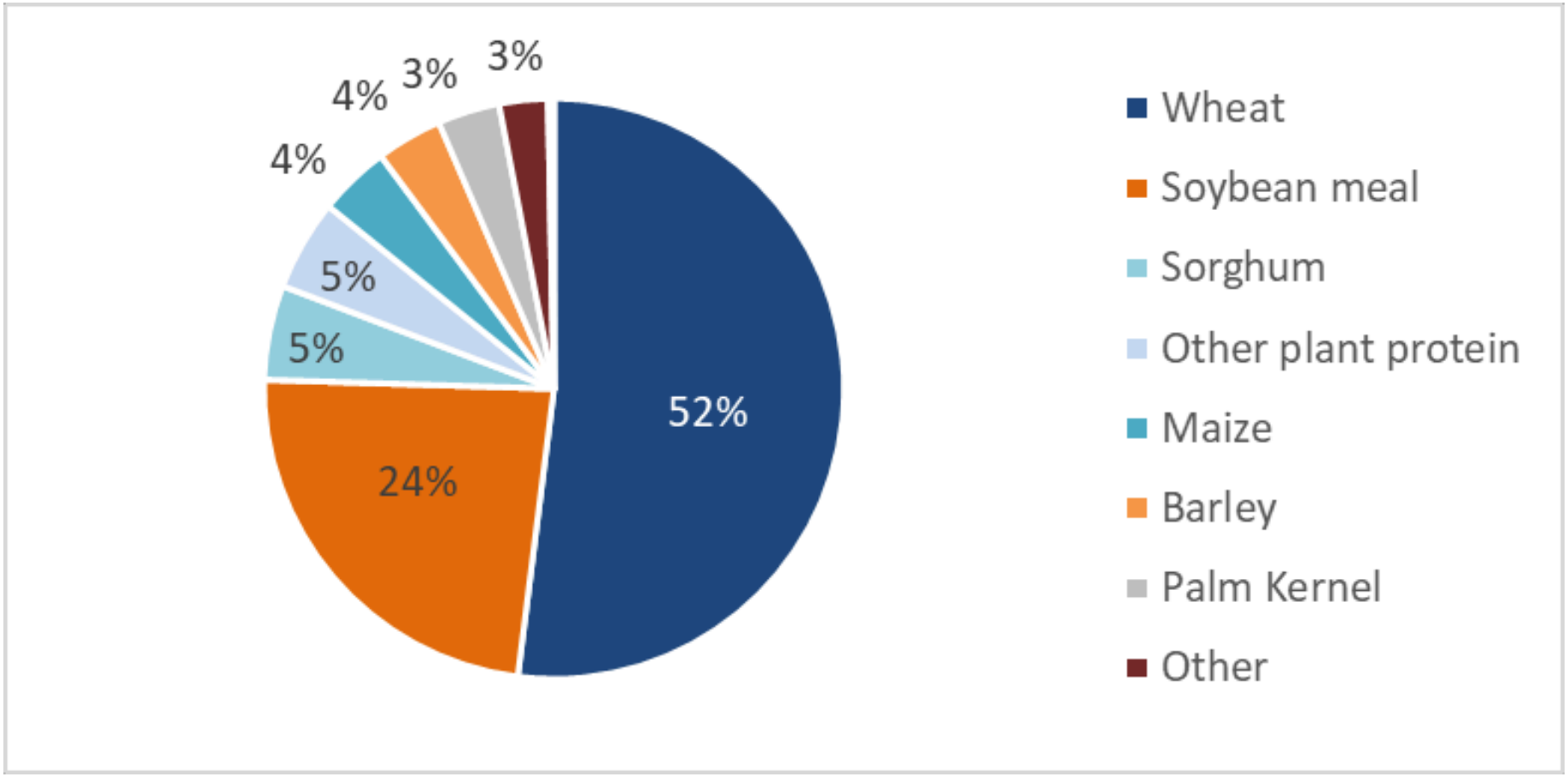
NZ grain and feed imports



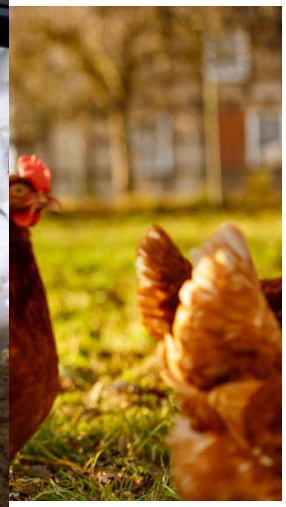
NZFMA compound feed manufacture

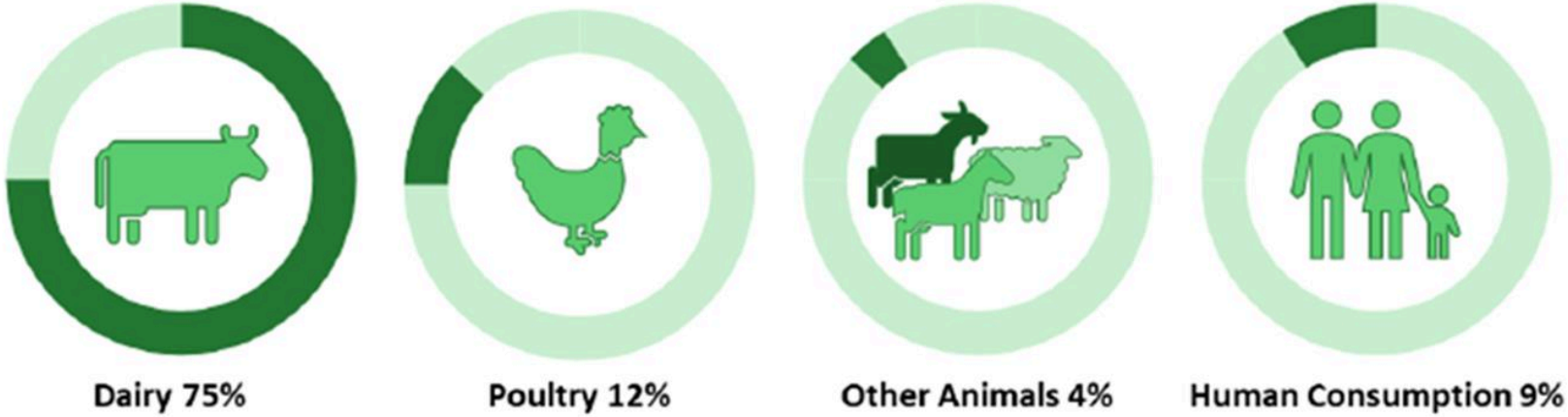


NZFMA imports for compound feed



Who uses IPF?





