

# Future Food: Sustainable Diets for Healthy People and a Healthy Planet\*

## *O futuro da alimentação: Dietas sustentáveis para pessoas e um planeta saudáveis*

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Int J Nutrol 2019;12:23–28.

### Abstract

#### Keywords

- ▶ sustainable diet
- ▶ sustainable nutrition
- ▶ environmental impact
- ▶ animal foods
- ▶ food system
- ▶ guidelines
- ▶ diet transformation

The current food system is associated with poor health outcomes, food insecurity, and significant environmental damage. While, globally, more than enough food calories are produced than theoretically needed, this does not guaranty a good quality diet for all. At the same time, the environmental pressures of the current food system threaten several planetary boundaries, which define the environmental limits within which humans can safely operate. This narrative review gives a brief overview of the shortcomings of the current food system regarding its impact on nutrition, health, and the environment. It outlines recent advancements in the development of guidelines for a healthy and sustainable diet and discusses options on how to realize such a dietary transformation, involving all stakeholders in the food value chain.


### Resumo

O sistema alimentar atual está associado a impactos em saúde ruins, insegurança alimentar, e danos ambientais significativos. Embora globalmente sejam produzidas mais calorias alimentares do que o que é teoricamente necessário, isso não garante uma dieta de boa qualidade para todos. Ao mesmo tempo, as pressões ambientais do atual sistema alimentar ameaçam vários limites planetários, que definem os limites ambientais dentro dos quais os seres humanos podem operar com segurança. Esta revisão narrativa fornece uma breve visão geral das deficiências do atual sistema alimentar em relação ao seu impacto na nutrição, saúde, e meio ambiente. Ela descreve os recentes avanços no desenvolvimento de diretrizes para uma dieta saudável e sustentável e discute opções de como realizar essa transformação alimentar, envolvendo todos as partes interessadas na cadeia de valor dos alimentos.

### Introduction

Every day, in different ways, we appreciate how central food is to our lives. Food provides essential nourishment but also gives pleasure, opportunities for some of our best social interactions, and an enduring connection to diverse global cultures and traditions. But there is another side to food, as it has become apparent that the ways in which we now

\* The present review was carried out at Unilever R&D Vlaardingen and presented at ILSI Brazil event on Sustainable Nutrition, in São Paulo, on 27<sup>th</sup> November 2018.

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produce, consume, and waste our food are no longer fit for purpose. The global food system has become increasingly associated with poor health outcomes, continuing food insecurity and significant environmental damage. Business as usual—continuing to do the same things in the same way—is no longer an option.

### The Current Food System is Falling Short

Food systems have not always been associated with such wide-ranging negative outcomes, but global diets have changed significantly between 1961 and 2011,<sup>1</sup> with energy consumption increasing by 31%, and consumption of fruits, vegetables, and grains from staple crops decreasing while the consumption of meat, sugar, and fat has increased. The food system remains associated with food and nutrition insecurity while producing more food than is theoretically needed—nearly 3,000 calories are available for everybody, everyday.<sup>2</sup> Producing more than sufficient calories does not guarantee a good quality diet for all, and with large increases in the consumption of animal produce, fat, and sugar, typifying the major dietary changes that have occurred over the past 50 years, the global food system is massively failing to meet nutritional needs. A total of 820 million people, mainly in developing countries, do not have access to sufficient food,<sup>3</sup> and 2 billion people—many of whom live in high and middle income countries—suffer from deficiencies of key vitamins and minerals.<sup>4</sup> At the same time, and too often in the same people, global obesity rates have reached epidemic proportions, with more than 2 billion people overweight or obese.<sup>5</sup> The obesity epidemic is a serious global public health problem, which is driving the increasing prevalence of life-threatening chronic diseases, such as type 2 diabetes, cardiovascular disease, and cancer. Unhealthy diets are now recognized as the major cause of global disease, being responsible for more than 12 million deaths in 2015. The risk that poor diets pose to mortality and morbidity is now greater than the combined risks of unsafe sex, alcohol, drug and tobacco use.<sup>6</sup>

