Planetary Impacts of Food Production & Consumption

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alpro Foundation
Knowledge in plant-based nutrition

Table of contents

1. Key messages

- **Livestock contribute 14.5% of GHGe and significant quantities of land would be released by moving towards more plant-based diets.**
- **Nature is declining globally at rates unprecedented in human history, with over 1 million species threatened with extinction. One estimate suggests 30% of global biodiversity loss is linked to livestock production.**
- **Dietary shift could significantly reduce the total quantity of energy used within the food system, reduce water stress and improve water quality.**
- **The environmental and social impacts of food production and consumption are not truly reflected in the price of food many consumers pay. True cost accounting approaches, which recognise the external environmental and health costs of diets, will continue to influence the debate around the use of fiscal measures which drive consumer behaviours.**

Food production, distribution and consumption lie at the centre of many of the key sustainability challenges we confront today. Food is responsible for a major part of the environmental impacts in both developing and developed countries [30], with significant advances in Life-cycle analysis (LCA) methods [31] capturing a wide variety of environmental impacts across the food value chain, from production of inputs to agriculture, through farming, industry and retail to household (end consumer). The main sustainability impacts associated with food production and consumption are highlighted below.

2. Food security

Food security is a concept that is used to think systemically about how and why malnutrition arises, and what can be done to address and prevent it, alongside other key sustainability impacts. Underlying it is the international goal of food as a human right. [32] The FAO provides this well-accepted definition of a state of food security '*Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life*'. [33] It reflects an individuals' accessibility to food, where accessibility includes affordability. Many countries are facing the double burden of hunger and undernutrition alongside overweight and obesity, with one in three people across the globe currently suffering from some form of malnutrition. [34] Plant-based eating is key to ensuring long term food security. The use of crops and arable land for livestock production indirectly places rich meat and dairy consumers in competition for calories with those who need them most. Moreover, 6 kg of plant protein is required to yield 1 kg of meat protein, on average. Consequently, only 15% of protein and energy provided by feed crops will be consumed by humans indirectly. [35] Incidentally, the 85% of these crops that are lost for human consumption (and so for food security) strongly contribute to ammonia emissions from degradation of livestock manure, one of the major drivers of biodiversity loss.

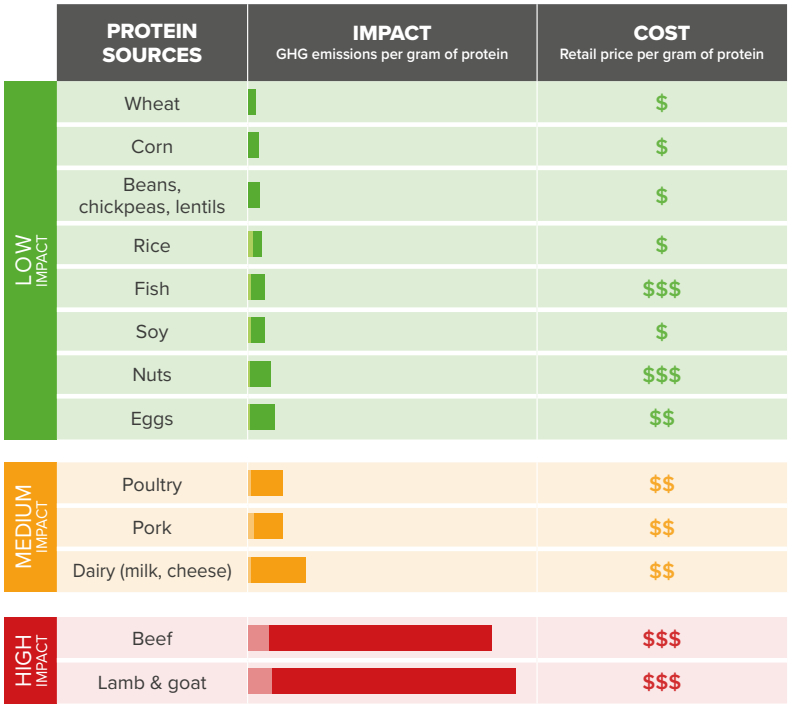
3. Climate change and greenhouse gas emissions (GHGs)

Food and agriculture are major contributors to climate change. Including land-use change, the food system is estimated to contribute approximately 19-29% of global human made GHGs.[36] The major impacts come from farming/agriculture and land-use change, with fertilisers, pesticides, manure, farming and land-use change together contributing as much as around 24% of global GHGs.[37] Livestock alone contribute 14.5% of total GHG emissions, more than the direct emissions for the transport sector. Livestock production is the largest global source of methane (CH_4) and nitrous oxide (N_2O) - two particularly potent GHGs.

