Submission No 73

INQUIRY INTO LONG-TERM SUSTAINABILITY OF THE DAIRY INDUSTRY IN NEW SOUTH WALES

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Submission to inquiry into long-term sustainability of the NSW dairy industry

Vegan Australia is pleased to have the opportunity to provide a submission to the NSW Parliament Portfolio Committee No. 4 - Industry inquiry into the long-term sustainability of the dairy industry in New South Wales. We hope this submission assists the committee in recommending actions to transition the unsustainable dairy industry towards a plant based future.

Vegan Australia is a national organisation that informs the public about animal rights and veganism and also presents a strong voice for veganism to government, institutions, corporations and the media. Vegan Australia envisions a world where all animals live free from human use and ownership. The foundation of Vegan Australia is justice and compassion, for animals as well as for people and the planet. The first step each of us should take to put this compassion into action is to become vegan and to encourage others to do the same. Veganism is a rejection of the exploitation involved in commodifying and using sentient beings.

Introduction

The focus of this inquiry is on the sustainability of the NSW dairy industry. Vegan Australia believes that the dairy industry is intrinsically unsustainable in a number of areas and that it should be transitioned to other forms of land use.

This submission will demonstrate that the negative impact of the dairy industry on non-human animals is considerable, and this should be taken into account when considering the future of the industry; that the market for animal dairy products, both in Australia and globally, is in decline; and that both current dairy farmers and Australia as a nation would improve long term financial stability by moving away from dairy and into plant-based agriculture.

Vegan Australia has made submissions to similar inquiries in the past, such as the Senate Economics References Committee's inquiry into the Australian dairy industry and the Australian Competition and Consumer Commission's dairy industry inquiry. The current submission reiterates and extends these.

The impact of the dairy industry on non-human animals

It is the position of Vegan Australia that any animal exploitation, including the

exploitation occurring in the dairy industry, is inherently unfair. While examining the sustainability of this industry, it is important to keep in mind that the competitiveness of the dairy industry is predicated on the use and suffering of animals. Narrowing the scope of any inquiry to ignore this reality does a disservice not only to the non-human victims of the industry, but also to society as a whole. The Australian public is very concerned about animal welfare and the suffering intrinsic in the dairy industry is causing consumers to shift to the many alternatives to animal dairy products. This concern is growing and further contributing to the unsustainability of the dairy industry.

Cows are social animals who form close personal relationships with other cows. When they are paired with their friends they are less agitated and have a lower heart rate than when they are paired with an unknown individual[1]. When separated from their friends for an extended period of time, they show significant behavioural and psychological changes[1]. Cows and calves not only form friendships with others, they have also been observed to develop a dislike for other individuals and bear grudges[2]. Cows also display great inquisitiveness for their surroundings[2], and display emotional reactions upon having solved problems[3].

Although we have shown that cows are able to feel both positive and negative emotions, the usual life of a dairy cow, from birth to death, is one of suffering. Many standard practices of the dairy industry would be perceived as abhorrent to the general population if they were widely known:

Over the last 40 years, dairy cows have been selectively bred to double their milk production and ensure increased profitability to the farmer at the expense of the wellbeing of the cow[4,25]. This level of milk production is exhausting; it is the equivalent of a human jogging for six hours per day, seven days per week[5].

Dairy cows, like all mammals, must give birth before they are able to produce milk. In the dairy industry, cows are impregnated every year, usually by artificial insemination, to ensure maximum milk production[6]. Cows have a strong maternal instinct[7], yet Dairy Australia recommends that calves are separated from their mother within 12 hours of their birth. This has a significant stressing effect on both the mother[8] and the calf[9].

Most of the male calves born into the dairy industry are considered wastage[10,27]. Each year, 800,000 male calves are slaughtered, either on-farm or at commercial slaughter, within five days of birth[11]. The methods of slaughter can be disturbing. Agriculture Victoria, for example, allows the use of a hammer to slaughter calves in their first day of life[12]. Female calves either replace worn-out 'milkers' or are themselves killed soon after birth.

