Briefing Paper – Phasing out synthetic nitrogen fertiliser

Greenpeace Aotearoa - 2021 Update

The New Zealand Government brought in a cap on synthetic nitrogen fertiliser (**synthetic fertiliser**) as part of the 2020 freshwater reforms. During the consultation period Greenpeace submitted in support of a full phase-out of synthetic fertiliser, along with thousands of New Zealanders. The following briefing makes the case for a full phase-out and includes:

a. A summary of the climate and water quality impacts of synthetic fertiliser and its role in the breach of the safe planetary boundary for nitrogen pollution.
b. An overview of the use of synthetic fertiliser in New Zealand
c. The economic benefits of phasing out its use.
d. Other matters relevant to the need for a full phase-out.
e. How a synthetic fertiliser phase-out could be applied.
f. International examples of synthetic fertiliser prohibitions and stringent caps

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THE CLIMATE IMPACTS OF SYNTHETIC FERTILISER

In essence, the research on the climate impacts shows that:

a. Agriculture is responsible for 48% of New Zealand's emissions. Its emissions have increased 17% since 1990.[1]
b. According to the Ministry for the Environment (**MfE**), this increase: "is primarily due to an 85.6 per cent increase in the national dairy herd since 1990 and an increase in the application of synthetic nitrogen fertiliser of 670 per cent since 1990.." [2]
c. The use of synthetic fertiliser in New Zealand has enabled the intensification of dairy farming. It has led to higher stocking rates and a

[1] Ministry for the Environment 2020, New Zealand Greenhouse Gas Inventory 1990-2018. Page 11 (Link)
[2] Ministry for the Environment 2020, Snapshot - New Zealand's Greenhouse Gas Inventory 1990–2018. Page 4 (link)

substantial increase in the number of dairy cows. [3] This has in turn increased the methane and nitrous oxide emissions from the dairy herd.

d. According to the Parliamentary Commissioner for the Environment (**PCE**): *"The increased use of urea fertiliser has, along with irrigation and supplementary feed, enabled higher stocking rates."* [4]
e. Since 1990, methane emissions from dairy cattle have increased 129%.[5]
f. The dairy herd is now New Zealand's largest emitter, responsible for 22.9% of all domestic emissions.[6]
    a. It is important to note, that this statistic is not representative of the dairy industry emissions in full as it only captures emissions from the cows. It excludes emissions from the roughly 700,000 tonnes of coal burnt for milk dehydration annually[7], transport emissions and offshore emissions from deforestation for supplementary feed.
g. Synthetic fertiliser is a climate pollutant itself, notwithstanding its effect on intensification. It emits nitrous oxide and carbon dioxide when applied to land. These are known as direct emissions.
h. Synthetic fertiliser's direct emissions have increased 512% since 1990. They are now greater than those from the entire domestic aviation industry.[8]

THE WATER QUALITY IMPACTS OF SYNTHETIC FERTILISER

In essence, the research on water quality impacts shows that:

a. The use of synthetic nitrogen fertiliser has enabled the intensification of dairy farming. This has increased pollution from dairying and particularly diffuse nitrogen pollution from urine patches.[9]
b. Nitrogen pollution has a significant negative impact on water quality in New Zealand and this pollution is worsening, overall.[10]

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[3] PCE 2013: Water quality in New Zealand: Land use and nutrient pollution. Page 16. (Link)
[4] Ibid
[5] Ministry for the Environment 2020, New Zealand Greenhouse Gas Inventory 1990-2018. Page 179 (Link)
[6] Ministry for the Environment 2020, Infographic - New Zealand's Greenhouse Gas Inventory 1990–2018. (link)
[7] Ministry of Business and Innovation, 2020. NZ Energy Quarterly Data. (Link)
[8] Ministry for the Environment 2020, New Zealand Greenhouse Gas Inventory 1990-2018. Page 41. (link)
[9] Parliamentary Commissioner for the Environment 2013: Water quality in New Zealand: Land use and nutrient pollution. Page 16 (Link)
[10] Ministry for the Environment & Stats NZ 2017: New Zealand's Environmental Reporting Series: Our fresh water 2017 Pages 9 and 10. (Link)

c. The nitrogen balance 1998 - 2009 has worsened more than in any other OECD country,[11] primarily due to expansion and intensification of dairy.

d. Synthetic nitrogen fertiliser is a water pollutant itself, notwithstanding its effect on intensification.[12]

e. The largest sources of nitrogen pollution into New Zealand's rivers, in order of magnitude, are; urine from dairy cattle, urine from sheep followed by synthetic nitrogen fertiliser itself.[13]

f. According to MfE, *"Between 1990 and 2012, the estimated amount of nitrogen that leached into soil from agriculture increased 29 percent. This increase was* ***mainly due to increases in dairy cattle numbers*** *(and therefore urine which contains nitrogen) and* ***nitrogen fertiliser use****."* [14]

g. At elevated levels, nitrate in drinking water impacts on human health. At levels higher than the World Health Organisation (**WHO**) limit nitrate contamination can be fatal. Many groundwater wells already exceed this limit.[15]

h. Recent research indicates that nitrate levels much lower than the WHO limit, are associated with an increased risk of colorectal cancer. [16] [17]

i. The Canterbury Medical Officer of Health has warned nitrate contamination is a looming public health risk in Canterbury[18], which is home to the highest stocking rates and highest synthetic fertiliser use in the country.[19]

THE SAFE PLANETARY BOUNDARIES

[11] OECD 2017, OECD Environmental Performance Reviews: New Zealand 2017, OECD Publishing. Page 36 (Link)

[12] Ministry for the Environment & Stats NZ 2017: New Zealand's Environmental reporting series : Freshwater and nitrogen leaching. (link)

[13] Ibid

[14] Ministry for the Environment & Statistics New Zealand (2015). New Zealand's Environmental Reporting Series: Environment Aotearoa 2015. Page 54. (Link)

[15] Ministry for the Environment & Stats NZ 2017: New Zealand's Environmental Reporting Series: Our fresh water 2017 Page 55. (Link)

[16] Espejo- Herrera, et al. 2016 "Colorectal Cancer Risk and Nitrate Exposure through Drinking Water and Diet." International Journal of Cancer, vol. 139, no. 2, 2016, pp. 334–346.