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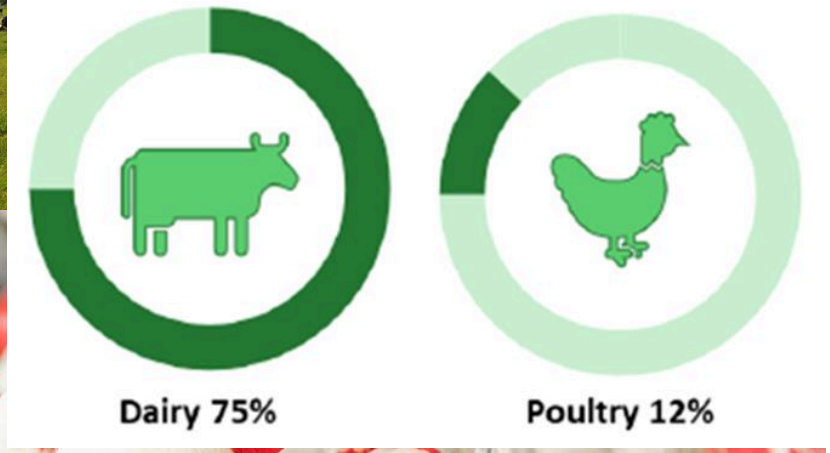
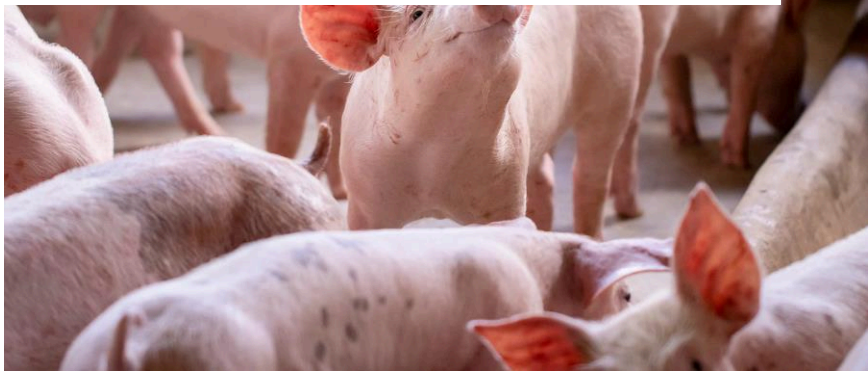
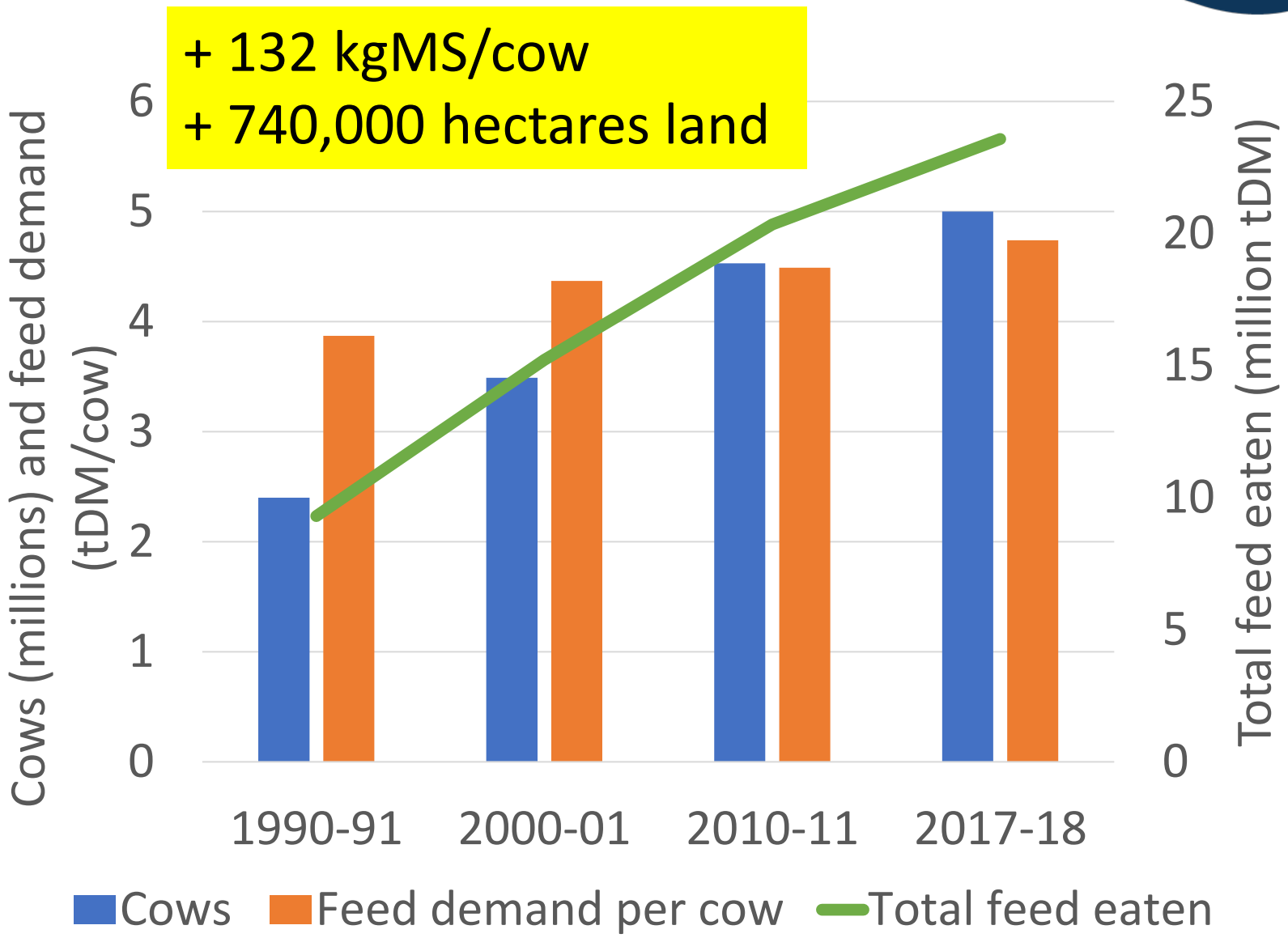
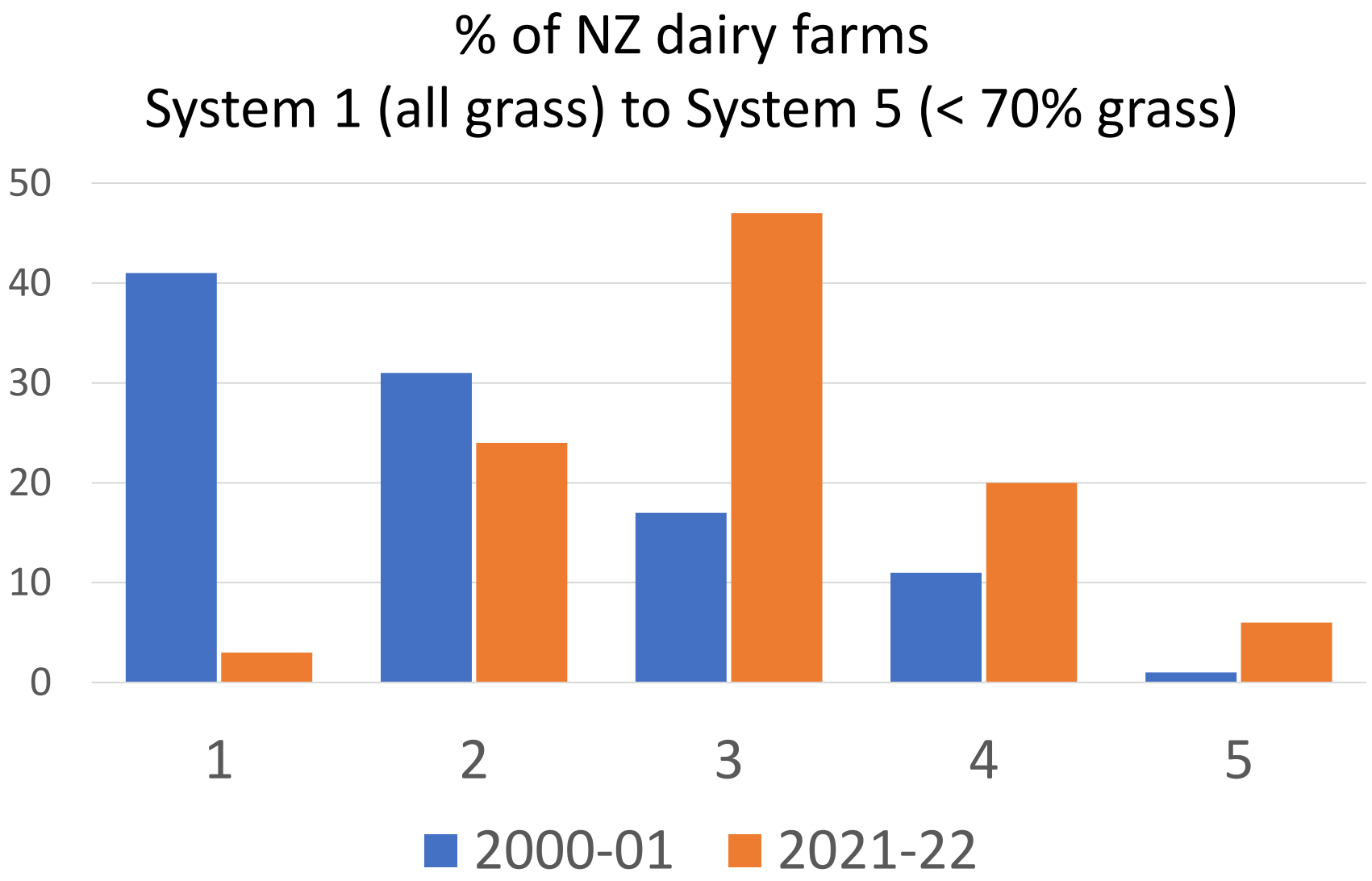




