The Environmental and Health Impacts of Animal Source Foods

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It is now well-established that our diets and the food systems underpinning them have substantial impacts on both our health and the environment. What is also clear is that without dietary changes towards more balanced and predominantly plant-based diets, there is little chance of limiting global warming, biodiversity loss, and environmental resource use and pollution more generally. In this blog post, I summarise my group's research and the research of colleagues on the topic, including studies of the environmental, health, and social aspects related to changes in diets and food systems with a particular focus on the role of animal source foods.

The key point I will be making is that animal source foods have large impacts on health and the environment, and that dietary changes to predominantly plant-based diets can be associated with benefits for health and the environment. However, social challenges might impede dietary changes. While solutions exist, their implementation will be dependent not only on the personal choices of populations but also on political support and incentives for changes towards healthier and more sustainable diets.

The environmental impacts of animal source foods

The environmental impacts of the global food system have reached planetary proportions, and animal source foods are contributing a disproportionate share to these impacts. The food system, containing everything from production to consumption, is responsible for about a third of all greenhouse gas emissions and almost half of all land use, making it one of the major drivers of climate change and biodiversity loss. The majority of these impacts are due to animal source foods, especially meat and dairy, which are associated with about 55% of all food-related emissions and more than 80% of all land use, despite contributing less than 20% of overall calories.

The reason for the outsized impacts of animal source foods is that animals require several times more feed to produce a comparable gain in mass or nutrient than what is contained in the feed, so that the environmental impacts of growing feed multiply. These factors – or feed conversion ratios as they are called – range from 2 for dairy cows and fish over 3-6 for chickens and pigs to 50 for beef cows when measured in weight, and from 3-20 when measured in protein. The feed-related impacts primarily concern land use and the emissions of nitrous oxide, a potent greenhouse gas that is generated by fertilizer application. In addition, there are direct impacts from ruminant animals (cows and sheep) in the form of methane, another potent greenhouse gas that is generated during digestion in their rumens (stomachs).

Several options exist for reducing the environmental impacts of diets in general and animal source foods in particular. For example, changes in feed composition can have some impact on feed conversion ratios and methane emissions, but they are limited by the fundamental characteristics of animals (the need for feed and, for some, their rumens) that cannot be engineered away. Reductions in food loss and waste can also reduce emissions and resource use if production follows changes in demand. However, because it is mostly perishable plant-based foods that are lost and wasted, the mitigation potential of reducing the impacts of animal source foods is similarly limited.

Animal source foods have 10–100 times greater emissions and other environmental impacts than plant-based foods, so the greatest mitigation potential that has been identified is for dietary changes in which animal source foods are replaced with plant-based

ones. Studies suggest that dietary changes towards flexitarian diets with low to moderate amounts of animal source foods could reduce global emissions by about a third and land use by almost half, whereas changes to completely plant-based diets could result in global reductions of 50% in emissions and of 70% in land use. Systems analyses have also shown that without changes towards predominantly plant-based diets, it will not be possible to limit global warming to below 2 degrees and stay within other planetary boundaries such as those related to land use and biodiversity loss, even if other measures on the production and distribution side are implemented.

The health impacts of animal source foods

A common argument for animal source foods is that they are necessary for good health and nutritional adequacy. Animal source foods, like other foods, contain some nutrients that can help in attaining adequacy. However, they also contain nutrients that should be limited, such as saturated fats, cholesterol, and salt in the case of processed meat. Modelling studies have found that it is possible to attain nutritional adequacy throughout the life course without consuming animal source foods provided a balanced and diverse diet is followed, something that is in agreement with the advice provided by several dietetic societies.

While nutritional adequacy is important for maintaining health in the short term, the greatest burden of unhealthy diets is on long-term health and their impacts on non-communicable diseases such as heart disease, stroke, cancer, and type-2 diabetes, which most people die from. The types of studies most suited for identifying dietary risk factors and their impacts are meta-analyses of observational cohort studies which follow the life courses of 10-100 thousands of participants. Such studies have established a clear association between increased intake of red and processed meat and diet-related diseases such as coronary heart disease, stroke, colorectal cancer, and type-2 diabetes.

For food-disease correlations to be interpretable as causal, one usually looks for several strands of evidence. They include the presence of so-called dose-response relationships, meaning the greater exposure (intake), the greater the impact (disease cases), evidence from complementary studies including clinical trials on intermediate risk factors such as blood pressure, as well as plausible biological pathways. All these are present for red and processed meat, which has prompted the cancer agency of the World Health Organization to classify processed meat as carcinogenic and unprocessed red meat as probably carcinogenic to humans, in both cases based on strong mechanistic evidence.