[17] Schullehner, J., Hansen, B., Thygesen, M., Pedersen, C.B. and Sigsgaard, T., 2018. Nitrate in drinking water and colorectal cancer risk: A nationwide population-based cohort study. *International journal of cancer*, *143*(1), pp.73-79.

[18] https://www.rnz.co.nz/national/programmes/outspoken/audio/2018627863/outspoken-canterbury-water

[19] DairyNZ 2019, New Zealand Dairy Statistics 2018-19, Pg 16 (link) AND StatsNZ, Agricultural Production statistics, final results by farm type accessed via www.stats.govt.nz (Link)

a. Scientists have identified a set of nine ecological and biophysical limits within which the Earth can continue to sustain human society. These are known as the '**safe planetary boundaries.**'[20]
b. A diagram of the boundaries and the human impact on them so far is in Appendix 1.
c. Scientists warn: *"Transgressing one or more planetary boundaries may be deleterious or even catastrophic due to the risk of crossing thresholds that will trigger non-linear, abrupt environmental change within continental- to planetary-scale systems."*[21]
d. There are three planetary boundaries that have already been breached. They are biodiversity loss, climate change and the nitrogen cycle.[22]
e. The impacts of the nitrogen cycle breach are many and are already being seen around the world. They include; the rapid growth in nitrous oxide emissions, freshwater pollution, ozone depletion, acid rain, oceanic dead zones, loss of potable drinking water and human illnesses.[23]
f. Moreover, nitrogen pollution impairs humanity's efforts to return to or remain within a number of the other planetary boundaries, including stratospheric ozone depletion and climate change.[24]
g. Synthetic nitrogen fertiliser is the single largest cause of this breach.[25]

AN OVERVIEW OF THE USE OF SYNTHETIC FERTILISER IN NEW ZEALAND

Synthetic nitrogen fertiliser is manufactured using fossil fuel gas and a chemical process called "Haber-Bosch", which extracts inert nitrogen from the atmosphere and converts it to a form plants can use to grow.[26] In the 1980's the Muldoon Government built the synthetic fertiliser factory in Kapuni, Taranaki.[27] Since then synthetic fertiliser use has grown rapidly. The data on synthetic fertiliser use in NZ shows that:

a. New Zealand has had the highest rate of increase in synthetic nitrogen fertiliser use in the OECD.[28]

[20] Rockstrom, J., W. et. al 2009. Planetary boundaries: exploring the safe operating space for humanity. Ecology and Society 14(2): 32. Page 1 (Link)
[21] Ibid
[22] Ibid
[23] Fields, S., 2004. Global nitrogen: cycling out of control. *Environmental Health Perspectives*, *112*(10), Page 560 (link)
[24] Kanter, D.R., Chodos, O., Nordland, O., Rutigliano, M. and Winiwarter, W., 2020. Gaps and opportunities in nitrogen pollution policies around the world. *Nature Sustainability*, Page 1. (Link)
[25] Rockstrom, J., W. et. al 2009. Planetary boundaries: exploring the safe operating space for humanity. Ecology and Society 14(2): 32. Page 20 (Link)
[26] Fields, S., 2004. Global nitrogen: cycling out of control. *Environmental Health Perspectives*, *112*(10), Page 558 (link)
[27] Stephen Levine, 2006 *New Zealand as it Might Have Been, Volume 1* Victoria University Press, Page 168 (Link)
[28] OECD 2008 Environment Performance of Agriculture in OECD countries . Page 54 (Link)

b. Since 1991, the annual application of synthetic nitrogen has increased 629% (just over a sixfold increase), from 62,000 to 452,000 tonnes in 2019[29] See figure 1 Appendix 2.
    a. **Note**: this is the percentage and tonnage of nitrogen applied as fertiliser, not as the bulk weight of urea, DAP etc.[30]
c. The regions applying the most fertiliser in order of magnitude are: Canterbury, Waikato, Southland, Taranaki, Manawatū-Whanganui.[31] See figure 3 in Appendix 3
d. Synthetic nitrogen is applied via various fertilisers, all of which have different amounts of synthetic nitrogen in them. The majority is applied via urea followed by, diammonium phosphate (**DAP**) and ammonium sulphate (**SOA**).
e. Urea contains 46% synthetic nitrogen, DAP 17.6% and SOA 20%.[32]
f. **Important note:** The data on synthetic fertiliser use in Aotearoa is **self-reported** and is almost certainly an underestimate because it does not account for the true total synthetic nitrogen used, only that which is found used in urea, SOA and DAP, and not the "other" fertiliser category.
    a. According to statsNZ **"**Farmers provide tonnes of urea, DAP, SOA, and 'other' fertilisers applied over the year ending 30 June… We do not know the nitrogen component of fertilisers included in the 'other' category, so do not report on them here."
g. Around 265,000 tonnes of urea is made annually at the factory in Kapuni, Taranaki.[33] The rest of the synthetic fertiliser used in New Zealand is imported, mostly from Saudi Arabia, Malaysia and China.

Between 2002 to 2019[34]:

a. Dairy farms increased synthetic nitrogen use by 100%
b. Grain farms increased synthetic nitrogen use by 187%
c. Canterbury dairy farms increased synthetic nitrogen use by 306%.
d. Southland had the largest total increase in nitrogen use - 164%.