Producing the food associated with nutrition insecurity and poor health outcomes, also now comes at significant environmental cost, with agriculture being responsible for around 25% of all human-generated greenhouse gas emissions—and, therefore, representing one of the major contributors to global warming.<sup>7</sup> Agriculture is also the leading cause of deforestation, land and soil degradation, biodiversity loss, accounts for 70% of all human water use and is a major source of water pollution.<sup>8</sup> These different pressures now threaten several of the planetary boundaries that define the environmental limits within which the human race can safely operate.<sup>9</sup> Crossing planetary boundaries means that key biophysical earth systems are likely to become unstable, leading to uncertain and potentially disastrous consequences for future life on our planet. In particular, the planetary boundaries related to climate change, biodiversity loss, land use change due to deforestation, and chemical flows related to nitrogen and phosphorous cycles—linked to animal waste and fertilizer use—are being seriously challenged by agricultural activities.<sup>10</sup>

Looking at the environmental impact of food production in detail, livestock and other animal source foods are major

contributors in terms of greenhouse gas emissions—delivering at least 70% of total emissions from the agricultural sector.<sup>11</sup> Beef and lamb production are particularly associated with high greenhouse gas emissions. Ruminant animals produce significant amounts of the greenhouse gas methane, which, although short-lived, has a global warming potential over 100 years around 30 times higher than that of carbon dioxide.<sup>12</sup> Producing 100 g of beef protein is associated with up to 105 kg of greenhouse gas emissions, whereas most plant sources have much lower impacts, less than 5 kg per 100 g protein.<sup>13</sup> The impact of meat production goes beyond greenhouse gas emissions, with more than 80% of available farmland being used for livestock while producing just 18% of available food calories and 37% of our protein supply.<sup>14</sup> In addition, using low-impact, plant crops such as soy and maize to produce animal protein is relatively inefficient, with all livestock using ~ 14 kg of human edible feed and soybean cakes to produce 1 kg of protein.<sup>15</sup> About 80% of the global soy crop is currently used for animal feed; so, reducing demand for animal products and replacing them with appropriate, sustainably produced, plant-based protein sources would help to reduce several environmental pressures.

However, there is currently not much evidence that global meat consumption is declining. On the contrary, the Food and Agriculture Organization (FAO) data shows that meat consumption is high in developed, wealthy countries, reaching around 3 times the current recommended healthy intake in North America at 90 kg per capita per year.<sup>16</sup> The growth in meat consumption is projected to continue in all world regions, due to income and population growth, especially in countries with large middle classes in Asia, Latin America, and the Middle East. In developed countries, meat demand is projected to further increase but at rates lower than those in developing countries.

High levels of meat consumption in wealthy regions mean that many people are eating more protein than they need.<sup>17</sup> Protein is an essential component of the human diet, supplying nitrogen and amino acids for tissue growth and maintenance, but it can be environmentally impactful to produce, particularly when it comes from animal sources, so, it is important that the intake closely matches the requirements. In line with the increased availability of animal products since the 1960s, wealthy regions are now not only consuming too much protein but the ratio between animal and plant protein intake has increased. For example, the ratio in European countries was 50:50 in the 1960s but is now 65:35 in favor of animal protein, with health and environmental impacts increasing at the same time.

However, plant protein production is also not without environmental consequences. The three most important food crops in the world are rice, wheat, and maize (corn), and these three cereal grains directly contribute more than half of all calories consumed by human beings.<sup>18</sup> These crops are now typically grown in intensive monocultures, which has resulted in high crop yields; however, such intensive agriculture requires high pesticide and fertilizer use and is associated with a range of negative environmental impacts, including biodiversity loss and loss of natural ecosystems. It

also means that these crops are vulnerable to the effects of climate change, as they may become less tolerant to drought and heat stress. Clearly, it is time to re-think how both animal and plant protein can be optimally produced for the health of people and the environment.

It is also time to consider why we are wasting so much of the food that we are producing, both before it reaches the consumer (defined as food loss) and after consumer purchase (food waste)

A recent American study<sup>19</sup> looked at the amount of nutrients lost per day in the United States food supply of 2012 and expressed the nutrient loss as a percentage of the amount recommended for daily consumption. Many of the nutrients identified are currently consumed below recommended levels in the United States, and this study highlighted just how much of these critical nutrients are being lost from the food supply. Focusing on fiber, an important plant-based and indeed critically under-consumed nutrient, the amount wasted per day - 5.9 g per average person, globally, would allow providing the complete recommended daily allowance of fiber to 74 million women or closing the gap between the current intake and the recommended amount in 207 million. Clearly, the nutritional, economic, and environmental costs of this degree of food loss and waste are huge.

