Consumer attitudes to dairy should focus on consequences not footprints

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Foreword

With climate change posing challenges across the Australian economy, the environmental impacts of agricultural production are front of mind for both farmers and consumers.

However assessment of those impacts can be problematic, as highlighted in recent *Farm Policy Journal* articles and AFI research projects.

This Occasional Paper by Aaron Simmons and David Perovic of the NSW Department of Primary Industries discusses the use of environmental footprints in context of the Australian dairy industry. These footprints can be misleading when used to influence consumer attitudes, they write. The paper covers some of the difficulties of using Life Cycle Assessment, which estimates the environmental footprints of existing production. 'Consequential' LCA is now becoming recommended best practice for next steps in LCA development, because of the issues the authors highlight in the somewhat simplistic implementation of LCAs to date. For example, we know that the water footprint of almond milk is substantially higher than dairy, and a consequential LCA would pick this up.

The main benefit of estimating the consequences of a potential change, they note, is to assess the risk of burden shifting (i.e. when a reduction in the environmental impacts in one location/system are transferred to another location/system).

While this paper does not delve into the complexities of assessing the entire costs of changing production systems, AFI is pleased to present this work as an introduction to a much-needed area of research.

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Executive summary

The production of dairy products is associated with environmental impacts, and these impacts have resulted in calls within the popular media to reduce dairy consumption for the benefit of the environment (e.g. Carrington, 2018; Eating Better, 2020). Impacts of current production are estimated by environmental footprints; the use of environmental footprints, however, can be misleading when used to influence consumer attitudes. Instead, the consequences of a proposed change need to be estimated by including the market effects of the proposed change. For example, to estimate the consequences of a reduction in Australian dairy production, we would need to consider the impacts of increasing the production of 'functional equivalents', products that would replace milk, butter, cheese, meat and other animal products that currently come from diary systems. In addition, an estimation of the consequences of a reduction in dairy production would also need to include the impacts of the commodities that would be then grown using the land and water that is made available once dairy production declines.

Assessing environmental impacts

The calculation of environmental impacts associated with the production of dairy products has to-date been assessed through attributional life cycle assessment (i.e. a retrospective analysis using life cycle assessment that estimates the environmental footprints of existing production). Using environmental footprints to inform consumer decisions, or to develop policies that affect the demand of a product, can be misleading (Plevin et al., 2013; Perry, 2014). This is because attributional analyses do not consider the consequences of changes in production (e.g. how reduced dairy consumption may interact with market forces). Consequential life cycle assessment (CLCA) on the other hand is a prospective analysis that aims to predict the environmental impacts that would need to occur if the production of a commodity changes. Research has demonstrated that reducing the (attributional) footprints of Australian agricultural commodities may not lead to reduced environmental impacts. For example, Simmons et al. (2020) showed that the (attributional) carbon footprint (CF) of Australian wheat production increased when additional N fertiliser was applied to close the yield gap. Yet, the consequence of increasing N fertiliser applications would actually result in a reduction in GHG emissions at a global scale because the associated increase in yield per hectare would negate the need for additional land to be made available for wheat production, while meeting increasing global demand for wheat production. A similar study (Wiedemann et al., 2018) for Merino wool showed that GHG emissions would be 47% lower, compared to the CF of current Merino wool production, by increasing, not decreasing wool production. Despite mounting evidence to support the notion that using footprints to inform decisions may be misleading, they are still used to support consumer choice. The Higg Material Sustainability Index, developed by the Sustainable Apparel Coalition, guides consumer choices for materials used in apparel based on footprints, and the European Union is implementing a Product Environmental Footprint scheme to allow consumers to compare the relative impacts of their potential choices.

Impacts of existing dairy production

The emission of greenhouse gases (GHG) from, and use of water by, dairies means that the carbon and water footprints of dairy products are already relatively well studied. Gollnow et al. (2014) reported that the CF of fat and protein corrected milk from Australian dairies was on average 1.11 kg $CO_2e\ l^{-1}$. Similar studies for the CF of dairy production have been conducted in other jurisdictions (Vergé et al., 2013; Vasilaki et al., 2016), and other studies have compared the CF of different dairy production systems (Henriksson et al., 2011; O'Brien et al., 2014). Dairy production is also associated with water use for watering livestock, irrigation of pasture and fodder crops, and for washing the dairy after milking. This has led to studies estimating the water footprint (WF) of Australian dairy production (Ridoutt et al., 2010) and comparing the WF of different dairy systems (Palhares & Pezzopane, 2015). While the environmental footprints of dairy products may be high relative to other foods, an analysis of the consequences of a change to Australian dairy production is yet to be done.