Dairy farm feed demand



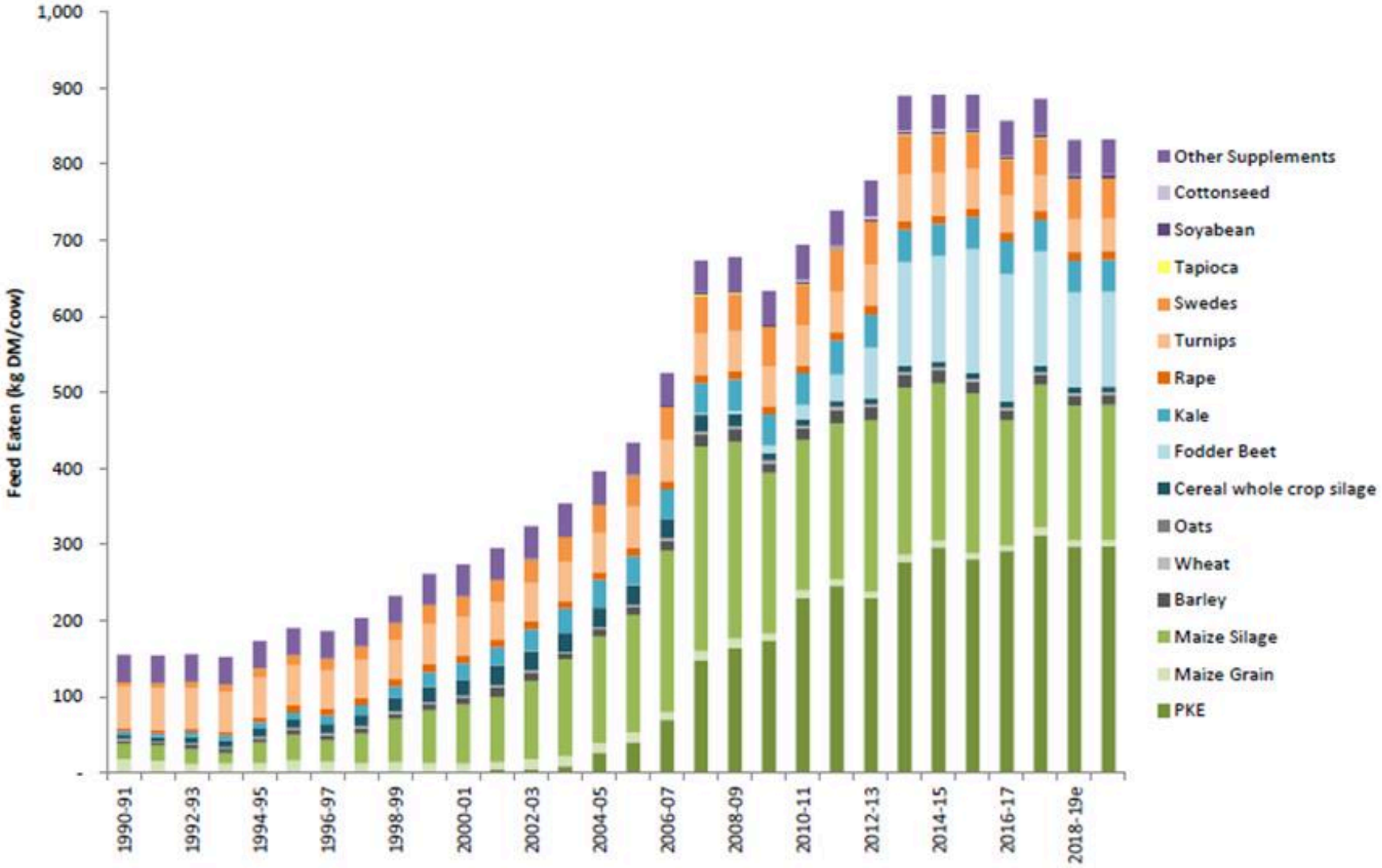
Five farm systems



Changes in cow feeding

- 1990-91 to 2017-18 feed eaten by cows increased 157%
- 80% more cows, feed eaten per cow 3.87 tDM/year to 4.72 tDM/year.
- Compound annual growth rates for supplements:
  - Harvested supplements (e.g maize sil/barley) +5.6%
  - Grown supplements (e.g. beet, kale, swedes)+5.6%
  - Imported feeds (e.g. PKE) +9%

Total feed eaten on NZ dairy farms 1990-91 to 2018-19



Poultry

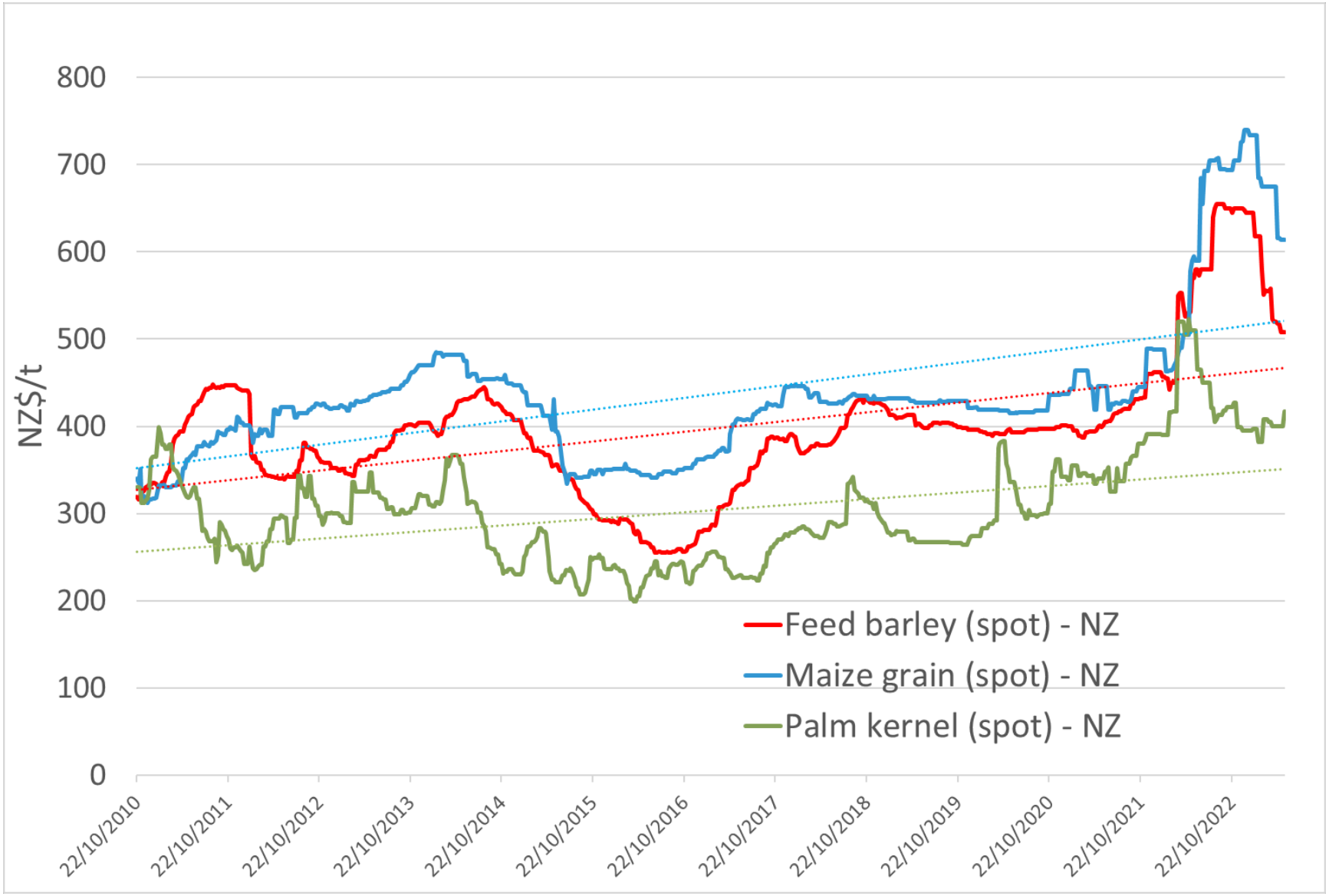
- Second largest user of IPF
- In 2022 19.2 million broilers and 3.7 million laying hens.
- NZ free of avian influenza, Newcastle disease and infectious bursal disease (IBD)virus.
  - No fresh poultry or in-shell egg imports
- Meat chicken industry highly efficient, vertically integrated.
- Poultry rations formulated using LCR software and global pricing is used to make purchase decisions.

Pig

- Declining industry (327,000 in 2011 vs 249,000 in 2021)
- High welfare standards and a high grain price have lifted price of production.
- Locally grown pork often can’t compete with imported product which is produced using cheaper feed and less stringent health, welfare and environmental regulations.

4. Impact of global feed price rises or unavailability

NZ feed spot prices (NZX)



Is a shortage of IPF likely?