## Developing Guidelines for Healthy and Sustainable Diets

With the current food system being associated with outcomes that are not optimal for human or planetary health (so-called lose-lose diets), the question emerges of what future win-win diets could look like. A good place to start answering this question is the 2010 definition of sustainable diets published by the FAO of the United Nations.<sup>20</sup> This definition states that:

“Sustainable diets are those with low environmental impacts, which contribute to food and nutrition security and to healthy life for current and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.” This is a broad and visionary perspective, but it does not give guidance on the types and amounts of different foods and food groups that global citizens should be affordably consuming on a daily basis. What should healthy and sustainable diets look like on our plates?

For guidance, we can start by looking at national dietary guidelines, as many countries around the world have translated recommendations on healthy nutrient intakes into food based dietary guidelines that aim to give practical guidance on what a healthy diet should look like. In general, national dietary guidelines do already guide consumers toward healthy and sustainable eating. Despite differences with regard to specific recommendations, most national guidelines implicitly state that a healthy diet should consist of a significant proportion of a diversity of plant-based foods, such as vegetables, fruits, legumes, whole grains, and nuts, with only moderate consumption of meat and dairy products.<sup>21</sup>

Several recent studies performed in Europe and North America, mainly, have shown that plant-based dietary patterns reflecting the current guidelines in the respective countries are indeed associated with better health outcomes.<sup>22</sup> Tilman and Clark<sup>23</sup> compared the impact of different, widely consumed, predominantly plant-based dietary patterns (Mediterranean, Pescatarian, and Vegetarian) with high meat-containing, omnivorous diets on the risk of various chronic disease outcomes, such as type 2 diabetes, cancer, and coronary heart disease. This study showed that all diets in which the consumption of fruits, vegetables, nuts, and pulses was increased, and the consumption of meat and empty calories was reduced, significantly reduced the incidence of all these chronic diseases. In addition, eating more plants and less meat is associated with environmental benefits, such as lower greenhouse gas emissions with decreasing meat consumption. A meat intake of more than 100 g per day (corresponding to what many people are currently eating in high and middle income countries) was associated with greenhouse gas emissions of 7.2 kg CO<sub>2</sub> equivalents per person per day.<sup>24</sup> In low meat-eating populations (< 50 g/day) and vegetarians, greenhouse gas emissions were reduced to 4.7 and 3.2 kg CO<sub>2</sub> equivalents per person per day, respectively. The vegan diet was associated with the lowest greenhouse gas footprint (2.9 kg CO<sub>2</sub> equivalents per person per day).

In relation to defining the optimal intakes of animal-sourced foods for health and environmental benefits, there are some indications that meat consumption should be lower than the current guidelines (~ 70 g per person per day), but the global evidence base remained limited until recently. The need for globally-relevant science-based targets on the consumption of animal-sourced foods was recognized and addressed by an influential body of scientists who came together on a global initiative on dietary change targets called the EAT-Lancet Commission on Food, Planet, Health. This commission brought together world-leading scientists from across the globe—representing nutrition, environment, food policy and food system expertise—with the aim to provide the scientific consensus that defines a healthy *and* sustainable diet for the global population.

Scientists working for the commission published, in October 2018, 2 key articles,<sup>25,26</sup> which form a key part of the EAT-Lancet report published in January 2019.<sup>27</sup> This milestone report calls for a *Great Food Transformation* and outlines global guidelines for healthy eating within environmental boundaries, which is an important step in aligning national dietary guidelines with the most current evidence on healthy eating and the environmental impact of diets.

