Should we stop “meating” like this?

Group 1: *Ida Brix Lassen, Kathrine W. Helgøy, Mia Kjær, Marcus Fjeld Gran, Silje Maria M. Høydal*

Introduction

Our planet is under great pressure as the global population will reach 10 billion people by 2050 (Ramankutty *et al.*, 2018). With higher consumption and thereby greater demand for processed food, meat and dairy products, global food production threatens climate stability and ecosystem resilience (Ibid.). Animal-based food products such as beef are generally more resource-intensive to produce than those which are plant-based, requiring 20 times as much land and emitting 20 times the amount of GHG emissions per gram of edible protein compared to common plant proteins, such as beans (Waite, Searchinger & Ranganathan, 2019). To reach the UN Sustainability Goal 15 (SDG 15): Life on Land, a radical transformation of the global food system is needed. This paper seeks to highlight how changes in diets can help reach the SDG 15: Life on Land, and reduce some of the problems related to global food production: biodiversity loss and land use, greenhouse gas (GHG) emissions, freshwater use and phosphorus and nitrogen emissions.

Land-use as a driver of biodiversity loss

Agriculture is the single largest driver of habitat loss and is therefore considered as a major threat towards biodiversity (Benton *et al.*, 2021; Godfray *et al.,* 2018). On a global scale, agriculture accounts for 80% of all land use change including crops and livestock farming (Benton *et al.,* 2021). Livestock farming and meat production make up 78% of all agricultural landscapes (Ibid.). Furthermore, global meat production contributes to the conversion of natural habitats into grassland as well as land for growing grains and soya for livestock consumption (Godfray *et al.,* 2018). Global meat production is increasing in tropical developing countries within America, Africa and Asia (Machovina, Feeley & Ripple, 2015; Benton *et al.,* 2021). These areas are considered biodiversity hotspots and contain approximately 44% of the world's plants and 35% of terrestrial vertebrates (Machovina, Feeley & Ripple, 2015). Furthermore, human alterations of biodiversity hotspots such as the Caribbean, Madagascar and Brazil's Atlantic forest have been reduced to 90% of their original size (Ibid.). In order to reduce the negative impact on biodiversity global meat production must be significantly reduced (Machovina, Feeley & Ripple, 2015).

GHG emissions from livestock production

GHG emission sources are mainly due to land use changes, converting peat soils to agricultural land needed to grow animal feed for pasture management: fertilizing, irrigation and subsequent emissions from slaughter waste. The release of methane (CH_4) in a process called enteric fermentation, following the digestion of grasses and decomposition of manure is common in ruminant animals such as cows and goats. Through deforestation for livestock agriculture, clearing more land allows for feed crops and grazing, but represents an indirect, yet important issue from the ever increasing beef production (Waite, Searchinger & Ranganathan, 2019). This in turn releases stored CO_2, as forests are important carbon sinks, sequestering carbon and preventing it from reaching the atmosphere. Red meat and dairy have a larger footprint from CH_4 due to its potency, but CH_4 also has a shorter lifetime in the atmosphere than CO_2, complicating efforts of estimating its temperature impacts (Ritchie, 2020).

Excluding CH_4, the average footprint of beef is nearly quadruple that of chicken and even ten to one hundred fold of plant-based foods. The production of CO_2 from livestock agriculture appears in numerous ways. The use of high energy feed such as corn for factory farmed animals requires large amounts of chemical fertilizer, and the production of this may emit up to 40 million tons of CO_2 annually on a global scale. Nearly 90 million tons of CO_2 is emitted as a result of using large quantities of fossil fuel based energy in operating (cooling, heating and ventilating) facilities and farm machinery when cultivating and harvesting crops (The Humane Society of the United States). As soils are carbon sinks, the grazing of pastures can cause fertile soil to dry and this releases nearly 100

million tons of CO_2. The process of slaughtering, packaging and transporting livestock products also contributes to the release of tens of millions of tons (Petrovic *et al.*, 2015).

The livestock agricultural sector includes the production of feed crops, the manufacturing of fertilizer, and the shipment of meat and dairy products. This is responsible for 18% of all GHG emissions and 9% of human-induced emissions. CH_4 (37%) has more than 20 times and N_20 (65%) has nearly 300 times the global warming potential (GWP) of CO_2 (González *et al.,* 2020).