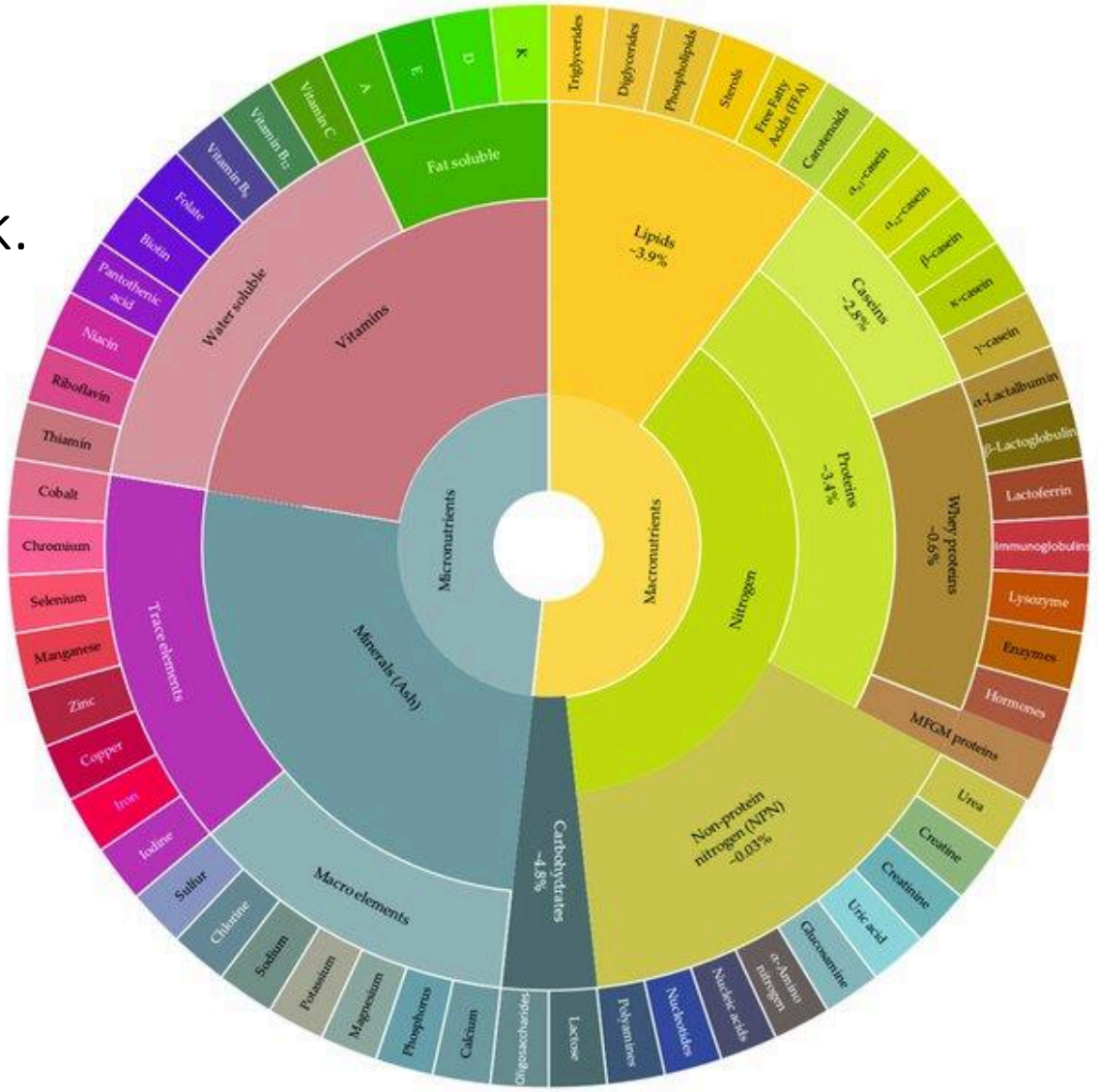
- Grain exported by many countries, spread in crop type, location, time of harvest etc.
- Large amount used in poultry industry – vertically integrated.
- Australia exported 40.6 million tonnes of grain in 2021. This is more than 10x annual NZ demand for IPF and more than 40x the amount of imported grain.
- PKE traded by two neighbouring countries – higher risk

Trend away from palm oil?

- Western consumer resistance to palm oil use – environmental, health, socio-economic.
- However, palm oil is very productive producing 6-10 times more oil per hectare than temperate crops.
- Palm oil (3.73 kg CO2e/kg refined oil) vs 2.49 kg CO2e/kg for rape seed and 4.25 kg CO2e/kg for soybean oil.
- Two companies looking at single cell oils made from yeast to replace palm oil.
- Range of climatic, pest and disease, government policy or geopolitical factors could impact availability and shipping of PKE.

Impact of PKE on milk composition

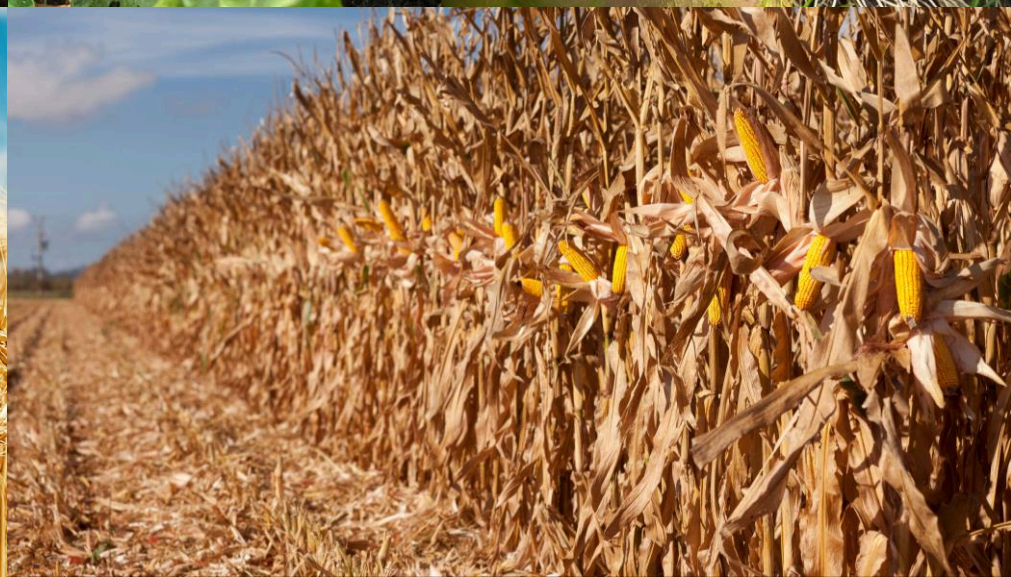
- PKE changes fatty acid profile of milk.
- More short chain fatty acids.
- Milk with higher atherogenic and thrombogenic indices



What would happen if shortage of IPF?

- High prices/shortage of chicken and eggs
- More imported pork
- Impact on farm profitability.
- Not enough feed for the current national herd.
- 2.8 million less tonnes DM – equal to entire feed requirement of 11% of the current national herd.
  - Less production
  - Could be hard to cull surplus stock
  - Potential animal welfare challenges
- **How can we be less reliant on IPF?**

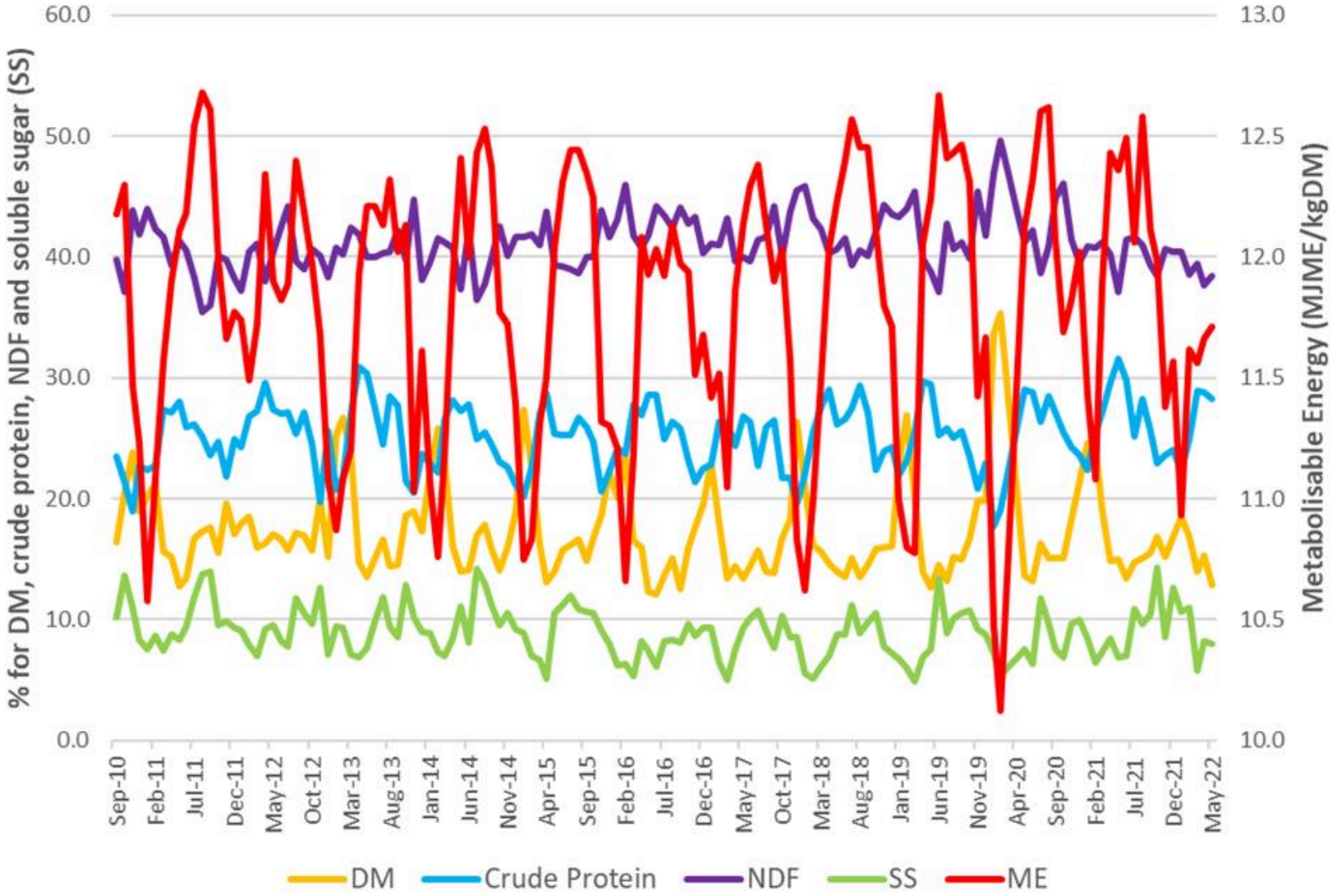
4. Reducing NZ's reliance on internationally produced feed