Cows in the dairy industry are constantly milked, even throughout most of their nine-month pregnancy. Due to the enormous volume of milk production, dairy cows commonly suffer from painful mastitis and lameness[26].

The repeated cycle of pregnancy, birth and separation and milking places an extreme physical burden on the cows and leaves their bodies nutritionally depleted. They are usually 'spent' (no longer economically viable) at about seven or eight years and are slaughtered at an age long before their natural lifespan of over 20 years[13].

Dairy cows are frequently subjected to mutilation practices such as tail docking, disbudding, and dehorning which cause severe pain and distress[14]. These operations are done without pain relief.

For a more complete picture of the impact of the dairy industry on animals in Australia, it is recommended that the Commission read "The Life of the Dairy Cow" prepared by Voiceless, the animal protection institute[15].

While Vegan Australia believes that the dairy industry should ultimately be phased out in Australia, in the intervening period, in the interests of transparency, the public has both a right and a responsibility to understand the realities of production of dairy products they consume. To this end, mandatory labelling of all dairy products sold in Australia should be introduced to educate the public on the effect of the dairy industry on animals. Such a label should include the significant relevant types of suffering endured by the animals, to allow consumers to make an informed choice. An example of information that should be provided is:

- The milk in this carton was taken from a dairy cow.
- She had her horns removed without pain relief.
- She is forcefully made pregnant every year.
- She is a deeply maternal animal, but she is separated from her calves soon after birth, causing both great distress.
- The milk she produces to feed her calf is taken from her.
- She has been selectively bred to produce such a huge volume of milk that her health is compromised.
- She has a one in five chance of becoming lame, a very painful condition that can lead to early slaughter.
- She has a one in ten chance of getting painful mastitis.
- And she will be slaughtered after she is worn out at about seven years old even though she could live until she is 15 or 20.
- The male calves of this cow were taken to an abattoir at just five days old and killed.
- The female calves of this cow were raised to suffer like their mother as a dairy cow.

To reiterate, consumers are becoming aware of the suffering intrinsic in the dairy industry and are shifting to alternatives to dairy products. This is contributing to the unsustainability of the dairy industry.

Environmental unsustainability of the dairy industry

The dairy industry damages the environment in a number of ways, including by land clearing, greenhouse gas emissions and water use. These all impact biodiversity negatively and increase the risk of species extinction.

Biodiversity

The area of grazing land owned by dairy businesses is estimated by the ABS at almost 4 million hectares[28]. This is about 8 times the area of land used for all the fruits, vegetables and nuts grown in Australia[29]. Dairy farming is a highly inefficient use of fertile land. Dairy farms are generally in previously wooded areas that have been cleared of native vegetation and animals to allow grazing. A sad example of this is the Northern Rivers area of NSW which was clear felled of ancient rainforest. Much of this land, which had amongst the highest biodiversity of plants and animals of anywhere in Australia, was used for dairy farming[30].

Another indicator of the inefficiency of animal agriculture comes from the Global Assessment Report on Biodiversity and Ecosystem Services released by IPBES which states that worldwide the meat and dairy industries use 83% of farmland but contribute only 18% of food calories[31].

Climate change

The dairy industry is responsible for significant greenhouse gas emissions. Like all cattle, dairy cows emit large amounts of greenhouse gases, including methane which has a very high Global Warming Potential (GWP) compared to carbon dioxide. Cattle grazing is major source of methane and it is unlikely that can be reduced any time soon. The National Farmers' Federation said in their submission to the 2017 Review of Climate Change Policies Discussion Paper "there is still a distinct lack of clear options to profitably reduce net emissions in livestock (dairy, beef and sheep) farming systems in southern Australia."

A better way to reduce these emissions is by transitioning from agricultural systems based on animal products to plant based alternatives. This should occur in parallel with campaigns to encourage the public to move away from diets based on animal products.

By moving away from inefficient animal based agriculture a lot of land will be able to be reforested and hence draw down carbon from the atmosphere in native vegetation.