Very high calorie diets are common in high-income countries and are associated with high total per capita GHGe (3.7-6.1 kg of carbon dioxide [CO_2] equivalent per day) due to high carbon intensity and high intake of animal products.[38] If everyone were to reduce their meat consumption, or even switch completely to plant-based protein food, up to 3,500 million hectares of pasture and 375 million hectares of cropland could be abandoned, resulting in a large carbon uptake from re-growing vegetation.[39] Altogether abolishing consumption of grazing animals is not an optimal solution for sustainability and food security with an important role more extensive grazing systems play within regenerative agriculture for example.[40]

A Lancet Commission report, 'The Global Syndemic of Obesity, Undernutrition, and Climate Change (2019)'[42], explored the interconnections between climate change, obesity and undernutrition. It highlighted that malnutrition in all its forms, including obesity, undernutrition, and other dietary risks, is the leading cause of poor health globally and that climate change will exacerbate these health challenges. An increasing body of evidence indicates that reducing levels of carbon dioxide in the atmosphere would increase concentrations of protein, micronutrients (zinc, iron, calcium and potassium), and B vitamins, in key food crops that provide global populations with most of our calories, including wheat, rice, millet, barley, potatoes, and rice.[43]

A Comparison of the GHG impacts of different protein sources

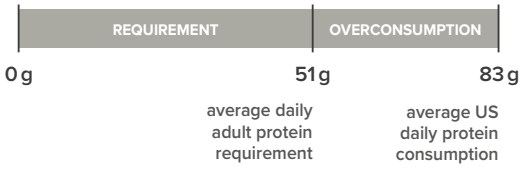


Lighter shade shows emissions from agricultural production, darker shade shows emissions from land-use change.

Figure 8 - From WRI 2016[41]

How Much Protein Do You Need?

The average daily adult protein requirement is **56 g** for a man and **46 g** for a woman but many people consume much more than they need.



4. Land-use change and biodiversity

Over the last several hundred years human uses have come to dominate the earth's land surface, progressively eroding the area that is in a natural state. As figure 9 demonstrates, humans use half of global habitable area for agricultural production[44] with 77% of agricultural land used for the rearing of livestock through a combination of grazing land and land used for animal feed production. Despite being dominant in land allocation for agriculture, meat and dairy products supply only 17% of global caloric supply and only 33% of global protein supply. Eleven million square kilometres used for crops supply more calories and protein for the global population than the almost 4-times larger area used for livestock.