RATES OF APPLICATION BY LAND-USE

Important notes on accuracy of statistics:

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[29] Stats NZ. "Fertilisers – nitrogen and phosphorus" (2021) Accessed August 2021 https://www.stats.govt.nz/indicators/fertilisers-nitrogen-and-phosphorus
[30] Ibid
[31] Ibid
[32] Ibid
[33] Ballance Agri-Nutrients 2017: Submission on New Zealand Productivity Commissions Low Emissions economy. Page 15 (link)
[34] Stats NZ. "Fertilisers – nitrogen and phosphorus" (2021) Accessed August 2021 https://www.stats.govt.nz/indicators/fertilisers-nitrogen-and-phosphorus

- There are several discrepancies both within StatsNZ data, and between StatsNZ and Fertiliser association data and the data used by the Government in official reports.
- All sets of differing statistics are given here and the discrepancies within the StatsNZ data are highlighted.
- The StatsNZ data has a significant chunk of synthetic N use listed as being used by "other" land-use (26% of the total, or 118,397 tonnes). If this was all actually used by dairy or dairy support then the statistics align much more closely with the fertiliser association.

a. By volume the dairy industry is the largest user of synthetic nitrogen.[35] See figure 2 in Appendix 2.
b. According to **Stats NZ's data**, in 2019[36]:
    i. Dairy used 67% (223,000 tonnes).[37]
    ii. Sheep and Beef used 17.6% (79,380 tonnes)
    iii. Grain Growing/Arable used 4.2% (19,159 tonnes)
    iv. Vegetable growing used 1.2% (5,254)
    v. Other livestock used 1% (4,320 tonnes)
    vi. Fruit and Berry used 0.2% (958 tonnes)
    vii. Forestry used 0.2% (1009 tonnes)
    viii. The livestock sector together (dairy, sheep, beef and other livestock) used 68% of the total (306,700 tonnes)
    ix. The horticulture sector together (vegetable, fruit and berry) used 1.4% (6,212 tonnes)
c. Using the statistics NZ data the average rate of synthetic N/ha in 2019 are as follows:
    i. Dairy - 102 kg/ha
    ii. Sheep and Beef - 11 kg/ha
    iii. Grain Growing/Arable - 39 kg/ha
    iv. Horticulture (Vegetable growing, Fruit and Berry) 47 kg/ha

d. However, the **fertiliser Association data** is very different, they report that in 2017[38]:
    i. Dairy used 66.5% (294,551 tonnes)
    ii. Sheep and beef used 24.5% (108,688 tonnes)
    iii. Arable/Grain growing used 6.6%, (29,415 tonnes)
    iv. Horticulture excl. vegetable growing used 0.5% (2,216 tonnes)

[35] Ibid.
[36] Ibid.
[37] This is reported as 67% on the StatsNZ website. However this calculation is somewhat confusing because 223,000 tonnes is not 67% of 452,000 tonnes. It's 49%. Fertiliser Association reports 294,551 tonnes (a greater tonnage than StatsNZ) is equivalent to 66.5% (a lesser percentage than StatsNZ).
[38] AgFirst, 2020. Value of N Fertiliser Report 2 (link)

    v. Vegetable growing used 1.3% (5,670 tonnes)

e. Using the fertiliser association data the average rate of synthetic N/ha in 2017 were:
    i. Dairy is the highest per hectare user, using on average 120 kg/ha.
    ii. Arable is the second highest user per hectare, using on average 80 kg/ha.
    iii. Vegetable growing is the third highest user, using on average 72 kg/ha.
    iv. The average per hectare use in horticulture (excluding vegetable production) is 17 kgs/ha.
    v. The average per hectare use of the largest land-user in New Zealand, pastoral sheep and beef farming, is only 12 kg/ha.

f. Different again, the Government says:
    i. "Current average rates of nitrogen fertiliser use vary between the sectors and regions, ranging from 222 kg N/ha on dairy farms in Canterbury, to 102 kg N/ha on dairy farms in Northland (2017/18 data), with rates of around 9-18 kg N/ha in the drystock sector. "[39]
    ii. "In the horticulture and arable farming sectors, rates vary much more widely, with low rates applied to most fruit crops, and high rates recommended for many vegetable crops (in excess of 200 kg N/ha in some cases)"[40]

ECONOMICS AND YIELDS

Studies show that getting rid of synthetic fertiliser is a Win-Win for farmers and the environment:

a. A ten year in-field study by DairyNZ compared a farm with no synthetic nitrogen application and a farm using 181/kg/ha/yr of urea. It found that in a system using no synthetic nitrogen at all:
    a. **"profitable milk production systems can be achieved without N fertiliser applications**"
    b. At lower milk price ($4.60 kg/MS) the farm using no synthetic N **was more profitable** than the one using 181 kgs. [41]

[39] Ministry for the Environment, 2020 "Regulatory Impact Analysis Action for healthy waterways Part II: Detailed Analysis p.264 (Link)

[40] Ibid.

[41] Glassey, C.B., Roach, C.G., Lee, J.M. and Clark, D.A., 2013. The impact of farming without nitrogen fertiliser for ten years on pasture yield and composition, milksolids production and profitability; a research farmlet comparison. In *Proceedings of the New Zealand Grasslands Association*. Vol. 75. Page 71 (Link)

b. A recent economic model done by the NZ Landcare Trust compared farms with varying stocking rates, fertiliser use and imported feed. It found that:
    a. **The farm with the lowest synthetic fertiliser** use and the second smallest herd **had the largest increase in profitability (29%)** and a 13% reduction in nitrate leaching and an 18% reduction in GHG emissions.[42]

c. A decade long study in the USA found that a farm can reduce 100 kg/ha of nitrogen fertiliser by simply increasing the varieties of pasture crops used in the field from 1 to 16 species, and still produce the same yield as the farm using the 100 kgs/N/ha.[43]

d. A global meta-analysis used financial performance of organic and industrial agriculture from 40 years of studies covering 55 crops on five continents and found: **Organic agriculture was significantly more profitable than industrial agriculture.**[44]

e. A field study in the USA on vegetable farms found soil health and fertility was higher on farms that were not using synthetic fertiliser than on farms that were. By the **second year the vegetable farms using no synthetic fertiliser had higher yields**.[45]

f. A field study in the USA, done over two decades, compared a mixed organic crop and livestock farm and a monoculture crop system that used synthetic fertiliser. It found that in 4 out of the 5 drought years the **organic maize and soybean out yielded the synthetically fertilised monoculture by significant margins**[46]

OTHER MATTERS RELEVANT TO THE NEED FOR A SYNTHETIC FERTILISER PHASE-OUT

Notwithstanding the above evidence regarding the significant environmental impacts of synthetic fertiliser use and the economic benefits of phasing out its use, these additional arguments support the case for a phase-out of synthetic fertiliser.