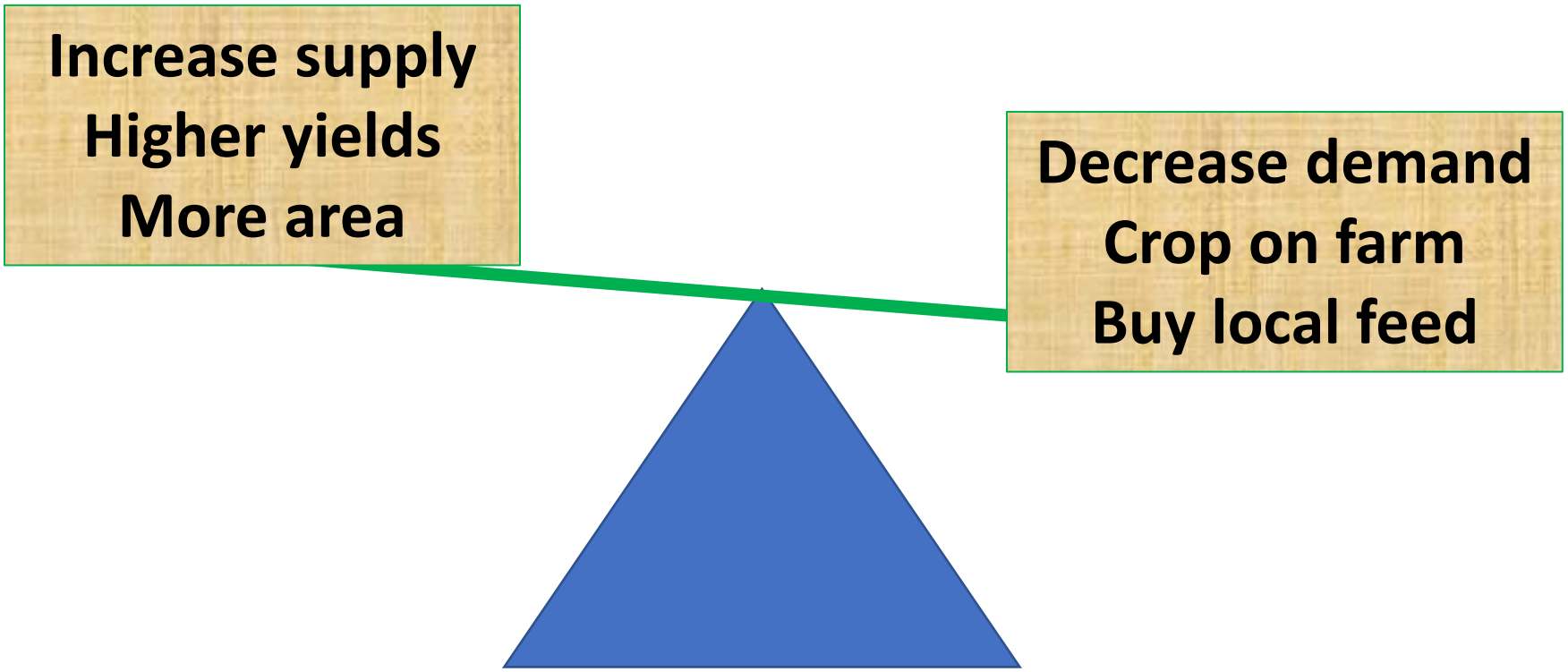
Future demand for IPF – will we need more or less

- Pig and poultry demand likely to remain flat.
- Likely reached “peak cow” will future dairy systems need more or less IPF?
- Environmental regulations and labour shortages are driving an increasing focus on per cow production.
- While pasture yields are likely to remain stable, seasonal growth and quality likely to be more variable.
- Move away from bobby calves will increase calf meal requirements significantly.

Seasonal variation in pasture quality



How can NZ reduce it's demand for IPF?



Increasing grain production in New Zealand

- More yield from the existing area
  - Identifying yield limitations, better hybrids and varieties, improved management practices
- More area planted in grain
  - Māori land
  - Lifestyle blocks
  - Sheep and beef
  - Smaller or uneconomic dairy farms
  - Dairy farms need infrastructure upgrades

Decreasing demand for IPF

- Approach needs to be targeted on dairy farms
- Instead of maintaining high stocking rates with IPF, reduce stocking rates and grow more feed on farm.
- Potential to decrease the environmental footprint of dairy farms.
- In line with published modelling done by DairyNZ which showed farm with decreased stocking rate had slightly lower profitability but less N and less GHG.

4. Growing grain an opportunity for whenua Māori

Māori land in Aotearoa

- 1.47 million hectares of land in NZ.
- Average block is 53 ha with 111 owners.
- Predominately North Is but some in South Is.

Region	No. of Land Titles	Area (ha)
Taitokerau (Northland)	5,478	138,936
Waikato (Waikato/King Country)	3,787	124,197
Waiariki (BOP/Waikato)	5,191	304,667
Tairāwhiti (Gisborne/East Coast)	5,365	269,160
Tākitimu (Hawkes Bay/Wairarapa)	1,417	88,042
Aotea (Whanganui/Taranaki)	4,045	412,558
Te Waipounamu (South Island)	2,235	66,129
Total	27,608	1,403,693

Why Māori land?

- Currently an underutilised resource.
- Small, fragmented blocks which are not really suitable for livestock operations.
- Landowners lack the capital to develop for horticulture.
- Modern arable practices (eg precision agriculture, reduced tillage) align with Māori values of kaitiakitanga.
- Utilising the land aligns deeply with other values including Manaakitanga.

Waikato/King Country case studies

Criteria	Block 1	Block 2	Block 3	Block 4
Active governance	Yes	Yes	No	No
Administrator	Ahuwhenua Trust	Ahuwhenua Trust	Māori Trustee	Māori Trustee
Leased	Yes	Yes	Yes	Yes
Lease tenure	Monthly	Monthly	3 Years	7 Years
Total area (ha)	14.2	23.5	9.4	273
Effective area (ha)	12	21	9.4	90
Dominant soil type	Allophanic - well drained	Allophanic - well drained	Gley - poorly drained	Allophanic - well drained
Dominant slope	<10 degrees	<10 degrees	<10 degrees	20% <10 degrees
NZLRI	LUC4e1, LUC 6e9, LUC3w1	LUC4e1, LUC3w1	LUC3w1, LUC4e1	LUC6e15, LUC6e1, LUC6s1, LUC3w1
Current land use	Pastoral-Maize Silage	Pastoral-Maize Silage	Pastoral-Maize Silage/Store Livestock	Store Livestock

Current land use and returns

	Block 1	Block 2	Block 3	Block 4
Current land use and current returns				
Current Land Use	Pastoral-Maize Silage	Pastoral-Maize Silage	Pastoral-Maize Silage/Store Livestock	Pastoral- Store Livestock
Lease ($/eff ha)	$650	$550	$760	$300
Annual Revenue	$7,800	$11,550	$7,144	$27,000
Net Profit ($)	$4,972	$8,337	$2,218	$20,335
Net Profit per effective hectare	**$414**	**$397**	**$236**	**$226**

Future land use and returns

	Block 1	Block 2	Block 3	Block 4
Effective area (ha)	12	21	9.4	90
Area suitable for grain (ha)	**7**	**8.5**	**6**	**35**
Remaining effective area for grazing (ha)	**5**	**12.5**	**3.4**	**55**
Maize grain return @ $1,431/ha	$10,017	$12,164	$8,586	$50,085
Pastoral return @ $400 (Blocks 1,2 &3) or $300 (Block 4)/ha	$2,000	$5,000	$1,360	$16,500
Rates ($)	$2,828	$3,213	$2,915	$3,165
Net profit ($)	**$9,189**	**$13,951**	**$7,031**	**$63,420**
Net Profit per effective hectare	**$766**	**$664**	**$748**	**$705**
Increase in net profit/ha (%)	**85%**	**67%**	**217%**	**212%**

Key findings of discussion

- Land trusts who manage their own land have a high level of satisfaction with the control they have over their whenua.
- The active land trusts value the information and engagement they currently have with advisors.
- Many positive impacts from land trusts actively managing their land, including supporting kaitiakitanga, building links with communities and personal growth of trustees.
- Industry experts were extremely optimistic about the opportunities Māori landowners to grow maize for grain.

5. On-farm cropping – a solution for the dairy industry

Decreasing demand for IPF

- Whole farm systems modelling using Farmax and OverseerFM
- Five regions – Northland, Waikato/BOP, Taranaki, Canterbury and Southland
- Base models used data for the regions from DairyNZ Economic Farm Survey, Dairy Statistics and the 2019 Dairy NZ report on feed consumed in the dairy industry.