Global surface area allocation for food production

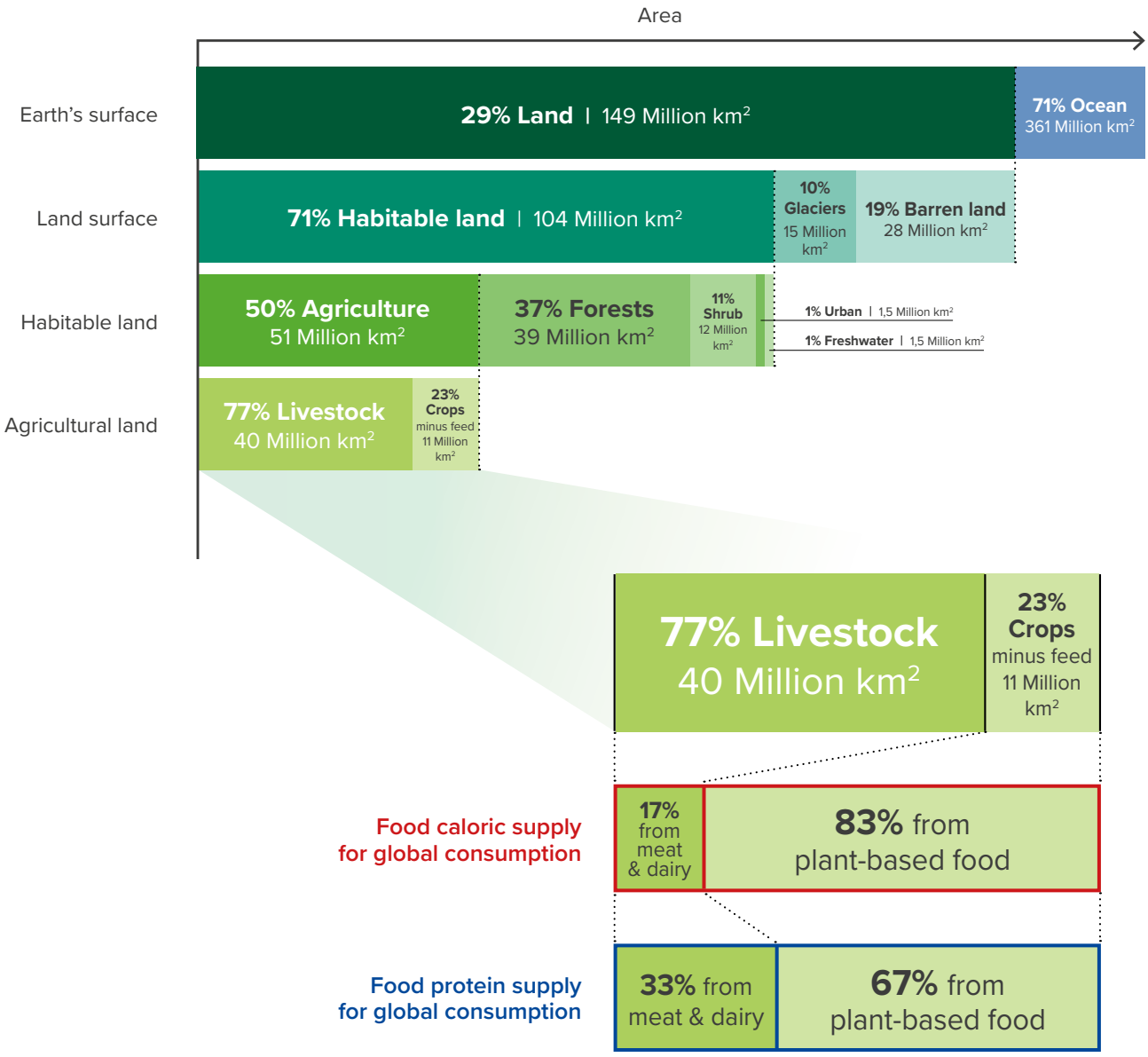


Figure 9 - From UN Food and Agriculture Organization Statistics[44]

According to one estimate, 30% of global biodiversity loss is linked to livestock production, driven by livestock's role in deforestation and land conversion, overgrazing and degradation of grasslands, and desertification.[45] Another United Nations Convention to Combat Desertification report showed that food production accounts for 80% of global deforestation.[46] The World Resources Institute has estimated that the area of land needed for agriculture could shrink by 800 million hectares and be liberated for reforestation, through a combination of measures including reducing food waste, the move towards more plant-based diets and improvements in productivity (see figure 10).[47]

More recently (2019) the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reported that nature is declining globally at rates unprecedented in human history, with over 1 million species threatened with extinction.[48] The average abundance of native species in most major land-based habitats has fallen by at least 20%, mostly since 1900. More than 40% of amphibian species, almost 33% of reef-forming corals and more than a third of all marine mammals are threatened. WWFs Living Planet Index[49] reveals that global populations of fish, birds, mammals, amphibians and reptiles decreased by 60% globally between 1970 and 2014.