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[42] A.J. Litherland (NZ Landcare Trust), B. Riddler (E2M modelling), M. Langford (Fonterra), M Shadwick (DairyNZ) 2019. CASE STUDY Finding a win-win for the farmer and the environment. Page 2 (Link)

[43] Tilman, D., Reich, P.B. and Isbell, F., 2012. Biodiversity impacts ecosystem productivity as much as resources, disturbance, or herbivory. *Proceedings of the National Academy of Sciences*, *109*(26), pp.10394-10397. Page 1 (Link)

[44] Crowder, D.W. and Reganold, J.P., 2015. Financial competitiveness of organic agriculture on a global scale. *Proceedings of the National Academy of Sciences*, *112*(24), Page 7611. (Link)

[45] Bulluck Iii, L.R., Brosius, M., Evanylo, G.K. and Ristaino, J.B., 2002. Organic and synthetic fertility amendments influence soil microbial, physical and chemical properties on organic and conventional farms. *Applied Soil Ecology*, *19*(2), pp.147-160. Link here

[46] Lotter, D.W., Seidel, R. and Liebhardt, W., 2003. The performance of organic and conventional cropping systems in an extreme climate year. *American Journal of Alternative Agriculture*, *18*(3), pp.146-154.

The failure of industry self-regulation

a. There are currently no regulatory or financial policies in place to reduce greenhouse gas emissions from agriculture in New Zealand.
b. There is only a non-enforceable emissions target in the Zero Carbon Act and a plan to make the industry pay for only 5% of its emissions in 2025.
c. Instead of taking legislative action the Government has signed a voluntary agreement with the agricultural the industry called 'He Waka Eke Noa'.[47]
d. This is an example of 'industry self-regulation' which often comprises of voluntary commitments, codes of best-practice and industry-led media campaigns designed to shift responsibility for issues away from companies and onto individual consumers.[48]
e. Industry self-regulation was initially used aggressively by the Tobacco industry for decades to deflect legislative action that would damage their profits.[49]
f. Since then, several industries have also attempted to avoid government regulation and placate concerned stakeholders by promising to reduce their environmental impacts voluntarily.[50]
g. There are few, if any, examples where industry self-regulation has worked for the public good. Instead, there is now substantive evidence that industry self-regulation is ineffective and fails to protect environmental[51] or human health[52].
h. The most applicable and recent example of the failure of industry self-regulation in New Zealand is the **'The Dairying and Clean Streams Accord'**. This was an agreement signed between Fonterra, the Government and Regional Councils in 2003. Its aim was to protect water from dairy pollution and it was used in place of stringent state enforced regulatory protections. Since it was signed in 2003, water pollution from intensive dairying has increased demonstrably.[53]
i. The climate equivalent of the failed Clean Streams Accord is 'He Waka Eke Noa'. The evidence in the literature and in New Zealand's recent

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[47] https://www.mfe.govt.nz/climate-change/he-waka-eke-noa-primary-sector-climate-change-action-partnership
[48] Lisa L. Sharma, Stephen P. Teret, and Kelly D. Brownell, 2010: The Food Industry and Self-Regulation: Standards to Promote Success and to Avoid Public Health Failures. American Journal of Public Health 100. Pages 240 and 244 (Link)
[49] Ibid
[50] Lenox, M.J. and Nash, J., 2003. Industry self-regulation and adverse selection: A comparison across four trade association programs. *Business strategy and the environment*, *12*(6), pp.343-44. (Link)
[51] Gamper-Rabindran, S. and Finger, S.R., 2013. Does industry self-regulation reduce pollution? Responsible Care in the chemical industry. *Journal of Regulatory Economics*, *43*(1), Page 1. (Link)
[52]Noel, J.K., Babor, T.F. and Robaina, K., 2017. Industry self-regulation of alcohol marketing: a systematic review of content and exposure research. *Addiction*, *112*, Page 28. (Link)
[53] Ministry for the Environment & Stats NZ 2017: New Zealand's Environmental Reporting Series: Our fresh water 2017 (Link)

experience with agricultural industry self-regulation suggests He Waka Eke Noa will fail just as the Accord has.

'Input controls' and unambiguous rules.

a. New Zealand has been primarily using an effects-based approach to regulating environmental harm through the Resource Management Act. This has not proven to be an adequate approach to environmental management on its own, as evidenced by the ongoing degradation of the environment across most indicators.[54]
b. Effects-based management must now be coupled with input controls when there is substantive evidence of a pollutant causing environmental harm, as is the case for synthetic fertiliser.
c. Relying solely on effects-based management is problematic for agriculture, because diffuse nutrient loss from farms is difficult to measure.[55]
d. The main software used to measure nutrient loss on farms and increasingly being used in monitoring and enforcement is Overseer. It is part-owned by the fertiliser industry[56] which has a vested financial interest in maintaining and growing the use of large volumes of synthetic fertiliser. This is a clear-cut example of regulatory capture.
e. A solely effects-based regime also puts the bulk of the responsibility for meeting regulations onto farmers, of which there are nearly 30,000. The volume of farmers, coupled with complexity of measuring nutrient loss, makes monitoring and enforcement difficult for Government bodies to deliver.
f. The first global meta-analysis on nitrogen policy, which examined more than 2,700 nitrogen policies in 186 countries, states that: "*most policies to address agricultural nitrogen pollution focus on changing farmer behaviour, and doing so is extremely difficult because of challenges in monitoring and enforcement*."[57]
g. Measuring, controlling, monitoring and enforcing inputs is significantly simpler.
h. This is especially the case for synthetic fertiliser as there are essentially only two companies selling it in New Zealand.
i. The meta-anaylsis recommends: "*policymakers focus on agri-food chain actors beyond the farm capable of influencing farm-level N management, from* ***the fertilizer industry*** *to wastewater treatment companies. This*