The difference between the environmental footprint of dairy production – as assessed by attributional analysis – and the environmental consequences of a change in dairy production occurs because a change in the demand for a product induces market effects. Being a retrospective analysis, a footprint does not consider the market effects that may occur when demand for a product increases or decreases. Market effects occur whether there is an increase or decrease in demand but for the present discussion we will focus on a decrease, as that is the change to Australian dairy production that is assumed to result in environmental benefits.

The need to include substitutes of dairy production

One key market effect that would occur in response to a decline in demand for dairy products, and would therefore be included in a CLCA, is the replacement of the dairy products with a functional equivalent. For example, people that stop drinking cow's milk often replace that milk with a functional equivalent (e.g. soy milk). Hence, the first step in assessing the consequences of ceasing, or reducing, dairy production is to include the impacts of producing the functional equivalent for consumption. The impacts of producing a substitute product are potentially quite substantial. For example, it would take the production of an additional 310 kt of soybeans to replace the ~ 2.5 billion litres of drinking milk sold in Australia annually. If the environmental impacts associated with the production of the functionally equivalent product, in this case the production of soy milk, are greater than the impacts associated with the production of the dairy product, then the environmental consequence of substituting the dairy product with the functional equivalent is undoubtedly negative. It is not just the impacts of replacing the product of interest, however, that needs to be included in an analysis, co-products of a system also need to be considered. In the case of dairy production this means not only considering functional equivalents of milk, but also including replacements for butter, cheese, and cream as well as meat and associated animal products. If we consider that the Australian dairy industry has ~ 2.5 million head of cattle and that each dairy cow either produces a calf or is culled for age, then ceasing Australian dairy production would leave a considerable gap in Australian beef supply.

Marginal production

Importantly, it is insufficient to use the environmental footprint of current production of the functional equivalent to assess the consequences of changes in co-production. This is because increasing the demand for a functional equivalent will induce marginal production (i.e. new production that occurs in response to an increase in demand) and the environmental impacts of marginally produced products can differ to current production. The work by Wiedemann et al. (2018), mention above for Merino wool production, is an excellent example of how the impacts of marginal production can differ from average production. Another excellent example of how the environmental impacts of marginal production can differ to current production is the production of electricity. BREE (2014) forecasts that the proportion of electricity generated by renewable energy sources that are associated with relatively low GHG emissions will increase for the future Australian energy mix. As such, we can expect electricity supplied from marginal sources to be associated with far lower GHG emissions than electricity drawn from the current grid, which has a greater proportion of fossil fuel generated electricity (Lund et al., 2010).

Transfer of natural resources

Another key market effect is the transfer of natural resources (i.e. the natural resources that were used for dairy production changing to a different commodity once dairy products declines). The irrigation water, for example, that was previously used by a dairy would not be returned to the river (i.e. ceasing irrigated dairy production would not automatically increase water available). Rather, the irrigation water would be re-directed to the most profitable crop, which, at the time of writing, is undoubtedly almond production.

Agricultural land is another key resource used in dairy production and it is highly unlikely that the land used for dairy production would be abandoned if dairy production ceased. Instead, the land would be used to produce an alternative commodity (e.g. crops or red meat) and the environmental impacts of the production that commodity on the land would also need to be included when assessing the consequences of a reduction in dairy production.

Shifting of environmental burdens

The main purpose of estimating the consequences of a potential change is to assess the risk of burden shifting. Burden shifting is when a reduction in the environmental impacts in one location result in an increase in environmental impacts in another location. Organic agricultural production has a low environmental footprint due to the low inputs into organic systems. The lower inputs of organic agricultural systems, however, mean that they have lower yields than conventional agricultural systems (Seufert et al., 2012). Smith et al. (2019) considered this when they assessed the climate change consequences of the entirety of England and Wales attempting to source all their food requirements from organic production systems only. They found that doing so would require an additional ~6 million ha of land, which would shift the burden of food production to other countries outside England and Wales. Further, because the global supply of agricultural land is already constrained, grasslands and forests would need to be converted to agricultural land to maintain food supply; impacts not necessarily considered in a footprint. Burden shifting has also occurred in forestry. Meyfroidt et al. (2010) showed that countries that had experienced reforestation had shifted the burdens of agricultural production to other countries. The resulting deforestation associated with the need to produce agricultural products elsewhere meant that the equivalent to 75% of new reforested areas was lost in other countries, greatly reducing the net gain in global forest area and associated environmental benefits. These examples clearly show the need to use CLCA to assess the potential of burden shifting when assessing the consequences of a change in production for an agricultural commodity, such as dairy, and the existing agricultural lands it utilises.