Detailed analysis of the contribution of animal agriculture to greenhouse emissions

This section describes how the usual methods of reporting greenhouse gas emissions vastly underestimate the contribution of animal agriculture. This means that the dairy industry contributes much more to global warming than generally thought.

Accounts of greenhouse gas emissions in Australia generally report that agriculture and land use, land use change and forestry account for 66 Mt CO_2-e, or 12 per cent of

Australia's annual emissions in 2015[32]. This figure groups together a number of separate factors into "the land sector" emissions, and, in doing so, provides a misleading interpretation of reality. By separating out agriculture we can begin to see important features that may be missed when looking at the total figures.

The 66 Mt CO2-e figure takes the total emissions figure of 70 Mt CO2-e[33], and subtracts the 4 Mt[33] due to the (rare) net negative land use emissions [Note 1]. By including the effects of the carbon sinks of revegetation and forestry (which are not directly related to agriculture), greenhouse gas emissions from agriculture appear to be much lower than they actually are. With carbon sinks unrelated to agriculture removed from the calculation, the greenhouse gas emissions attributable to agriculture and associated land use can be revised upwards to approximately 110 Mt, or approximately 21 percent of the estimated 527 Mt CO2-e emitted in 2015.

Even this 21 percent figure relies on outdated data and assumptions. These figures convert methane, and other greenhouse gases to CO2-e using a 100-year Global Warming Potential (GWP)[35]. For example (using Department of the Environment and Energy figures), over 100 years, methane is approximately 25 times as potent as CO2, so is assigned a 100-year GWP of 25[35]. Using a 100-year GWP of methane of 25 is relying on outdated scientific information. The fifth IPCC report, for example, uses a 100-year GWP of methane of 28 without climate-carbon feedbacks, and 34 with these feedbacks [Note 2][36].

This 100-year timeframe, however, is arbitrary. The IPCC states that "There is no scientific argument for selecting 100 years compared with other choices (Fuglestvedt et al., 2003; Shine, 2009). The choice of time horizon is a value judgement because it depends on the relative weight assigned to effects at different times."[36] The 20-year GWP of methane as given in the fifth IPCC report is 86 (with feedbacks)[36], but according to Shindell et al., this figure rises to 105 once indirect radiative effects of aerosols are taken into account[37]. Howarth et al., argue that the 20-year timeframe is relevant because "the decadal scale is critical, given the urgent need to avoid climate-system tipping points [Note 3]"[38]. If we measure the impact of sectors using a 20-year timeframe, instead of the 100-year timeframe, the climate impact of agriculture (the largest emitter of methane[39]) is significantly higher. Failing to acknowledge this gives the false impression that the importance of the climate impacts of agriculture are much lower than they actually are.

While the figures provided include the impact of changing land use patterns, they fail to include the ongoing climate impact of land previously cleared for agriculture. Revegetating this land would allow for substantial carbon sequestration which is forgone when using this land for agriculture, as forests are approximately 10 times more effective at carbon sequestration than perennial grasslands[40], with pasture created from previously forested areas likely to be even less effective at carbon sequestration. While land clearing of agriculture has reduced significantly in recent decades, the ongoing impact of land previously cleared, coupled with reduced but still significant ongoing land clearing, must be accounted for when discussing agriculture emissions.

Taking into account these and other factors, the Beyond Zero Emissions Land Use discussion paper states that "Warming from Australian agricultural emissions over the next 20 years will be greater than warming from all fossil fuel emissions."[41] In a

subsequent study that "re-calculates emissions to include short lived gases and use 20 year Global Warming Potentials (GWPs)", Wedderburn-Bisshop et al. estimate that "Australia's annual emissions more than double when compared to the national inventory, with agriculture producing 54% of the national total."[42] Whilst reducing or eliminating our dependence on fossil fuels is vital to averting the worst effects of climate change in the long term, simultaneously reducing emissions from agriculture is vital to tackling Australia's contribution to climate change in both the short and long term.