The two key publications and the report focus on the impact of food production and on solutions to keep the environmental pressures of the food system within environmental limits as defined by the planetary boundaries. In the business-as-usual scenario, in a world where the global population could increase to 10 billion by 2050 and global income triples, the environmental pressures from the food system were projected to increase from 50 to 92% in 2050. All planetary boundaries would be exceeded due to the continued rise of diets high in fats, sugars, and meat.<sup>25</sup> To reduce environmental pressures in line

with healthy eating guidelines, the scientists who are part of the commission identified three potential mitigation strategies: dietary shifts to lower the intake of animal-sourced foods and increase the intake of plant-based foods; technological improvements in food production and reductions in food loss and waste in line with the Sustainable Development Goal targets. Scenario analyses have shown that global dietary shifts to a flexitarian pattern, with meat consumption significantly lower than most current guideline amounts (from 30–16 kg per person per year), based on the most recent evidence on healthy eating, enabled a significant 56% reduction in greenhouse gas emissions and reduced other environmental pressures by up to 22%. Technological improvements and halving of food loss and waste were also required to achieve the reductions in greenhouse gas emissions necessary for the agricultural sector contribution to the Paris agreement climate change target of only 2°C global warming by 2050. Similarly, a combination of the mitigation options would be necessary to obtain the reductions in environmental pressures needed to stay within planetary boundary limits, with improvements in technology being the key strategy for land and water use and nitrogen, phosphorous applications.<sup>25</sup>

The second study from the commission<sup>28</sup> modeled the impact of different energy-balanced, plant-based dietary patterns (flexitarian, pescatarian, vegetarian, and vegan) on diet-related disease mortality. Using 3 different modelling approaches, it was concluded that all plant-based diet patterns lead to reductions in premature mortality of between 19 and 24%. This approximates to prevention of around 11 million deaths globally per year and indicates that major health benefits can be achieved from dietary change. This study also showed that energy-balanced flexitarian and other healthy, plant-based dietary patterns, can deliver an adequate supply of the most essential nutrients. However, attention should be given to replacement of meat with a diversity of good quality plant protein sources that also deliver the key nutrients, i.e., vitamin A, zinc and iron, that are highly present in meat. For indicating calcium adequacy, the authors based their recommended dietary intake (> 520 mg/day) on the totality of evidence suggesting no decreased risk of bone fracture above this level. All the healthy dietary patterns with a moderate dairy consumption (250 g/day) delivered a calcium intake > 700 mg/day. However, some countries recommend dietary calcium intakes significantly higher than 520 mg/day (e.g., USA 1,200 mg/day), and there is likely to be continuing debate as to whether the recommended moderate dairy amount is sufficient. Choosing vegetarian or vegan dietary patterns may require supplementation and/or more innovative foods fortified with B12 and possibly riboflavin, which are respectively only and mainly found in animal-sourced foods.

The EAT-Lancet report<sup>27</sup> proposes the dietary shifts and food production improvements required for healthy people and a healthy planet. Transformation to healthy diets by 2050 will require substantial dietary shifts, including a greater than 50% reduction in the global consumption of unhealthy foods, such as red meat and sugar, and a greater than 100% increase in the consumption of healthy foods, such as fruits, vegetables, legumes, nuts, and seeds. In addition, a healthy diet should

include only low to moderate amounts of other animal source foods, such as dairy, egg, and fish, and unsaturated rather than saturated fats. Global adherence to the planetary health diet is proposed to reduce environmental impacts in most regions of the world and improve health outcomes in all regions. This does not imply, however, that the global population should eat the same foods, nor is it a prescription for an exact diet. Local interpretations and adaptations of the planetary health diet are necessary and should reflect the social, cultural, and geographical contexts of different populations and individuals.<sup>27</sup>

For many wealthy countries, achieving the global planetary health diet by 2050 will mean large reductions in meat consumption. Maximum values for meat consumption in the recommended plant-based flexitarian diet are 300 g per person per week, with maximum 100 g per week (1 portion) from red meat and 200 g (2 portions) from poultry. In addition to the 300 g meat, 2 portions a week of fish are recommended. In global terms, meat consumption by 2050 would need to reduce by 50%, but in high meat-consuming countries, including the United States, Canada, Brazil, and Argentina, the required reduction by 2050 to 16 kg per year is around 5 times less than current consumption levels. In lower income, developing countries where meat consumption is still low or moderate, it may be necessary from a nutrition security perspective to even increase consumption levels.