Conclusions

Environmentalists have called for a reduction in dairy consumption in order to improve the condition of our environment, and these calls have been made based primarily on the carbon and water footprints of dairy. It is highly unlikely that the expected reductions in the environmental impacts associated with reduced dairy production (i.e. a reduction equivalent to the carbon footprint of a litre of milk multiplied by the number of litres of milk no longer produced) would occur. As demonstrated above, this overly simplistic view, provided by footprints, is flawed because it does not consider the consequences of reducing Australian dairy production. This highlights two key points. The first is that an assessment of the water and climate change consequences of production changes for dairy is required. Such assessments, while complex, will fill this critical knowledge gap in a timely manner and should, therefore, be a priority for the industry. The second point is that the myriad of changes that would occur if dairy production were to be reduced, means that the environmental footprint of current dairy production and the consequences of a change in Australian dairy production are likely to differ. It is critical, therefore, that the carbon and water footprints of existing dairy production are not used to develop environmental policy or influence consumer decisions, these require consequential analysis, including consideration of burden shifting.

References

BREE (2014), Australian Energy Projections to 2050, Bureau of Resource and Energy Economics, Canberra, Australia.

Carrington, D (2018), Avoiding meat and dairy is 'single biggest way'to reduce your impact on Earth, *The Guardian.*

Eating Better (2020), Better by half: A roadmap to less and better meat and dairy, online.

Gollnow, S, Lundie, S, Moore, AD, McLaren, J, van Buuren, N, Stahle, P, Christie, K, Thylmann, D & Rehl, T (2014), Carbon footprint of milk production from dairy cows in Australia, *Int. Dairy J.,* 37, 31–38.

Henriksson, M, Flysjö, A, Cederberg, C & Swensson, C (2011), Variation in carbon footprint of milk due to management differences between Swedish dairy farms.

Lund, H, Mathiesen, BV, Christensen, P & Schmidt, JH (2010), Energy system analysis of marginal electricity supply in consequential LCA, *Int. J. Life Cycle Assess,* 15, 260–271.

Meyfroidt, P, Rudel, TK & Lambin, EF (2010), Forest transitions, trade, and the global displacement of land use, Proceedings of the National Academy of Sciences, 107, 20917–20922.

O'Brien, D, Capper, J, Garnsworthy, P, Grainger, C & Shalloo, L (2014), A case study of the carbon footprint of milk from high-performing confinement and grass-based dairy farms, *J. Dairy Sci.,* 97, 1835–1851.

Palhares, JCP & Pezzopane, JRM (2015), Water footprint accounting and scarcity indicators of conventional and organic dairy production systems, *Journal of Cleaner Production,* 93, 299–307.

Perry, C (2014), Water footprints: path to enlightenment, or false trail? *Agric. Water Manag.,* 134, 119–125.

Plevin, RJ, Delucchi, MA & Creutzig, F (2013), Using Attributional Life Cycle Assessment to Estimate Climate Change Mitigation Benefits Misleads Policy Makers, *J. Ind. Ecol.,* 18.

Ridoutt, B, Williams, S, Baud, S, Fraval, S & Marks, N (2010), The water footprint of dairy products: Case study involving skim milk powder, *J. Dairy Sci.,* 93, 5114–5117.

Seufert, V, Ramankutty, N & Foley, JA (2012), Comparing the yields of organic and conventional agriculture, *Nature,* 485, 229–232.

Simmons, AT, Cowie, A & Brock, PM (2020), Climate change mitigation for Australian wheat production, *Sci. Total Environ.,* 138260.

Smith, LG, Kirk, GJD, Jones, PJ & Williams, AG (2019), The greenhouse gas impacts of converting food production in England and Wales to organic methods, *Nature Communications,* 10, 4641.

Vasilaki, V, Katsou, E, Ponsá, S & Colón, J (2016), Water and carbon footprint of selected dairy products: A case study in Catalonia, *Journal of Cleaner Production,* 139, 504–516.

Vergé, XPC, Maxime, D, Dyer, JA, Desjardins, RL, Arcand, Y & Vanderzaag, A (2013), Carbon footprint of Canadian dairy products: Calculations and issues, *J. Dairy Sci.,* 96, 6091–6104.

Wiedemann, SG, Simmons, A, Watson, KJ & Biggs, L (2018), Effect of methodological choice on the estimated impacts of wool production and the significance for LCA-based rating systems, *Int. J. Life Cycle Assess.,* 1–8.