[54] Ministry for the Environment & Stats NZ 2017: Infographic - New Zealand's Environmental at a Glance (Link)
[55] Parliamentary Commissioner for the Environment, 2018 *Overseer and regulatory oversight: Models, uncertainty and clianing up our waterways*. Page 15 (Link)
[56] Ibid. Page 9.
[57] Kanter, D.R., Chodos, O., Nordland, O., Rutigliano, M. and Winiwarter, W., 2020. Gaps and opportunities in nitrogen pollution policies around the world. *Nature Sustainability*, Page 5. (Link)

would shift the regulatory burden away from farmers and thereby ***transform an intractable non-point-source problem into a series of more manageable point-source approaches***"[58]

APPLICATION OF A SYNTHETIC FERTILISER PHASE OUT IN NEW ZEALAND

The fertiliser supply chain

There are only two companies selling 98% of all the fertilisers used in New Zealand, Ravensdown and Ballance Agri-nutrients. Both are co-operatives that hold substantial information about their shareholders (fertiliser users) and the amount sold to them. They are selling both imported and domestically-produced synthetic fertiliser. This is purchased by fertiliser users and picked up from various distribution centres around the country. It is then applied by the users themselves or through an aerial or ground spreading company.

Internationally there are various parts of the synthetic fertiliser supply chain that have been regulated. Some have controlled synthetic fertiliser only at the point of use (on-farm), some have done so at the point of sale, and some at the point of import. Currently the synthetic nitrogen fertiliser cap in New Zealand is only regulating the on-farm use.

When considering how to apply a fertiliser cap in a jurisdiction it is appropriate to consider the "narrowest" part of the process. Regulating this narrow part enables clear regulations for control and easy parameters for monitoring, enforcement and compliance mechanisms. In New Zealand the narrowest point is clearly at the point of sale, given the market is dominated by two companies.

Greenpeace Recommendations

a. Based on the above evidence of synthetic fertiliser's significant environmental impacts and the evidence of the ability to farm profitably without it, Greenpeace recommends a full and regulatory phase-out of synthetic fertiliser.
b. We recommend this is applied both on-farm and monitored and enforced by Regional Councils and at the point of sale, with vendors monitored, and regulation enforced by a central government agency.

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[58] Ibid

c. Greenpeace recommends the initial limit be set at 60 kg/N/ha per year in 2021, reduced to 40kg in 2022, 20 kg in 2023 and 0 kg by 2024.
d. At this point, in 2024, we recommend the regulation be widened to prohibit not only the sale and use of synthetic fertiliser but also its importation and production.
e. We recommend the Government invests in providing the support and infrastructure needed to help farmers wean off synthetic fertiliser, by making the investments laid out in our Regenerative Farming Fund Proposal.[59]

INTERNATIONAL REVIEW

Many jurisdictions have adopted synthetic fertiliser prohibitions or caps to avoid adverse effects. The following outlines some of these international examples and associated improvements in water quality.

a. ***European Union:*** The 1991 European Union (EU) Nitrates Directive[60] designates Nitrate Vulnerable Zones (NVZs) which cover about 47% of the total EU area recognising the importance of groundwater in the drinking water supply. The directive requires EU member states to limit nitrate contamination to the equivalent to a stocking rate of one cow per ha.[61] It also allows states to completely prohibit fertiliser use in certain periods in NVZs.
b. The whole agricultural area in Denmark is a NVZ. As a result, there has been a **40% reduction in the nitrogen surplus of the country from 1980s-2010.**[62] Danish rules considered successful with regard to the input control of fertiliser have included farm monitoring and obligatory reporting from fertiliser suppliers.[63]
c. ***Minnesota:*** Minnesota has **prohibited the use of synthetic fertiliser** in Autumn and when the ground is frozen in designated "vulnerable groundwater areas" and "drinking water supply management areas. It also allows for the Government to set regional **caps and other controls on fertiliser** in areas with consistently high nitrate levels in groundwater. It is applicable to synthetic fertiliser only. The rule came

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59 https://storage.googleapis.com/planet4-new-zealand-stateless/2020/05/3e54dd9c-govt-investment-in-regenerative-agriculture-greenpeace-nz.pdf

60 European Commission: The Nitrates Directive. Link

61 Mateo-Sagasta, J., S. Zadeh, and H. Turral. (2018).

62 Dalgaard, T., Hansen, B., Hasler, B., Hertel, O., Hutchings, N. J., Jacobsen, B. H., Jensen, L. S., Kronvang, B., Olesen, J., Schjorring, J. K., Kristensen, I. S., Graversgaard, M., Termansen, M. and Vejre, H. (2014) Policies for agricultural nitrogen management - trends, challenges and prospects for improved efficiency in Denmark. Environmental Research Letters 9, 115002. Page 11 (Link)