Freshwater use

Agriculture is the biggest exploiter of freshwater on the planet, using 92% of the available resources. 29% of the water in agriculture is used for livestock production, with irrigation accounting for 64% of withdrawals worldwide (Gerbens-Leenes, Mekonnen & Hoekstra, 2013). The agricultural water use has had catastrophic impacts on freshwater resources, for example, the groundwater depletion crisis in North West India and the complete loss of the 68.000 km^2 of the Aral Sea (Ramankutty et al., 2018). The water used for livestock production mainly refers to water consumed or polluted to produce livestock feed and the water footprint therefore depends on the feed efficiency, what the animal eats and feed origin. Also, the water footprint is determined by local climate and soil conditions and agricultural practice. In the period 1996-2005, the annual global water footprint for livestock production was 2422 Gm_3 (Gerbens-Leenes, Mekonnen & Hoekstra, 2013).

Alterations of global phosphorus (P) and nitrogen (N) cycle

Crop-livestock production systems are considered the largest cause of human alteration of global nitrogen (N) and phosphorus (P) cycles (Bouwman *et al.*, 2013). N and P are essential nutrients for food production, but are closely related to water quality degradation (Ibid.). For instance, anthropogenically mobilized N is lost through emissions of ammonia, nitrous oxide and nitric oxide. Ammonia is directly linked to eutrophication of freshwater, groundwater pollution and harmful algal blooms (Bouwman *et al.*, 2013; Westhoek *et al.*, 2014). Similar negative effects on human health are linked to alterations of the phosphorus cycle. On a global scale, reduction of livestock is linked to 40% lower nitrogen emission (Westhoek *et al.*, 2014).

How to promote more sustainable diets

A dietary shift towards more plant-based diets is necessary to work towards a more sustainable food system. However, different regions of the world have very different dietary patterns, and in some regions people are dependent on meat both for consumption and for their livelihoods (EAT-Lancet Commision, 2019). As a result, it is important to take into account regional differences and circumstances when promoting a more plant-based diet (ibid). The EAT-Lancet Commission (2019) suggests five strategies in order for the global food system to become more sustainable. The first strategy they propose is national and international commitments through the implementation of dietary guidelines based on the planetary healthy diet and better access to and affordability of healthy foods. Second, they recommend a shift in the focus of agricultural practices from the production of high quantities of food to the production of healthy foods. Third, they suggest intensifying food production in a sustainable manner in order for output to be increased. Fourth, they advise coordinated and strong governance. Fifth, they recommend halving food waste and loss.

Different measures to influence consumer decisions are also needed in order to reach SDG15 and establish a more sustainable food production. In order to promote more sustainable diets, the policies and strategies aimed at meat substitution should focus on specific consumer segments instead of the average consumer. This will be beneficial as consumers have many different reasons for choosing or not choosing meat substitutes (Apostolidis & McLeay, 2016). Apostolidis & McLeay (2016) identified six different consumer segments who all have different preferences. These are preferences such as valuing health, organic,‘green’ or cheaper foods. The measures taken to make these consumer segments choose more meat substitutes includes developing educational campaigns and food labelling regulations which highlight the health and nutrition benefits for ‘the healthy consumers’; labelling the

environmental and carbon footprint for ‘the green consumers’ and labelling animal welfare benefits and methods of production for ‘the organic consumers’. Furthermore, decreasing the price on meat substitutes would encourage the ‘price-conscious consumer’ (Ibid.).

Conclusion

In order to solve some of the problems related to SDG15, such as biodiversity loss and land use, GHG, phosphorus and nitrogen emissions, changes in diets from meat-based to flex or plant-based can be crucial. To promote a more sustainable diet, policies and strategies should focus on specific consumer segments and implement measures, such as regulatory mechanisms, financial incentives and consumer education.

References:

An HSUS Fact Sheet Greenhouse Gas Emissions from Animal Agriculture

Apostolidis, C. and McLeay, F. (2016). Should we stop meating like this? Reducing meat consumption through substitution. *Food Policy*. Volume 65. Pp 74-89.

Benton, T. G, Bieg, C., Harwatt, H., Pudasaini, R., Wellesley, L. (2021). Food system impacts on biodiversity loss. Three levers for food system transformation in support of nature. Chatham House, London

Bouwman, L. *et al.* (2013) 'Exploring global changes in nitrogen and phosphorus cycles in agriculture induced by livestock production over the 1900–2050 period', *Proceedings of the National Academy of Sciences of the United States of America*, 110(52), pp. 20882–21195.

Gerbens-Leenes, P. W., Mekonnen, M. M. and Hoekstra, A. Y. (2013) 'The water footprint of poultry, pork and beef: A comparative study in different countries and production systems', *Water Resources and Industry*, 1–2, pp. 25–36. doi: 10.1016/j.wri.2013.03.001.