Options to reduce land-use

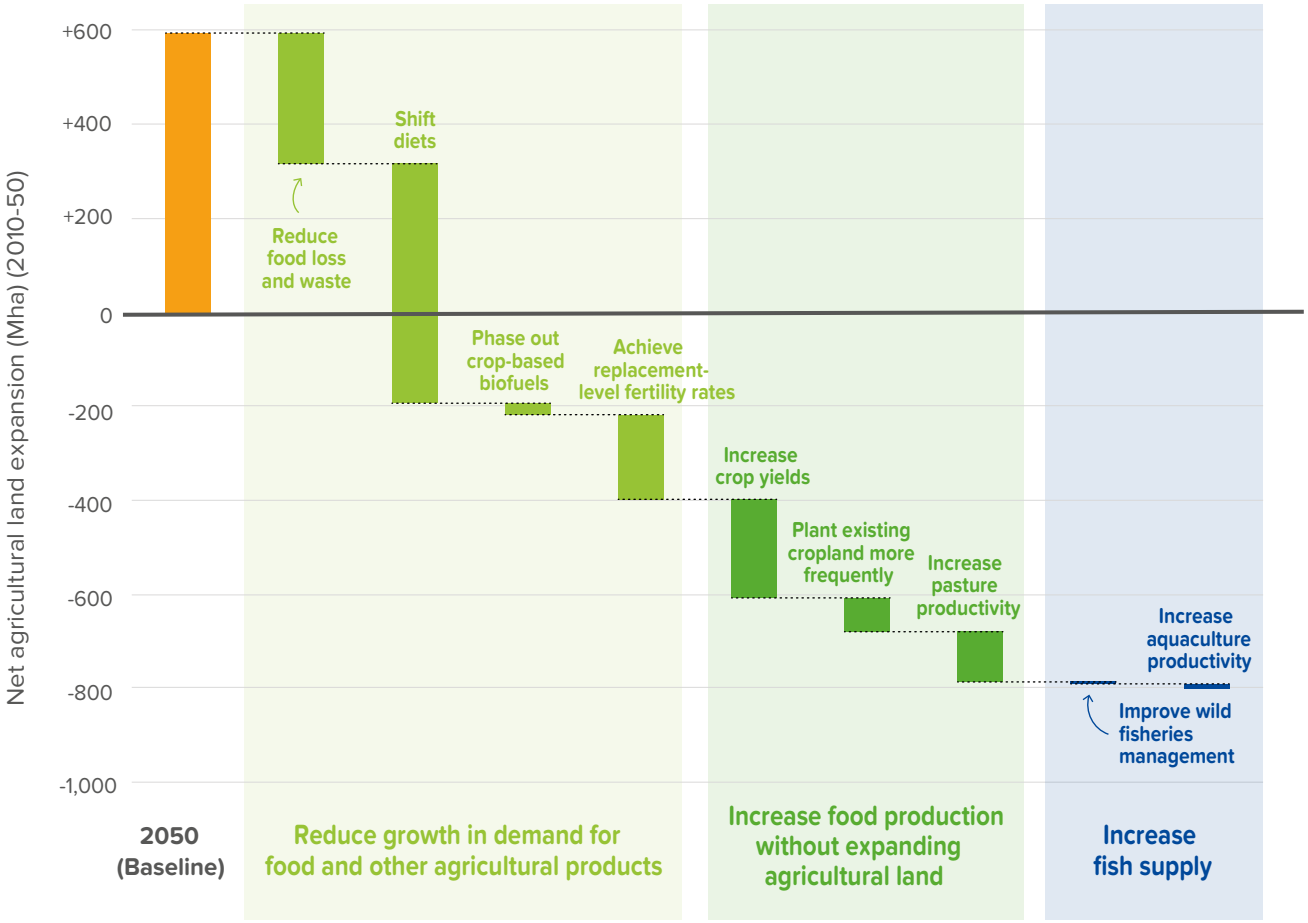


Figure 10 - From Searchinger (2018), The World Resources Institute[47]

5. Energy usage

The food systems energy demands are diverse and include fossil fuels for the production of fertilizers, pesticides, irrigation, food distribution, manufacturing, refrigeration and packaging. In industrialized economies, food production, processing, and household-level activities, such as refrigeration and cooking, account for the largest proportions of total energy used in the food system, whilst in many emerging economies agricultural production accounts for the highest proportion of energy usage. Energy use per unit of caloric output in intensive livestock and aquaculture production is typically much higher than for agricultural crops. Energy associated with feed inputs has been estimated to account for 53% to 86% of the total energy intensity of livestock products.[50] Given the wide variation in energy intensity within and between plant and livestock products, dietary choice is a key determinant of food system energy use.