While the first part of this section referred to agriculture as a whole, animal agriculture is responsible for a hugely disproportionate share of agriculture's total emissions. Using the conservative assumptions used by the Department of the Environment and Energy, approximately 58 Mt[33], or 83% of the 70 Mt CO2-e attributable to agriculture is directly attributable to animal agriculture. As a substantial majority of the methane emissions from agriculture are attributable to enteric fermentation and manure management, this figure raises significantly, both as an absolute figure and as a proportion, when using a 20-year GWP timeframe.

It is important to note that, of the remaining emissions not directly attributable to animal agriculture, a substantial proportion is indirectly attributable to animal agriculture. The Stock Feeds Manufacturers' Council of Australia estimates that 13 million tonnes of stock feed was fed to animals in 2015/16[43], which accounts for a significant proportion of total crops grown in Australia. The Beyond Zero Emissions Land Use Report states that "Two-thirds of crop production for domestic markets and all fodder production are consumed as animal feed."[41] While it is difficult to accurately estimate the climate impact of livestock feed grown in Australia, it certainly forms a substantial proportion of agriculture emissions not directly attributed to animal agriculture.

A similar pattern emerges upon inspection of Land Use, Land Use Change, and Forestry (LULUCF) emissions. The majority of emissions from LULUCF comes from deforestation, the majority being for animal agriculture[44]. In Queensland, the state with the highest rate of land clearing, for the 2014-2015 period, 91% of cleared woody vegetation was replaced with pasture[45]. A small additional source is management of existing grazing land. The majority of the carbon sinks in the LULUCF sector are from reforestation and forest management, which are areas that are not contributed to by the animal agriculture sector[44]. While reliable figures are difficult to come by, in part due to the prevalence of illegal land clearing[46], it is clear that the vast majority of emissions from the LULUCF sector are attributable to animal agriculture.

Taking these factors into account, the Beyond Zero Emissions Land Use discussion paper estimates that "Rangeland grazing, with associated deforestation, enteric fermentation and savanna burning, produces 49% of national emissions when accounted over 20 years."[41]

Water use

The dairy industry is a significant user of water in Australia.

According to the National Water Commission, 43% of agricultural water is used for pasture and hay production for grazing animals who are raised for the meat and dairy industry[48]. While much of this will go to animals in feedlots, the dairy industry is a large user of feed, with the average dairy cow consuming 1.6 tonnes of grain/concentrate per year[47]. Dairy farming uses 19% of agricultural water consumption, which includes livestock and irrigated pastures and grains for dairy farming purposes[51]. This use compares to only 10% water used for the production of fruit and vegetables for human consumption[48]. The dairy industry is responsible for 35% of water consumption in the Murray-Darling basin, Australia's most important agricultural region[52].

On average it takes 800 litres of water to produce one litre of dairy milk, almost 4 times as much as it takes to make one litre of soy milk[49,50].

Consumers are becoming aware of the damage caused to the environment by the dairy industry and are shifting to alternatives to dairy products. This is contributing to the unsustainability of the dairy industry.

Health issues with consuming dairy products

Dairy consumption is associated with cancer, heart disease and a number of health conditions related to the common inability to digest milk[54, 58].

Dairy foods are relatively high in saturated fats. The link between saturated fat and heart disease, diabetes and cancer is well established[54]. The American Heart Association concludes that lowering the intake of saturated fat reduces cardiovascular disease (the leading global cause of death) by about 30%, similar to the reduction achieved by statin treatment. Reduced consumption is also associated with lower rates other major causes of death. It points out that dairy fat is composed of 51% saturated fatty acids and that consumption of cheese also displays the harmful effects of its saturated fat. It also found that substituting carbohydrates from whole grains for dairy fat was associated with a 34% lower incidence of heart disease and a 16% lower incidence of stroke[54].

The Australian Dietary Guidelines state that eating foods containing high amounts of saturated fats "is linked with an increased risk of heart disease and high blood cholesterol levels." The guide puts dairy foods and meat at the top of the list of sources of saturated fat[53].