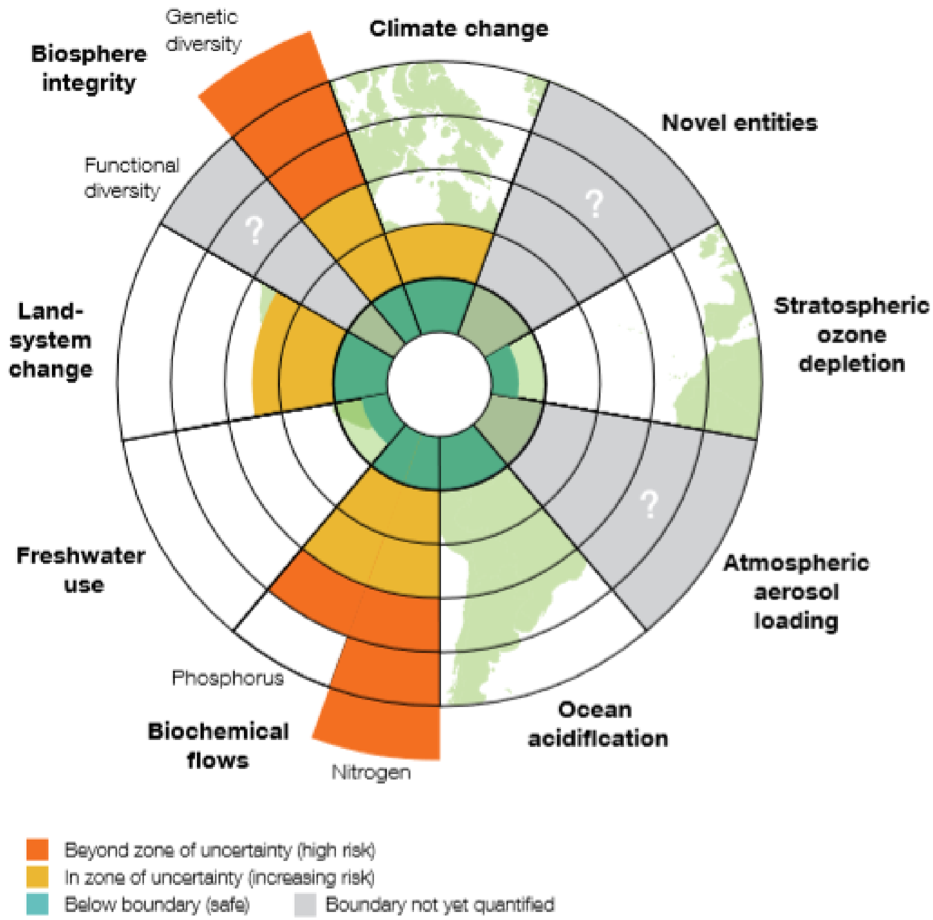
63 N.J Hutchings 2017. *A case study of agricultural nitrogen management policy in Denmark, Vera Eory, Scotlands Rural College.* Aarhus University. Page 6 (Link)

into effect in January 2020 so we are not able to report water quality benefits yet. [64]

d. ***The state of Sikkim in Northern India***: Completely **prohibited not only the use of but also the import and sale of chemical fertilisers and pesticides** in 2014.[65] Sikkim began its program to go fully organic, state-wide, in 2003. It started by reducing government subsidies on synthetic inputs by 10% each year coupled with major public funding, education and investment in transitioning its 66,000 farmers to certified organic.[66] It has now achieved this transition, all farmers are certified organic and synthetic inputs are banned. **There has been a marked increase in water quality, which has in turn led to a significant rise in tourism, as the state now successfully markets itself as a health destination**[67].

[64] https://www.mda.state.mn.us/nfr
[65] http://www.lawsofindia.org/pdf/sikkim/2014/2014Sikkim10.pdf
[66] https://www.futurepolicy.org/healthy-ecosystems/sikkims-state-policy-on-organic-farming-and-sikkim-organic-mission-india/
[67] http://www.fao.org/india/news/detail-events/en/c/1157760/

Appendix 1[68]



Planetary boundaries showing changes that are shifting Earth into a "new state" that is becoming less hospitable to human life, as updated by the newest research published in Science in 2015. Pollution with nitrogen and phosphorous fertilisers, together with Biosphere Integrity (Biodiversity), are the two planetary boundaries under the high-risk zone for disruption of life on Earth (Steffen et al., 2015). The 'novel entities' boundary refers to "new substances, new forms of existing substances, and modified life forms that have the potential for unwanted geophysical and/or biological effects" (e.g. microplastics, nanoparticles or genetically engineered organisms) (refs. 68-71, Steffen et al., 2015). Graphic © theguardian.com (2015).

[68] Adapted by The Guardian from Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F.S., Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H.J. and Nykvist, B., 2009. Planetary boundaries: exploring the safe operating space for humanity. *Ecology and society*, *14*(2).