Physical parameters for base farms

	Northland Base	Waikato/ BOP Base	Taranaki Base	Canterbury Base	Southland Base
Effective area (ha)	140	120	107	233	222
Stocking rate (cows/ha)	2.3	2.8	2.7	3.4	2.6
Potential pasture growth (tDM/ha)	10.0	13.6	12.4	16.0	12.4
Nitrogen use per total ha (excl. crops) (kg N/ha)	112	128	145	167	159
Replacement rate (% peak cows milked)	21	23	22	22	22
Planned start calving	14 July	14 July	24 July	31 July	9 August
Avg. BCS at calving	5.0	5.0	5.0	5.0	5.0

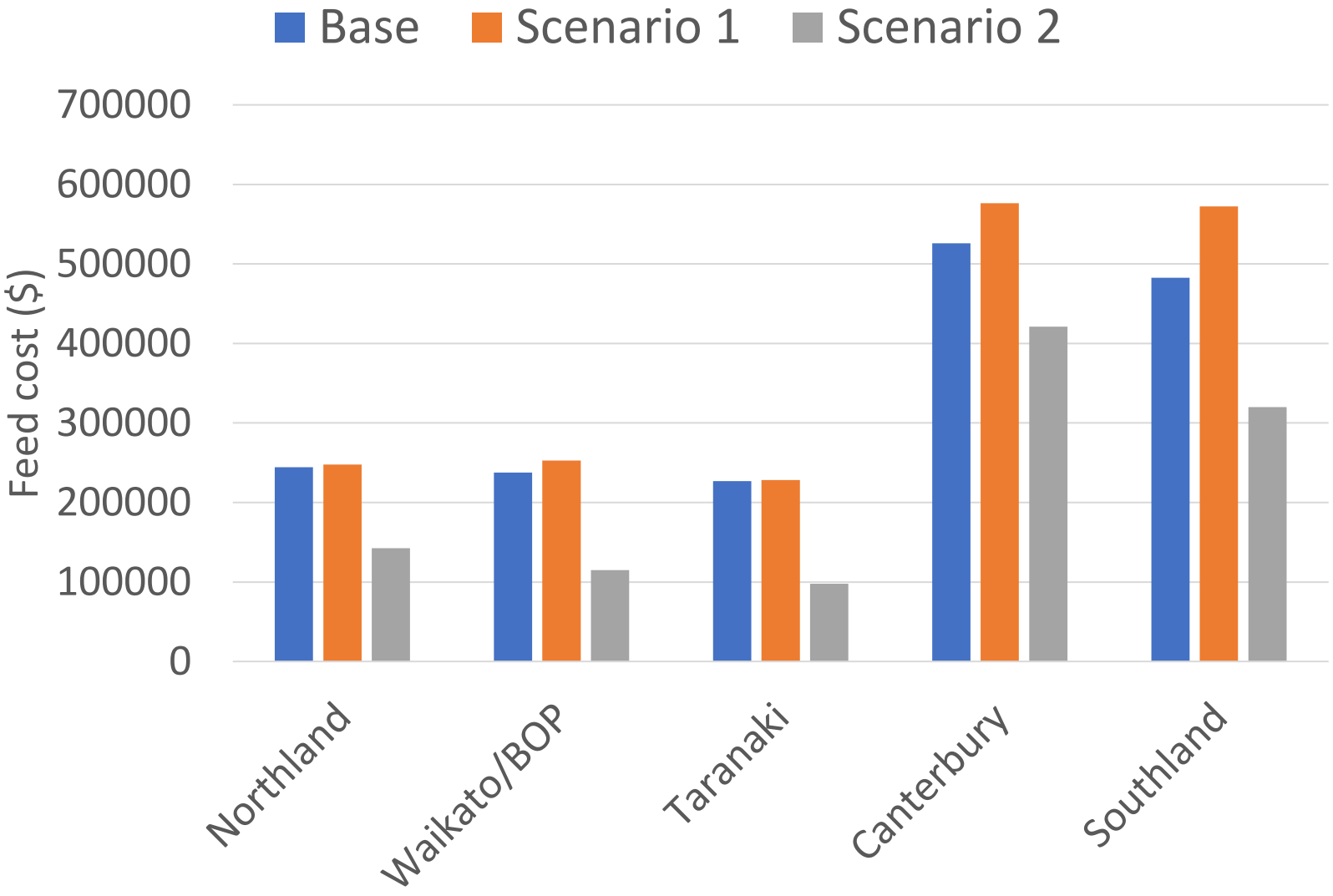
Financial parameters

Milk price ($/kgMS)	$7.00
Pasture silage grown ($/tDM)	$200
Home grown maize silage ($/ha stacked)	$4,000
Bulb turnip grown ($/ha)	$1,800
Fodder beet grown ($/ha)	$3,150
Concentrate price ($/tDM)	$500
Imported maize silage ($/tDM)	$450
Imported pasture silage ($/tDM)	$400
Urea ($/t)	$1,300
Regrassing ($/ha)	$1,000

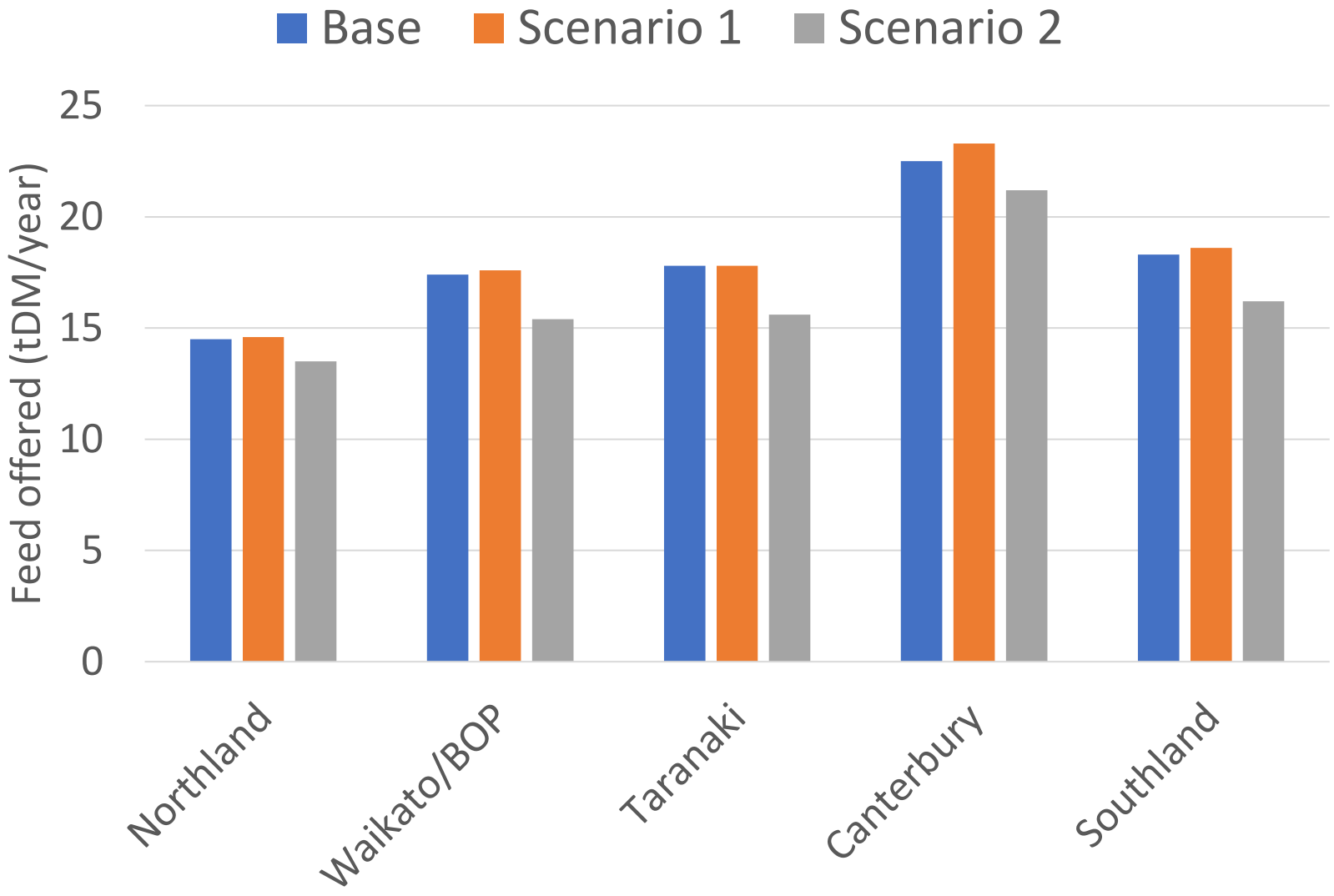
Alternative scenarios

- All of the base models used a mix of imported and homegrown feeds.
- To examine the impact of buying in all feeds or growing all feeds we created two new scenario's:
- **Scenario 1** – all feed imported excluding home-made pasture silage.
- **Scenario 2** – all feed grown on farm – cows still wintered off in Canterbury and Southland as the IWG rules didn't allow on-farm wintering on crop.