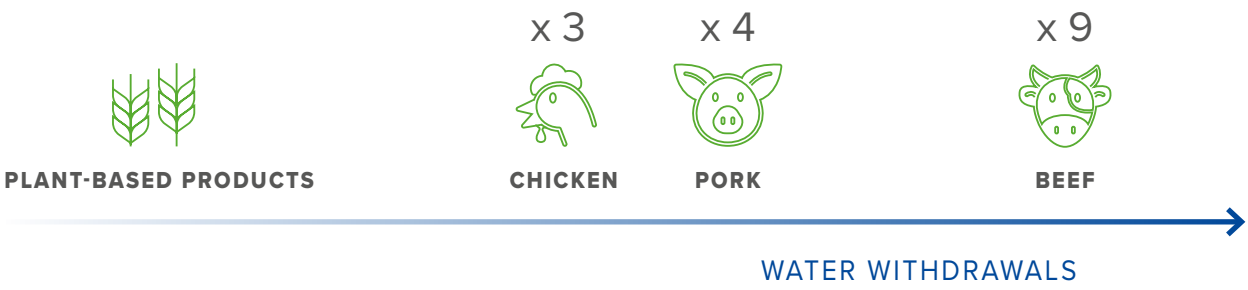
6. Water quality and quantity

Food production requires significant amounts of freshwater. Some foods are more water intensive than others, e.g. livestock products (livestock have extensive direct and indirect water demands - e.g. drinking/washing and irrigation of feed crops, respectively), many horticultural products and processed foods. Agriculture is responsible for 70% of water withdrawals (primarily for irrigation). According to the UN, today nearly half the global population are already living in water scarce areas with some estimated 700 million people worldwide being displaced by intense water scarcity by 2030.[51]

The production of beef, pork and chicken respectively uses around nine, four and three times as much irrigation water as plant-based products[52], such as cereals, but when rainfed crops are also included these estimates can be considerably higher (10-1000) under more intensive production systems[17]. According to recent research by the European Joint Research Centre[53], which compared the water footprint of different diets, greater compliance with national dietary guidelines would result in water reductions of 11% to 35% for diets with meat, 33% to 55% for pescatarian diets and 35% to 55% for healthy vegetarian diets.

Agricultural run-off containing nitrates and phosphates from excessive fertiliser use or more manure/slurry management can lead to waterways (both freshwater and marine) becoming enriched with nutrients, beyond levels that can be absorbed or dissipated by the natural system. This enrichment, which is of particular concern from more intensive livestock systems, can promote algal blooms that damage ecosystems through the release of toxins. Many countries in Europe, USA, Canada, India and New Zealand experiencing major environmental degradation due to water pollution via animal waste. Pesticides (insecticides and herbicides) sprayed onto fields which can accumulate in sediments that become washed into water bodies, are another concern. In the last few years, a new class of agricultural pollutants has emerged in the form of veterinary medicines (antibiotics, vaccines and growth promoters [hormones]), which move from farms through water to ecosystems and drinking-water sources.[54]

Comparison of irrigation water needs[52]