The Physicians Committee for Responsible Medicine states that scientific evidence shows that dairy products offer little if any protection for bone health and increase the risk of asthma, breast, ovarian, and prostate cancers, cognitive decline, heart disease, and early death[55, 58].

Note that Canada's latest food guide recommends that Canadians make water their "drink of choice" and no longer includes dairy as a separate food group. It's main message is "eat plenty of vegetables and fruits, whole grain foods and protein foods. Choose protein foods that come from plants more often. Choose foods with healthy fats instead of saturated fat."[59]

Another major health issue with dairy consumption is that most of the world's adult population can not digest it. In mammals during infancy, the LCT gene produces the lactase enzyme which allows babies to digest their mother's milk. After infancy the activity of this gene decreases, resulting in lower production of the enzyme and reduced ability to digest milk. This is true for all mammals and most human adults. For most people, symptoms of consuming dairy products in adulthood include abdominal pain, bloating, flatulence, nausea and diarrhoea. Some individuals have inherited genetic mutations which allow them to digest milk in adulthood[57]. In people of Australian Aboriginal or East Asian descent, less than 30 percent are able to digest milk[56].

Consumers are becoming aware that the consumption of dairy products is associated with cancer, heart disease and other health conditions and are shifting to alternatives. This is contributing to the unsustainability of the dairy industry.

Consumer awareness about issues with dairy

The dairy industry has been suffering from low prices for many years, making it increasingly economically unsustainable. One of the reasons for this is that consumers are voting with their dollars. Consumers are discovering that part of what they are getting when buying dairy products is animal suffering, climate change, environmental damage and health issues. They are switching to the many delicious alternatives that are becoming more and more available on supermarket shelves. Milk alternatives are growing their market share[61], with consumers turning to milks, yoghurts and cheeses made from soy, oats, almond, coconut and many other plant products. In the USA, "dairy consumption has plummeted over the past four decades"[60,68]. In Australia sales of dairy milk are currently steady[62] but is likely to follow the fall in sales like in the USA in the near future.

While the industry currently has support from some Australians, this largely stems from the community's ignorance of how the industry treats animals in standard practices on dairy farms and the facts about the health issues of consuming dairy products. The dairy industry has done an excellent job of manipulating the public. Dairy Australia is funded by levies paid by dairy farmers and uses these funds to influence the public's attitude to dairy. It does this through advertising, by producing biased educational material for schools (see dairy.edu.au) and by being a major sponsor or supporter of influential organisations such as Nutrition Australia, the Nutrition Society of Australia, the Healthy Food Partnership, Osteoporosis Australia, the Australian Dental Association, the National Asthma Council Australia, the Australian Institute of Sport and Sports Dietitians Australia[62].

Without this funding and manipulation, the public would more quickly become informed and move away from dairy products. But even so, as consumers continue to become more aware of animal suffering and the environmental impacts of this industry, the sales in animal milk products will continue to decline.

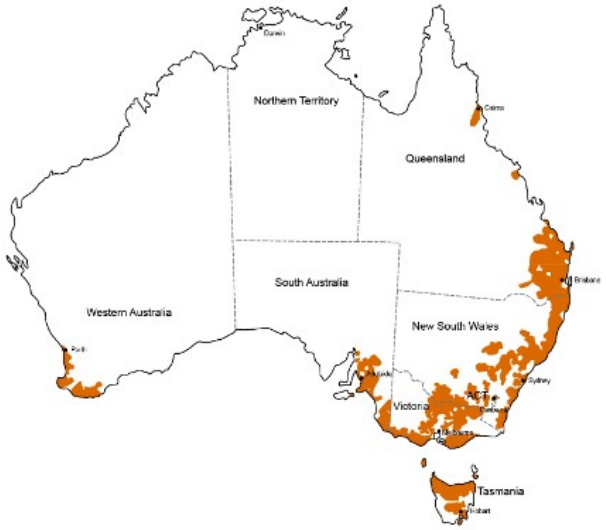
Transitioning dairy farmers to other uses of land