## How to Bring About Transformation?

The EAT-Lancet Commission report outlines for the first time quantitative scientific targets for healthy diets and sustainable food production, with the aim to provide the evidence-based consensus that will start to unlock major global efforts. It is unlikely that, with so many different players in the food system, consensus will be achieved by one report, but a direction of travel has been defined that can be seen as a basis for defining healthy and environmentally sustainable eating guidelines. Enabling the dietary shifts proposed in the EAT-Lancet report by 2050 will require radical transformation of the global food system involving all stakeholders in the food value chain, from the government and, the food industry through to consumers. Effective and scaled combinations of policies and approaches that are globally and locally relevant will require stakeholders to work together in new ways and in new partnerships to truly achieve this important shared goal. Realizing consumer behavior change on the scale required will be particularly difficult. Data from a 2017 Dutch study showed that the majority of European people surveyed were not interested in reducing their meat consumption over the next 5 years, and of those who were planning to eat less meat, most would do so because of health and animal welfare, not environmental, concerns.<sup>29</sup> The conclusions from this study are in line with other similar investigations,<sup>30</sup> and it is, therefore, fortunate that more healthy diets are also in general more environmentally friendly,<sup>31</sup> although looking at the most important purchase drivers, taste always comes in first place, followed by price.<sup>32</sup> To make it easier for consumers to choose more plant-based foods, the food industry should be producing and communicating about the health credentials of their plant-based products. However,



the communication should focus strongly on the fact that they taste great and are widely affordable.

New plant-based food innovations are not immediately needed for the food industry to offer consumers affordable, healthy and sustainable choices. For example, dried and canned plant-based foods have been available since the 1800s and have ensured that seasonal produce is available all year round and that local produce can be easily transported and widely consumed. Preservation of perishable plant-based foods also helps to prevent food loss while retaining nutrient content and, in some cases, even improving nutrient bioavailability.<sup>33</sup> But the food industry is in a good place to inspire a consumer shift to healthier and more sustainable choices in many new ways too. The food industry is incredibly diverse and all players, including farmers, manufacturers, retailers and food service can influence health and environmental sustainability across the food system. In particular consumer-facing businesses have a particular opportunity to influence diets, as in every interaction there is the potential to nudge consumers toward healthier and more sustainable choices. Small changes to popular products can have huge impacts on both health and environmental pressures. Americans eat 10 billion hamburgers a year, and the World Resources Institute estimated that replacing just 30% of the beef for mushrooms in a typical hamburger would be a relatively small change from a taste perspective, but would save as many emissions as taking 2.3 million cars off the road, conserve as much water as the amount used by 2.6 million Americans each year, and reduce agricultural land demand by an area larger than the state of Maryland.<sup>34</sup> Exchanging beef for mushrooms would also deliver nutritional advantages (e.g., lower calories, lower total and saturated fat and higher fiber), making this kind of small formulation change a “win-win” shift for people’s health and for the planet, which could be applicable to many popular products or dishes.

Different consumers will require different solutions to move toward the food group intakes recommended by the planetary health diet. In wealthy markets, the increasing availability of plant-based meat alternatives can make the transition to lower meat consumption less disruptive to perform. Technology is contributing to advances in plant-protein structuring, which is aiming to develop meat-analogues resembling the structure, fibrous texture, and juiciness of meat.<sup>35</sup> The development of meat-analogues with healthy nutrient profiles and low environmental impact could form a new generation of “processed foods,” foods that are good for both people and the planet.

## Conclusions

In conclusion, while there may not be consensus on the solutions, many now agree that the global food system needs to go through a transformation, so that it delivers more healthy and sustainable outcomes for people and for the planet. Dietary shifts to more plant-based and less animal-sourced foods in wealthy countries in addition to improvements in agricultural technologies and significant reductions in food loss and waste seem to be the key changes needed to

significantly reduce premature mortality and environmental pressures. The EAT-Lancet Commission has proposed scientific targets for these changes, which should be reached by 2050 to achieve the ambitions of the Sustainable Development Goals and the Paris Agreement. It remains to be seen how urgently this transformation will be addressed at policy and society levels.

### Conflict of Interest

All authors are employed by Unilever.

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