7. Food waste, packaging waste and trade-offs

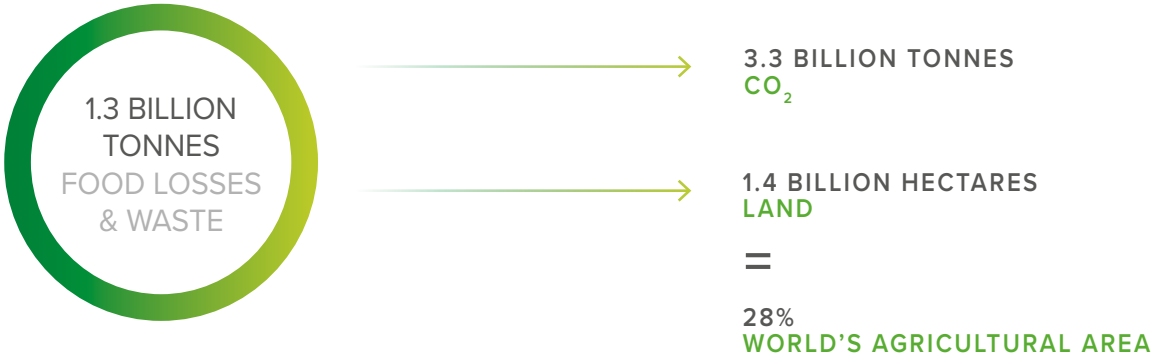
One third of the food produced in the world for human consumption every year, approximately 1.3 billion tonnes, gets lost or wasted.[55] **Food losses and waste** amount to roughly US$ 680 billion in industrialized countries and US$ 310 billion in developing countries. Food waste drives a range of environmental impacts, across the food system (plant and animal foods) including the generation of 3.3 billion tonnes of GHGe, uses up to 1.4 billion hectares of land, or 28% of the world's agricultural area.[56]

Food packaging has been demonstrably linked with high levels of waste, terrestrial and marine litter, as well as low rates of re-use or recycling. Food and beverage packaging items are amongst the most commonly found marine litter items globally. A UN study puts plastics from the global food industry to be responsible for $13 billion in natural capital impacts annually.[57]

The issue of plastics in relation to food sustainability and their impacts on the marine environment is of significant concern to many consumers, particularly since the EU have announced plans to ban the use of single use plastics, such as plastic cutlery and plates, cotton buds, straws and drink-stirrers.

It should be noted that food packaging can help reduce food waste and improve shelf life and that there are trade-offs to be made. Packaging will continue to play a role in preventing damage and can triple shelf life according to researchers at Wageningen University.[58] The development of sustainable packaging materials, such as bio-degradable and compostable materials made from plants, whilst improving the recyclability of existing materials, will be key to the success of reducing both food and packaging waste.

Environmental impacts of food losses and waste[56]



Food packaging can help reduce food waste and improve shelf life and that there are trade-offs to be made.

FOR FURTHER INFORMATION: FAO Policy Series - Food Loss & Food Waste

8. Social and economic impacts - true cost accounting

The environmental and social impacts of food production and consumption are not truly reflected in **the price of food** many consumers pay.[59] As outlined within this paper, our food system is creating damage to not only our environment, but it impacts negatively on the lives of many communities and to human physical and mental health and well-being. We are paying for this damage in hidden ways, for instance through water charges to clean up drinking water; taxes which fund livestock focused agricultural subsidies and environmental clean-up costs or through costs of diet-related disease (obesity, diabetes cardiovascular diseases etc.). So, although our food appears never to have been cheaper, when we look beneath the surface, we are paying far more than is the case at initial face value.

Full Cost Accounting approaches, such as the TEEB Agri-Food Framework[60] can help to bring to light the true cost of cheap food, and ensure consideration is given to wider health and social costs. Many health impacts and their costs continue to fall disproportionally on the poorest and most disadvantaged in society, reinforcing health inequalities. According to McKinsey the annual global economic costs of obesity are about US$2 trillion, representing 28% of the world's gross domestic product.[61] The World Health Organization estimates the direct costs of diabetes at more than US$827 billion per year, globally and this is set to reach $2.5 trillion by 2030.[62]

Over the next few years there is likely to be a renewed focus and more research around the 'True Cost of Food' (and protein); this will continue to drive the debate around the use of various forms of fiscal incentives.

Several diet optimization studies have calculated that it is possible to create healthy diets with a significantly reduced environmental impact at an affordable cost. [63, 64, 65]

SUSTAINABILITY AND PROTEIN QUANTITY

The average protein consumption in many Western countries is 150-200% of recommended values.[65] Across Europe more generally protein consumption is above the population reference intake which is recommended for an average person of 0.83 g per kg of body weight per day (higher for pregnant women[66], infants and children). Current intake is between 67 g and 114 g per day for men and between 59 g and 102 g per day for women. From a sustainability perspective, therefore, there is a need in many Western countries in particular, to reduce average intakes of protein whilst moving from a meat heavy diet to a plant heavy diet.

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