Goodfray, H., Aveyard, P., Garnett, T., Hall, J., Key, T., Lorimer, J., Pierrehumbert, R., Scarborough, P., Springmann, M. & Jebb, S., (2018). Meat consumption, health and the environment. Science. Volume 361. DOI: 10.1126/science.aam5324

Grossi, G, Goglio, P, Vitali, A, Williams, A.G (2019), Livestock and climate change: impact of livestock on climate and mitigation strategies, *Animal Frontiers*, Volume 9, Issue 1, January 2019, Pages 69–76, https://doi.org/10.1093/af/vfy034

González, N., Marquès, M., Nadal, M., & Domingo, J. L. (2020). Meat consumption: Which are the current global risks? A review of recent (2010-2020) evidences. *Food research international (Ottawa, Ont.)*, *137*, 109341. https://doi.org/10.1016/j.foodres.2020.109341

Machovina, B., Feeley, K. J. and Ripple, W. J. (2015) 'Biodiversity conservation: The key is reducing meat consumption', *Science of The Total Environment*, 536, pp. 419–431. doi: 10.1016/j.scitotenv.2015.07.022.

Machovina, B., Feeley, K. J. and Ripple, W. J. (2015) 'Biodiversity conservation: The key is reducing meat consumption', *Science of The Total Environment*, 536, pp. 419–431. doi: 10.1016/j.scitotenv.2015.07.022.

Petrovic, Z., Djordjevic, V., Milicevic, D., Nastasijevic, I. and Parunovic, N. (2015) 'Meat production and consumption: Environmental consequences'

Ramankutty, N., Mehrabi, Z., Waha, K., Jarvis, L., Kremen, C., Herrero, M. & Rieseberg, L. (2018). Trends in Global Agricultural Land Use: Implications for Environmental Health and Food Security. Annual Review of Plant Biology. 69. 10.1146/annurev-arplant-042817-040256.

Ritchie, H. R. (2020). The carbon footprint of foods: are differences explained by the impacts of methane? *The Carbon Footprint of Foods: Are Differences Explained by the Impacts of Methane?* Published. https://ourworldindata.org/carbon-footprint-food-methane#licence

Waite, R., Searchinger, T,. Ranganathan, J. (2019). 6 Pressing Questions About Beef and Climate Change, Answered. *6 Pressing Questions About Beef and Climate Change, Answered*. Published. https://www.wri.org/insights/6-pressing-questions-about-beef-and-climate-change-answered

Westhoek, H. *et al.* (2014) 'Food choices, health and environment: Effects of cutting Europe's meat and dairy intake', *Global Environmental Change*, 26, pp. 196–205. doi: 10.1016/j.gloenvcha.2014.02.004.

References (poster):

The Eat-Lancet Commission (2019) 'Healthy Diets From Planet; Food Planet Health', *The Lancet*, p. 9 & 15.

Logos borrowed from:

Beyond Meat: Clipartmax (2018-2019) [Logo]. Available from: https://www.clipartmax.com/middle/m2H7K9i8G6N4H7b1_restaurant-food-service-beyond-meat-logo-png/ (Retrieved: 21/04/2020).

Hälsans kök: Nestle - Good Food, Good Life (s.a.) [Logo]. Available from: https://www.nestle.fi/halsans-kok-fi (Retrieved: 26/04/2021).

Like Meat: Protein Report (2020) [Logo]. Available from: https://www.proteinreport.org/directory/like-meat (Retrieved: 26/04/2021).

Naturli': OrklaFoods Naturli' (2021) [Logo]. Available from: https://www.orklafoods-ooh.no/home-page/naturli-logo-1/ (Retrieved: 26/04/2021).

SDG15: United Nations, Sustainable Development Goals (s.a.) [Logo]. Available from: https://www.un.org/sustainabledevelopment/news/communications-material/ (Retrieved: 11/05/2021)

Vegan: V-label GmbH (2019) [Logo]. Available from: https://www.v-label.eu/press/press (Retrieved: 21/04/2021)

General icons borrowed from:

Meat: Vector Stock (2021) [Vector]. Available from: https://www.vectorstock.com/royalty-free-vector/meat-icon-cartoon-isometric-3d-style-vector-16911278 (Retrieved: 21/04/2021)

Tractor: Freepik Company (2010-2021) [Vector]. Available from: https://www.freepik.com/premium-vector/tractors-three-different-colors_1488086.htm (Retrieved: 19/04/2021).

Holding hand Earth: Pinclipart (2018) [Vector]. Available from: https://www.pinclipart.com/pindetail/TTwhJx_environment-clipart-take-care-environment-icon-png-transparent/ (Retrieved: 26/2104/20