For other animal source foods, the association with long-term health impacts appears to be more neutral. Compared to the kinds of average unhealthy baseline diets, increased intakes of dairy and poultry appear neutral from a risk perspective, whereas increased intake of fish appears to be associated with reductions in risk. However, most of the risk reductions seem to be mediated by dietary confounders such as reductions in red meat and increases in fruits and vegetables instead of changes in fish intake per se. Similarly, replacement of dairy, poultry, or fish with plant-based sources of protein such as legumes has been found to be associated with risk reductions. In addition to legumes, increased intakes of nuts, whole grains, fruits, and vegetables have also been associated with independent reductions in disease risk and mortality.

These findings suggest that replacing animal source foods with those plant-based foods that have been associated with clear reductions in disease risks (legumes, nuts, whole grains, fruits, vegetables) would generally be beneficial for health. Modelling of such replacement found that dietary changes to flexitarian diets with low to moderate amounts of animal source foods could be associated with a reduction in diet-related disease mortality of 10 million averted deaths, and changes to completely plant-based diets with about 11 million. About half of those averted deaths would be due to reductions in composition-related risks, i.e., less red and processed meat and more fruits, vegetables, legumes, nuts, and whole grains, and

another half due to balancing energy intake to avoid underweight, overweight, or obesity.

Social, economic, and political challenges

The research surveyed above strongly suggests that dietary changes towards predominantly plant-based diets are a prerequisite for addressing the many environmental challenges we are facing, including climate change and biodiversity loss. When done well, such changes would also be associated with improvements in health and reductions in the costs for treating diet-related diseases. However, there are often real or perceived social and economic barriers that complicate the adoption of diets with low or no amounts of animal source foods.

Affordability is one concern. However, global modelling studies based on current market prices of fresh foods in each country suggest that healthier and more sustainable diets that are predominantly plant-based are generally more affordable than diets with high amounts of animal source foods often found in many high and middle-income countries. In low-income countries, where diets are low in animal source foods and predominantly based on staples such as cereals and roots, healthier and more sustainable diets would be more expensive than current diets. In such contexts, policies that would increase households' spending power or reduce the relative costs of healthy and sustainable foods are essential for ensuring affordability.

Appropriate policy support is also required for changing food environments elsewhere. In countries with high intake of animal source foods, it is often challenging to access healthy, plant-based options in canteens, restaurants, and other food-related environments at reasonable prices. A range of fiscal incentives – climate and health taxes or levies, reforms of value-added taxes, changes in agricultural subsidies – have been proposed that would reduce the costs for healthier and more sustainable foods and increase those for unhealthy and unsustainable ones, including animal source foods. Their intended effects are to shift demand, availability, and ultimately production, whilst also accounting for the hidden health and environmental costs of animal source foods that are generally not priced in at the point of consumption.

Other policy approaches can also play a role. Informational approaches, such as labelling foods according to the health and environmental impacts, and the development and appraisal of food-based dietary guidelines are important parts of national food strategies. However, the behavioural science literature suggests that without pairing informational policies with economic ones or those that affect the food environment, they will not be very effective. Similar findings apply to nudge approaches such as changes in menu ordering and defaults. Although they might be effective in some contexts, their effects are generally small, and they can crowd in political capital that is then not available for pursuing more effective policies that include economic and other regulatory components.

Another policy approach that is sometimes favoured by policymakers is targeted support for specific industries. This circumvents regulating harmful or polluting industries, which can be politically costly, but it is less effective for addressing the health and environmental harms of those industries as they remain unregulated. In addition, it might support industries which offer only partial solutions for addressing the health and environmental challenges related to food systems.

A recent example is the support of meat and milk alternatives. A comprehensive multi-criteria analysis suggests that, while some processed plant-based alternatives are healthier and more sustainable than the animal source foods they aim to replace, they are often more expensive and fare worse from all perspectives than fresh plant-based foods such as legumes and nuts. Cellular or lab-grown meat performed worse still and was only marginally better than conventional meat at current levels of development. These findings call into question public investments and support for these processed food industries, and, similar to nudge-based policies, might steer political attention away from solutions that would address the health and environmental impacts of diets more holistically.

Conclusion

Without dietary changes towards healthier, more sustainable, and predominantly plant-based diets, there is little chance of limiting global warming, reducing biodiversity loss, and staying within planetary boundaries, while also addressing the high burden of diet and weight-related diseases. However, enabling and incentivizing dietary changes at the population level is subject to social and political challenges. Multi-component approaches and strategies would be best suited for maximising synergies and avoiding trade-offs across domains by simultaneously addressing the impacts our diets and food systems have on health, the environment, and the economy.

Synergetic, multi-component approaches include those that focus on diets as a whole and include incentives for both reducing unhealthy and unsustainable foods and increasing healthy and sustainable foods. Examples at the consumption side would be food-service approaches paired with economic incentives like true cost pricing, whereas examples at the production side include phasing out agricultural subsidies for animal source foods and instead coupling public support to the provision of public goods such as healthy foods produced following agro-ecological approaches that limit the environmental resource use and pollution associated with food production. Many of these are being trialled in local contexts or are under discussion to be tested. What is needed for supporting dietary and food system changes at the population level is increasing their number while upscaling their scope.

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