Vegan Australia is very aware that agriculture is a fundamental part of society and

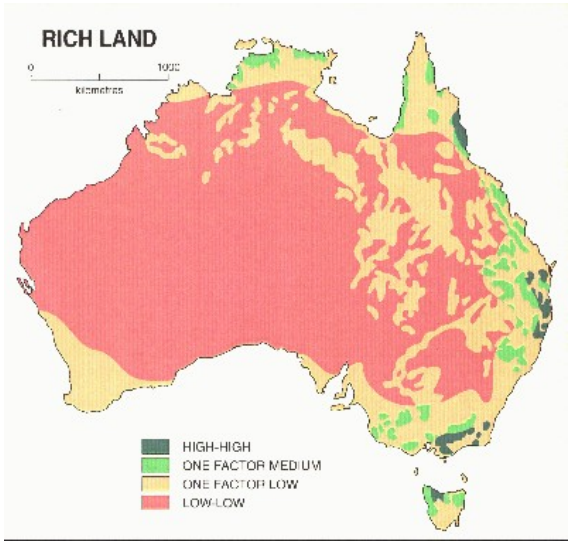
wants to see the continued prosperity of farming and farmers. We believe this can and should be done without the use and exploitation of animals. The long term solution to the dairy crisis is to transition the industry to other forms of agriculture and other uses of the land.

While the dairy industry may seem like a permanent fixture of the Australian landscape, it is only a matter of time before technology results in superior alternatives that are far more efficient. One promising example is the US startup, Perfect Day, that is using a specialised strain of yeast to brew the proteins (casein and whey) found in dairy milk[16]. While this technology is still in its infancy, it is expected to rapidly mature over the coming years. This will happen concurrently with advancements in technology used to produce plant-based dairy alternatives which will create better tasting products that are price competitive with dairy with reduced health, environmental and animal suffering concerns. While consumers in Australia may hold out some loyalty to the dairy industry, consumers in other countries, particularly China (our largest export market[17]) are unlikely to show the same loyalty. Chinese policy will shift to domestic production using advanced technology as soon as that technology becomes more cost efficient than importing Australian milk. A gradual transition of the dairy industry in Australia over the next ten years will minimise the impact of this inevitable shift.

This transition will be an opportunity for farmers currently in the dairy industry to shift into other industries, such as growing plant foods. Currently, dairy farms occupy some of the most fertile land in Australia, as can be seen from the following two maps.



Australian Dairy Industry: The Basics [18]



Boundless Plains? [19]

The dairy industry exists almost entirely on land that is suitable for plant-based agriculture. Thus, there is an opportunity cost to producing dairy. By using this land to produce dairy, the landowners are forgoing the possibility of producing plant foods, some of which could mean greater returns and stability than dairy. By producing dairy, Australia as a whole is producing a suboptimal amount of food, as plant foods tend to be much more efficient than dairy. Crucially, this means that dairy farmers can be encouraged to transition out of dairy without requiring them to abandon their livelihood.

One potentially profitable avenue is the growth of plants for the alternative milk, and other alternative dairy, markets. This sector has seen strong annual growth of 6% in Australia for the past five years[20] while, over the same period, the consumption of dairy milk has plateaued[21]. In the United States, the contrast has been starker in the last year, with a 7% drop in dairy consumption corresponding with a 9% rise in the consumption of alternative milk products[22]. Some entrepreneurial Australian farmers have turned to high profit alternatives, like macadamias[23], to fuel the growing demand both nationally and internationally, while others await the legalisation of hemp foods, hoping to corner a newly legal market[24].

It is the position of Vegan Australia that a transition out of dairy in Australia, along with other animal industries, would result in significant benefits to Australia's environment, to the health of our citizens, and to farmed animals. Gradually implementing this shift over ten years, and providing government support in switching industries, would allow such a transition to be of net benefit to Australian farmers.