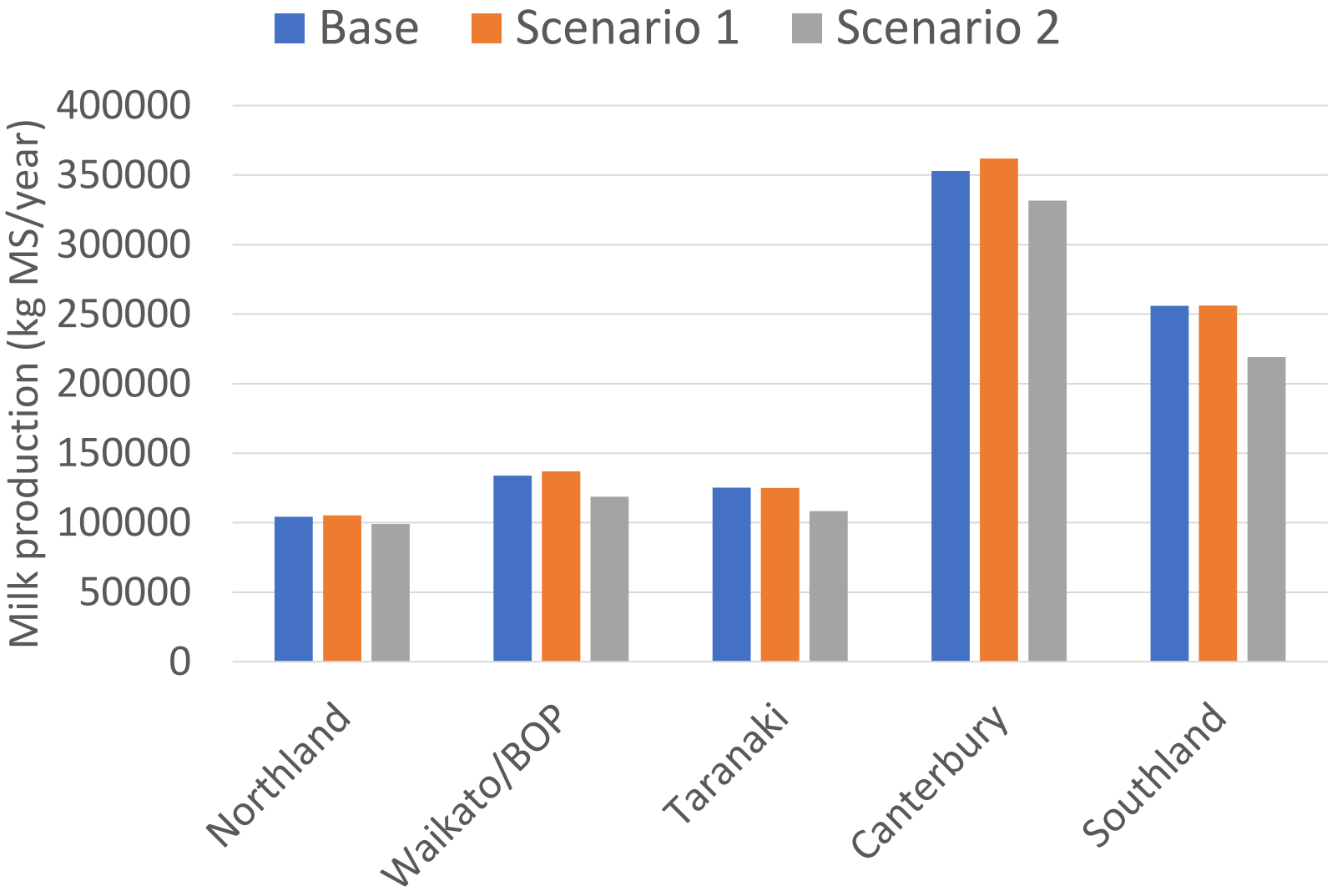
Total feed costs ($/farm)



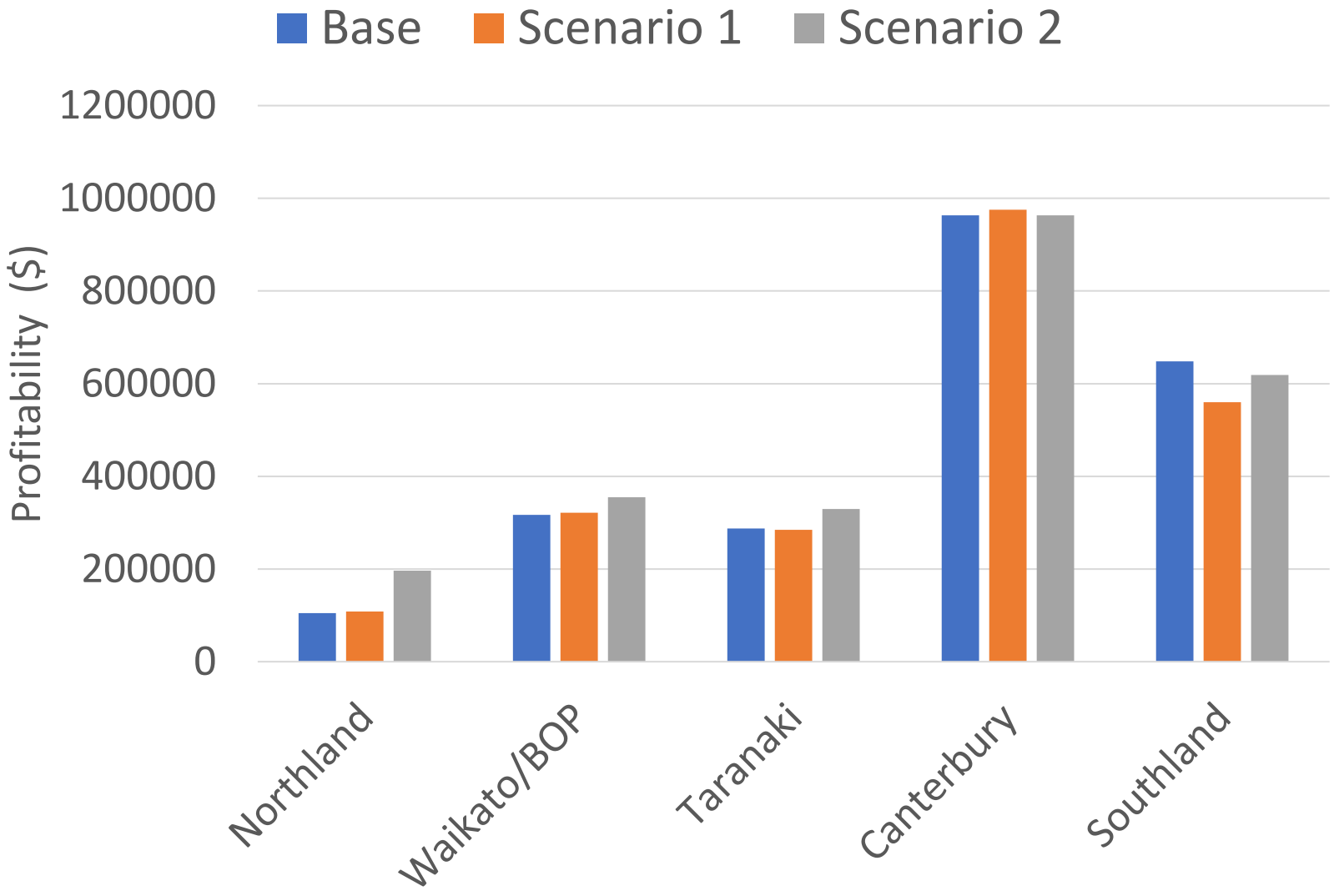
Total feed offered (tDM/yr)