Appendix 2 - Graphs of synthetic nitrogen use in Aotearoa

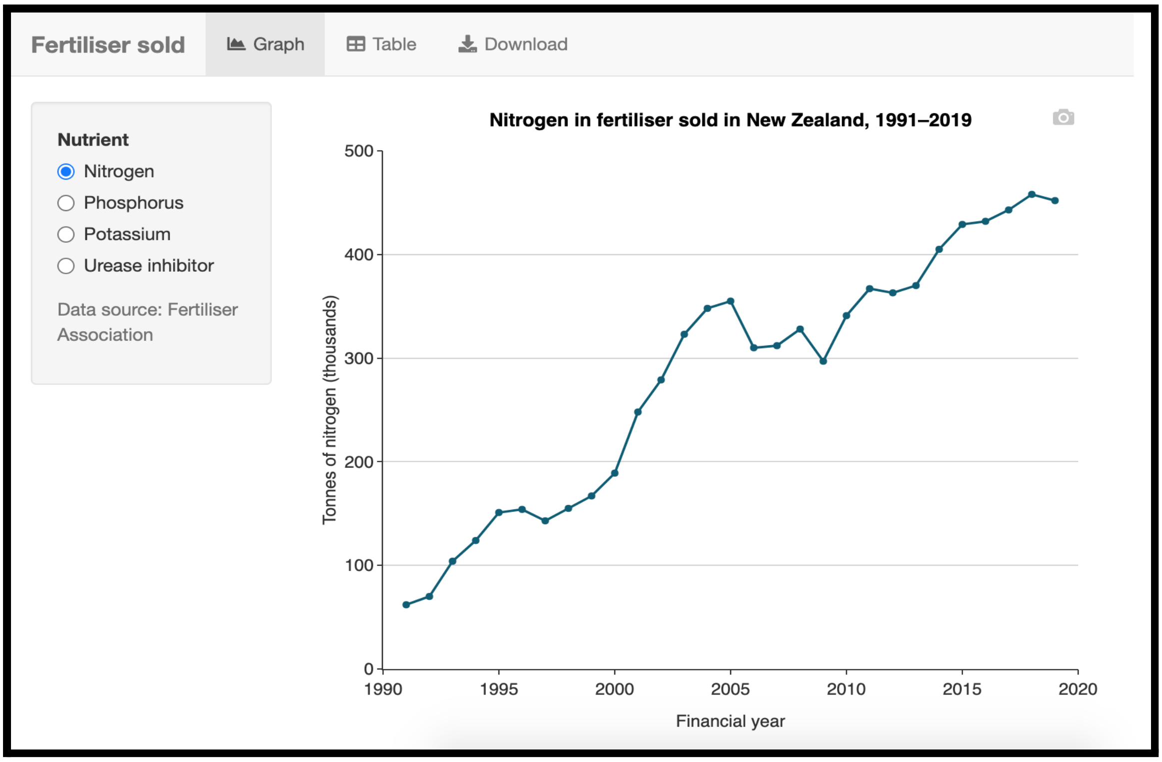
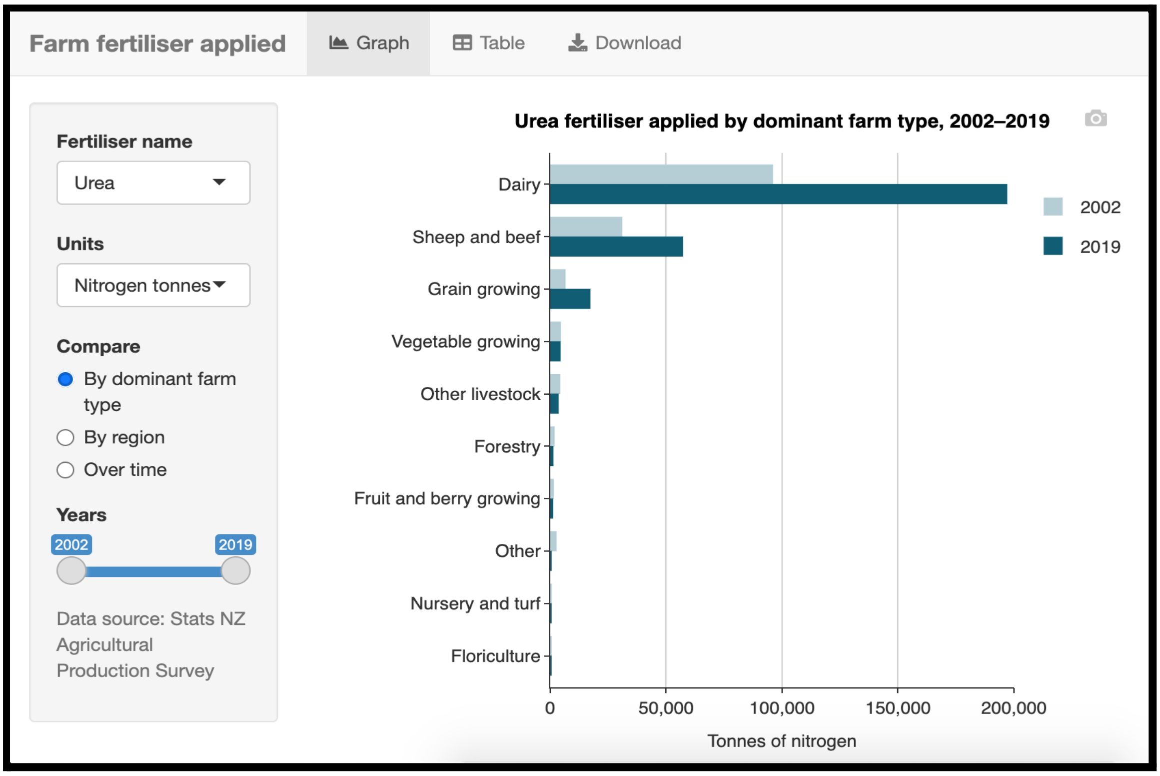


Figure 1[69]



[69] Stats NZ. "Fertilisers – nitrogen and phosphorus" (2021) Accessed August 2021 https://www.stats.govt.nz/indicators/fertilisers-nitrogen-and-phosphorus

Figure 2 (StatsNZ 2021)[70]