While there will be many benefits to society of this change, there will also be costs involved in this transition and so it is important that these cost be shared by society as a whole. We all have a shared responsibility to bear the costs of transitioning the dairy industry away from animal use. In particular, workers in the dairy industry should be assisted to move into other work. This has already started with new large scale plant protein factories being opened and new industries like vegan milk and vegan cheese growing.

About 43,000 people are currently employed in dairy farming in Australia[64]. This compares to about 52,000 people employed in the entire vegetable, fruit and nut industry[65]. This is another example of the inefficiency of the dairy industry, which requires almost as many people as grow all the fruits, vegetables and nuts we require as essential components of a healthy diet.

The 43,000 people employed in the dairy industry is about 0.35% of total employment in Australia. This is not a large percentage compared to other industries, for example construction (9.2%) and manufacturing (7.7%). In transitioning the industry, there is a role for governments to help with new industry innovation, research, employment training in other forms of agriculture and other assistance.

Many people involved in the current industry are suffering from the effects of the decline of the industry. "The pressures, and associated debt, create intense stress for farmers, increase family tensions, and have negative flow-on effects throughout rural communities"[61]. Not just in the dairy industry, but more generally, there is a crisis of farmer distress and suicide. The suicide rate for Australia's farming men is about double the general male population. While research often focuses on farm owner-operators, farm labourers account for 46.9% of farmer suicides[66].

As well as the difficult physical life of a dairy farmer, dairy farmers suffer from the cognitive dissonance of really caring for the welfare of their animals on the one hand but at the same time being a direct cause of the animals' suffering and death. This cognitive dissonance could be a cause of the higher rates of stress and depression experienced by farmers. If this is the case, then transitioning away from forms of farming that use animals may be beneficial to the mental health of the farmers and workers and their

families and communities. Most farmers mentioned in a 2018 article on rural suicide in Australia were animal farmers[67] and the same for the USA[68,69].

In the USA, vegan organisations are helping dairy farmers transition to plant-based farming, with some already transitioned[68,70]. There are the beginnings of such a movement in Australia, with some cases of dairy farms being converted to macadamia farms and producing macadamia milk instead[71].

With dairy farmers' income going down and more consumers moving toward plant-based options, there will be even more reason to move out of dairying.

Conclusion

Vegan Australia hopes to see a strong agricultural sector in Australia, but the prosperity of this sector must not be reliant on the exploitation of animals. Cows are sensitive, intelligent creatures who deserve to be treated with fairness and respect; this is not the treatment they receive in the dairy industry. Vegan Australia understands that this inquiry is focussed on the sustainability of the dairy industry. It is important, however, not to lose sight of the fact that the dairy industry not only impacts the lives of farmers and farm workers, it also results in inevitable harm to animals, the environment and human health. The long-term success of the industry is not guaranteed the face of disruptive technologies, a volatile global marketplace and changes in consumer behaviour. As a nation, we ought to plan for a compassionate, prosperous future.

To this end, Vegan Australia proposes a transition out of the dairy industry over ten years. To achieve this, government assistance should be given to current dairy farmers who wish to transition to plant-based agriculture. Such a move would allow Australia to produce more food, and potentially allow farmers to increase the profitability of their land. Dairy has had a strong past in Australia, but this nation could have a stronger future without it.

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Notes

(1) Every year previous to 2015 has had net positive LULUCF emissions. Net positive LULUCF emissions are projected in the period to 2030[33].
(2) When a greenhouse gas enters the atmosphere, it causes warming. This warming causes a number of climatic events to happen (such as increases in water vapor, a powerful greenhouse gas, in the atmosphere, and decreases in the area of ice sheets), which, in turn, further increase the amount of warming. Accounting only for the warming that occurs without these feedbacks significantly underestimates the amount of warming that actually occurs.
(3) Climate-system tipping points are thresholds which, if passed, "push components of the Earth system past critical states into qualitatively different modes of

operation". Examples include melting ice sheets, changing weather patterns, rain forest diebacks, and melting permafrost. Should these tipping points be reached, irreversible natural feedback cycles would render catastrophic climate change inevitable[34].

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