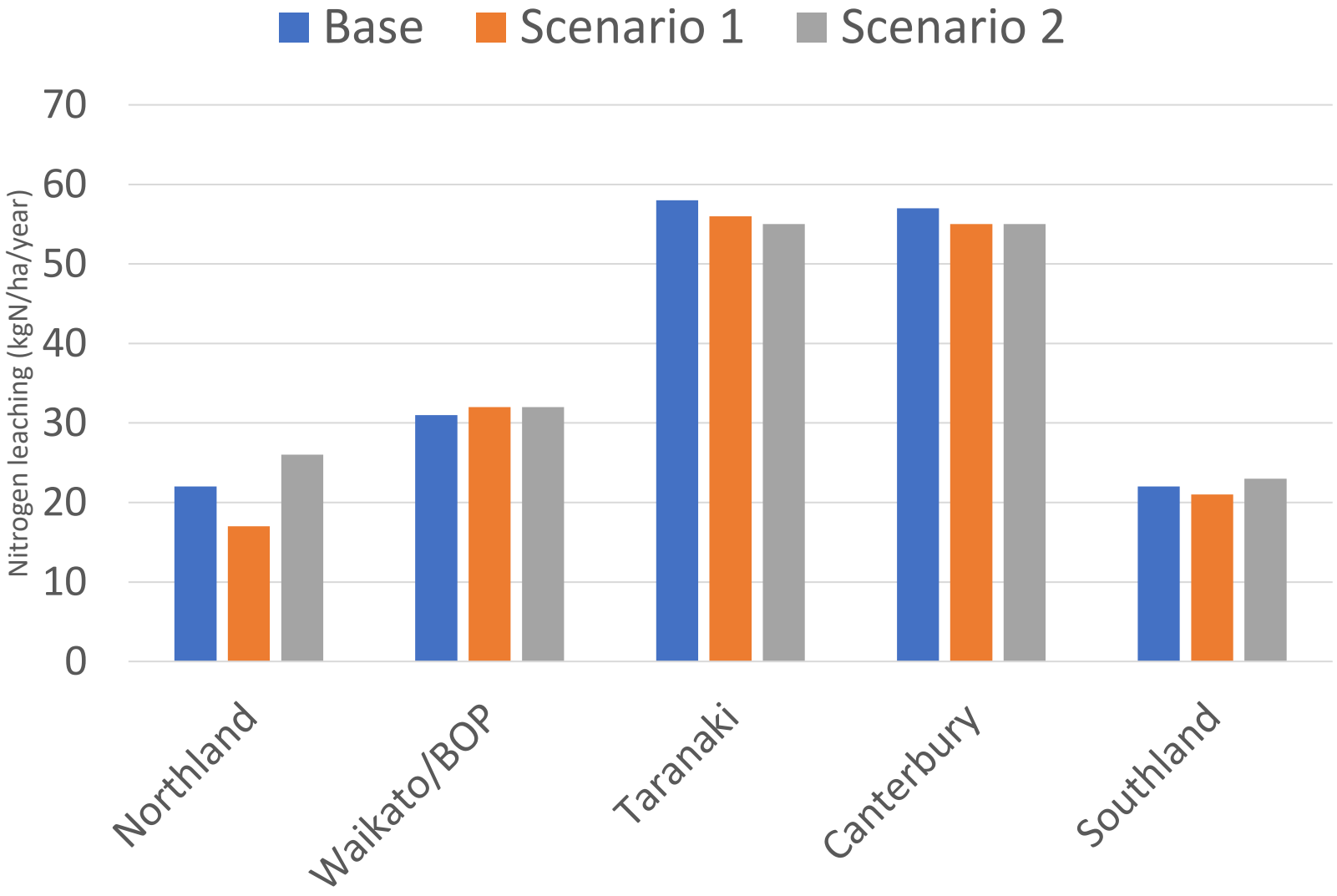
Milk production (kg MS/yr)



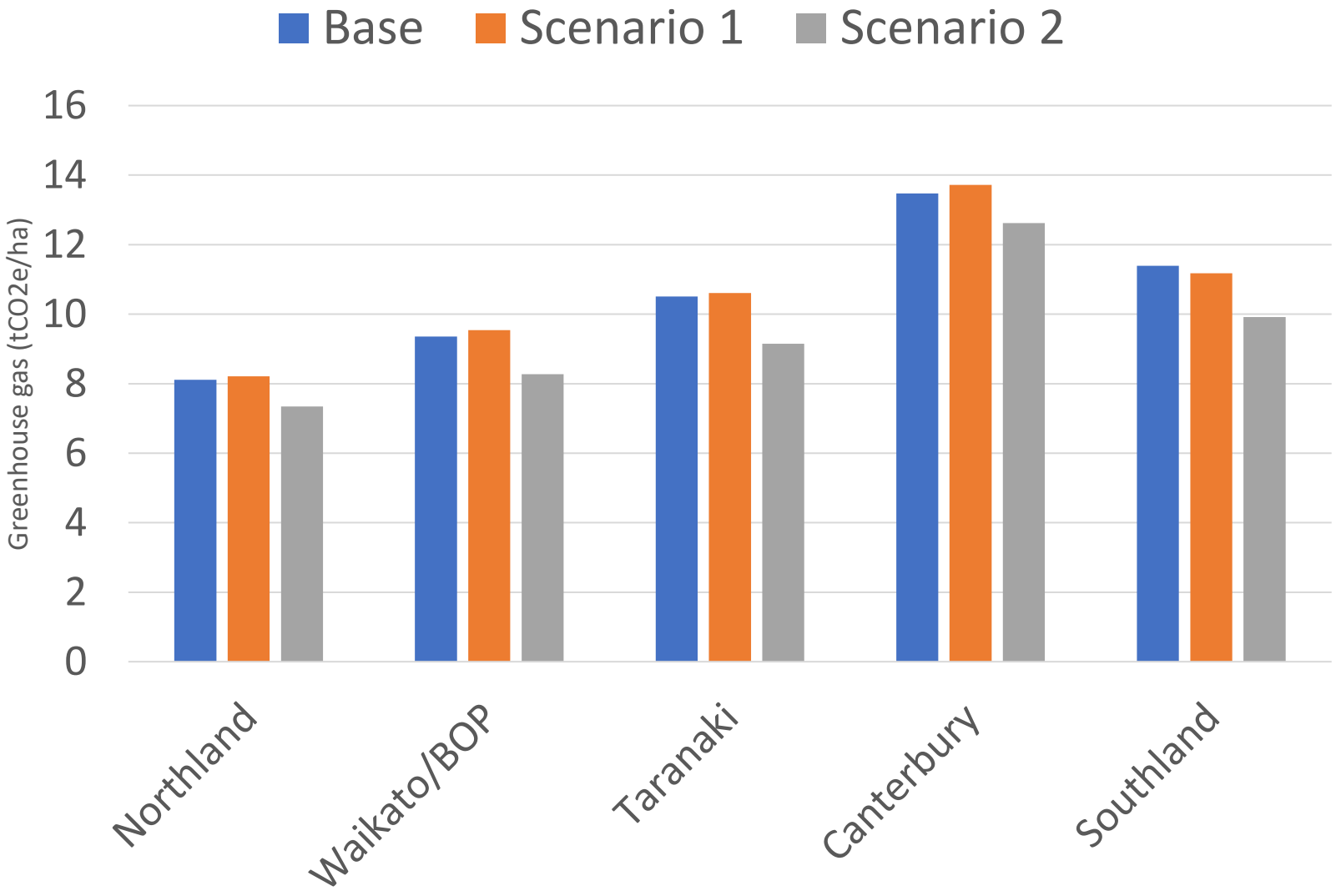
Profitability ($/farm)



Nitrogen leaching (kg/year)



Greenhouse gas (tCO2e/ha)



Sensitivity Analysis - Waikato

Waikato Scenario 2 v Scenario 1

Concentrate Price ($/t DM)	Milk Price ($/kg MS) $ 6.00	**$ 7.00**	$ 8.00	$ 9.00
$ 400	16%	4%	-1%	-4%
$ 450	21%	7%	1%	-2%
$ 500	28%	**10%**	3%	0%
$ 550	35%	14%	6%	1%
$ 600	43%	18%	8%	3%

Sensitivity Analysis – Cant.

Canterbury Scenario 2 v Scenario 1

Concentrate Price ($/t DM)	Milk Price ($/kg MS) $ 6.00	**$ 7.00**	$ 8.00	$ 9.00
$ 400	0%	-3%	-4%	-5%
$ 450	2%	-2%	-4%	-5%
$ 500	3%	**-1%**	-3%	-4%
$ 550	4%	0%	-3%	-4%
$ 600	6%	0%	-2%	-3%

Conclusions

- When compared to the Base, systems growing their own feed reduces milk production by 5-14%.
- Relying in homegrown feed was the most profitable option especially if the milk price was lower and the concentrate was over $500/tDM delivered.
- When compared to the Base scenario, Scenario 2 (all home grown feed) decreased N loss to water in three regions but increased it slightly in two.
- Coupling a low N feed with a feed pad would be expected to further decrease N loss.
- Reducing stocking rate and cropping on farm reduced biological GHG by 6-13%.

6. Reducing our reliance on IPF – the way forward

Increasing NZ grain supply

- NZ imported 3.7 m tonnes of feed in 2002.
- 91% used for livestock feed
- Deduct soymeal, DDG and PKE we are looking to replace around 500,000 tonnes of grain.
- In 2022 New Zealand harvested 900,000 tonnes of grain off 107,000 ha.
- If we kept a similar crop balance and yield, we would need around 60,000 additional grain hectares.
- NZ has enough suitable land, we just need to drive land use change.

Increasing NZ grain supply

Scenario	Average grain yield (t/ha)	Total area to grow 1.4 million tonnes of grain (ha)	Additional area above the current area (ha)
2022 average yield	8.4	166,667	59,667
+5%	8.8	158,730	51,730
+10%	9.2	151,515	44,515

Reducing dairy farmer demand for IPF

- No more land required – just dairy farm systems change.
- Fonterra have already recognised reducing imported feed can decrease on-farm GHG losses.
- They are also interested in embedded losses associated with feeds and PKE has the highest loss.

Conclusions

- On a global basis, only 17% of grain is traded between countries and there is growing demand for biofuel.
- NZ has relatively small arable industry and is a net importer of grain and feeds.
- Our main import is PKE from Malaysia and Indonesia and there are some concerns about long term supply.
- Seventy-five percent of IPF is used in the dairy industry and it is the major user of PKE.

Conclusions

- New Zealand could be less reliant on IPF by growing more grain and reducing dairy farm demand for IPF.
- The opportunities to grow more grain include getting more yield from existing acreage and converting suitable Māori, sheep and beef, lifestyle block or dairy land into arable.
- Dairy farmers could decrease stocking rate and grow more feed on farm.
- Modelling shows that this would decrease milk production but slightly increase profitability and improve environmental performance.

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