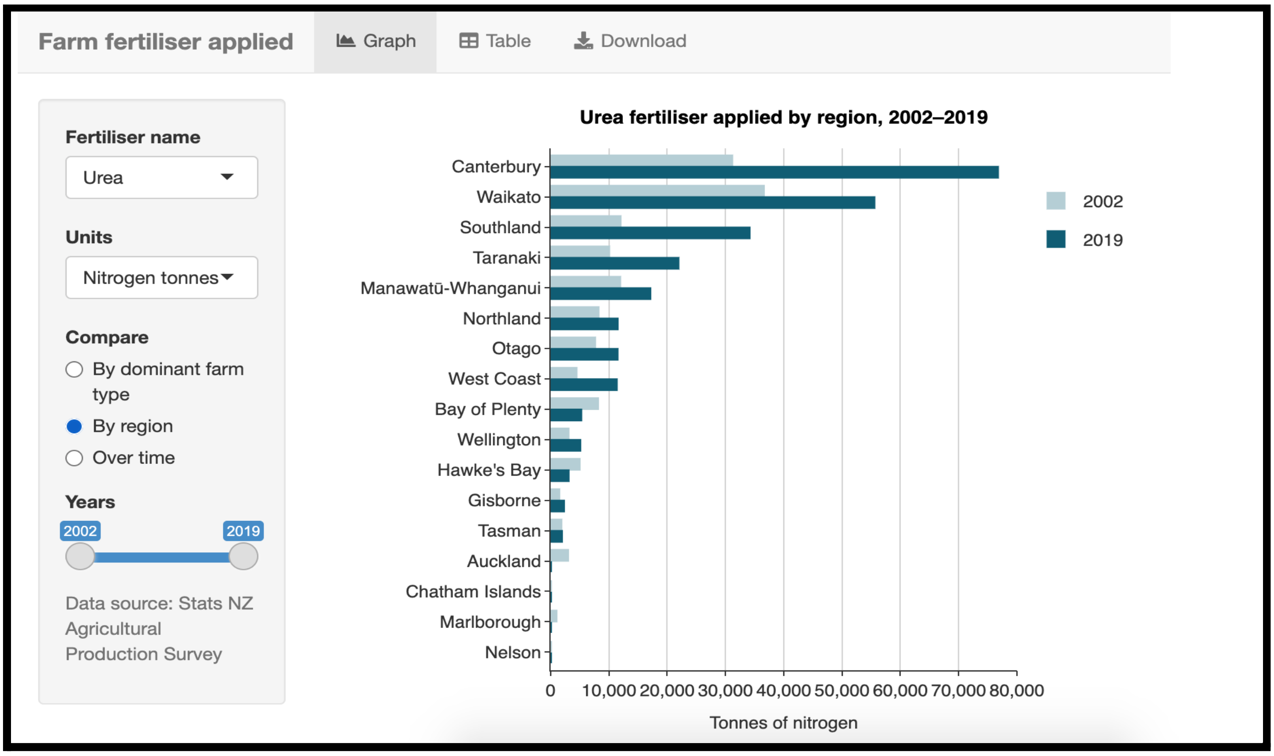


Figure 3[71]

[70] Ibid.
[71] Ibid.

Appendix 3 - Graphs of Nitrogen leaching in Aotearoa

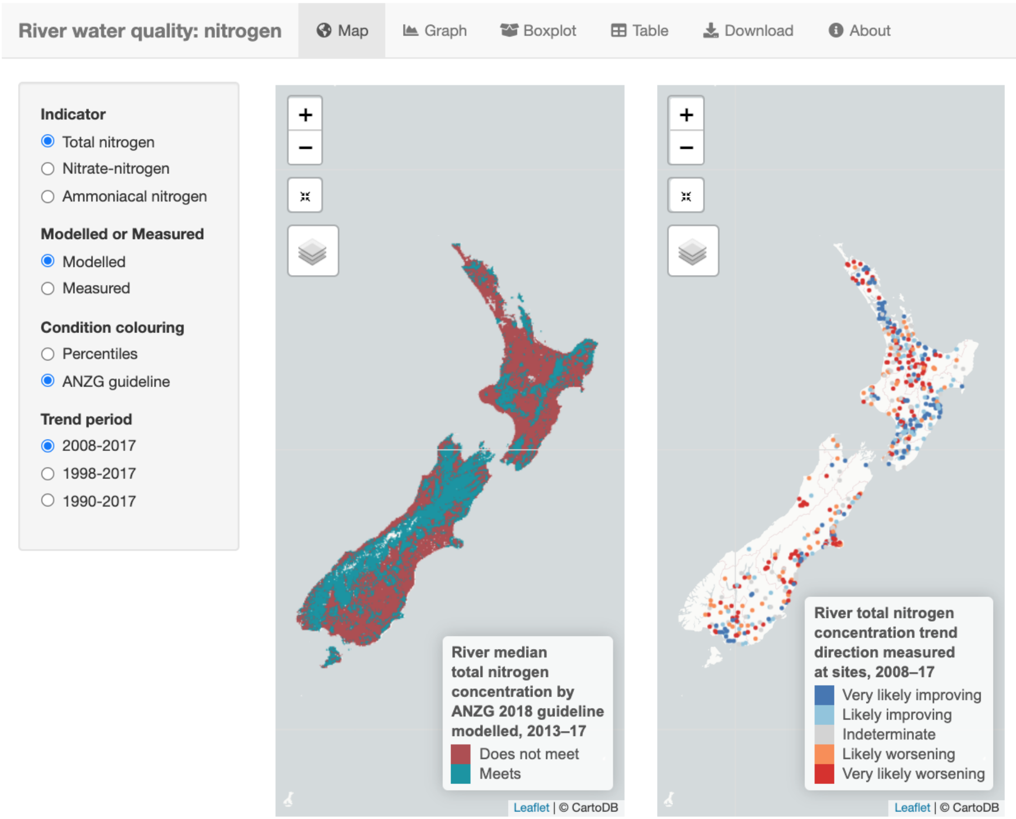


Figure 1[72]

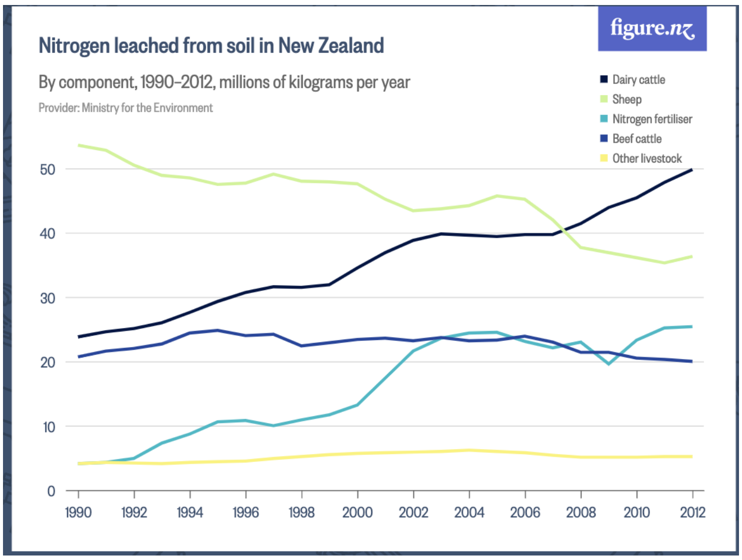


Figure 2 (figure.nz, 2021)[73]

[72] StatsNZ 2020 'River water quality: nitrogen' https://www.stats.govt.nz/indicators/river-water-quality-nitrogen
[73] https://figure.nz/chart/i2XV0tDS219VfB1z