The Global Sustainability Challenges: An Overview

Mark Driscoll

alpro Foundation
Knowledge in plant-based nutrition

Table of contents

1. Key messages

- **To address multiple sustainability challenges we need to look at a set of economic, social and environmental interventions which can deliver multiple outcomes, benefiting both human and planetary health**.
- **Key global trends include a population which may reach 9.7 billion by 2050, increasing global demand for meat and changing consumer expectations**.
- **We are breaching environmental limits especially with regards to biodiversity loss, nitrogen cycle disruption and climate change. The global demand for meat and other livestock products is one of the most significant factors contributing to the breach of these limits**.
- **To restore planetary and human health we need a combination of major dietary change (a greater proportion of plants within diets), improved food production through enhanced agriculture and technology changes, and reduced food waste across the food chain from production to consumption.**

2. What is a sustainable food system?

In 1987 the United Nations' (UN) Brundtland Report on Environment and Development: 'Our Common Future'[2] noted that sustainable development '*meets the needs of the present without compromising the well-being of future generations*'. There is no one legal or universally accepted definition of sustainable food and there are many different views as to what constitutes a 'sustainable' food system. However, in general, there are **3 main pillars[3] of a sustainable food system: economic, environmental, and social sustainability (including human health)**. If any pillar is weak then the food system as a whole is unsustainable.

The UN's Food and Agriculture Organisation (FAO) defines a sustainable food system as a '*food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised*'.[5]

Our food system is highly interconnected and so the decisions all stakeholders make, whether a producer, food business, investor, government or consumer, will have far-reaching implications on the environment, societies and economies around the world. To address any of the sustainability challenges highlighted here, will require interventions which can deliver multiple outcomes, benefiting both human and planetary health.

Figure 1 - Only if we address all 3 pillars is the food system sustainable - From Economist Intelligence Unit: UNDP[4]

3. Key trends impacting on our food system and planetary health

There are a wide variety of trends that will impact on the global food system over the next few years. These include:

DEMOGRAPHIC SHIFTS

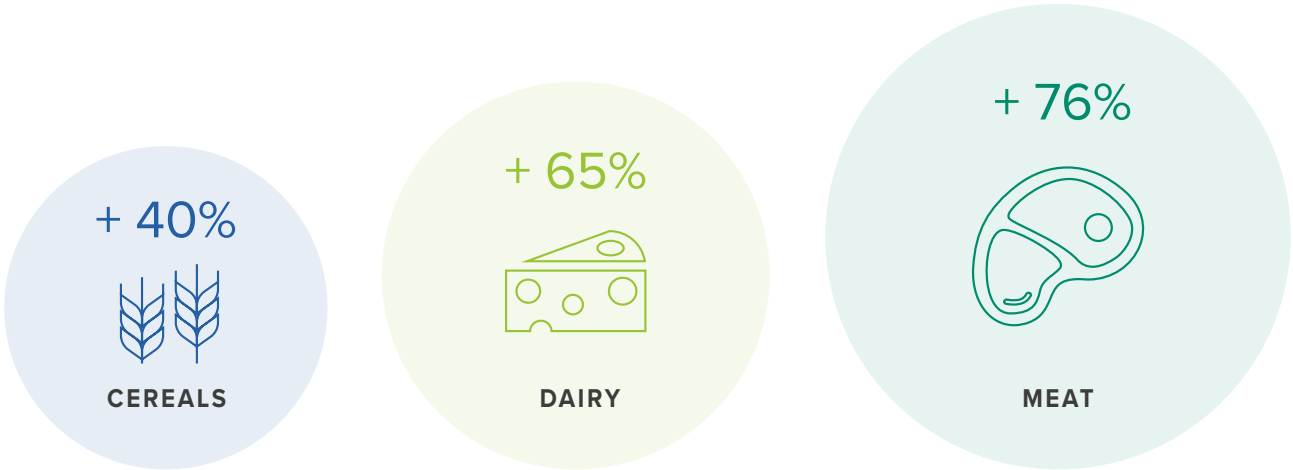
The global population is forecast to grow from 7.3 billion in 2015 and reach 9.7 billion by 2050[6] (with two thirds of these living in cities). According to the UN, food production will need to increase by 60% by 2050[7], while many others predict a doubling, based on business as usual scenarios.[8]

Projections of population growth[6]

INCREASING DEMAND FOR ANIMAL PRODUCTS

By 2050, global consumption of meat and dairy is expected to have risen by 76% and 65% respectively against a 2005-07 baseline, compared with 40% for cereals.[9] The latest OECD-FAO Agricultural Outlook datasets[10] indicate a 15% rise in global meat consumption over the next 10 years alone, driven by increasing demand in sub Saharan Africa, India and China. Today, some of the biggest meat-consuming countries include China, the European Union, the United States, Australia and South America.[11]

Expected rising of the global consumption[9]



Meat production by region

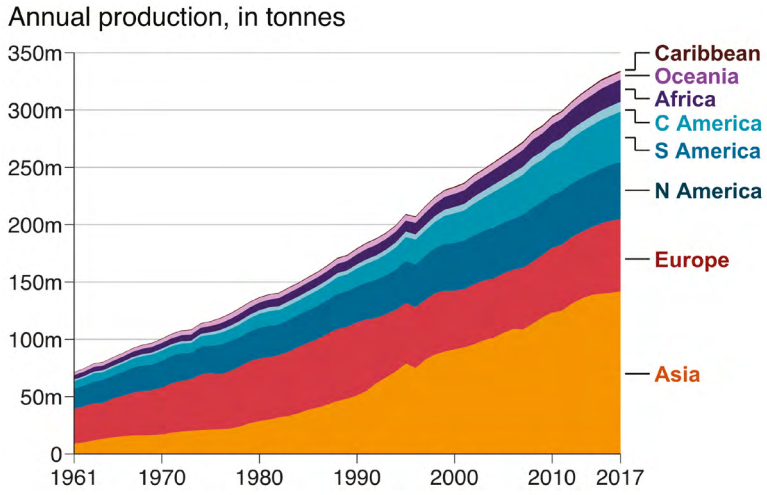


Figure 2 - From UN FAO, Our World in Data (2017)[12]

Over recent years the way we produce and consume protein has emerged as a key issue which is at the heart of many environmental and health impacts of food production and consumption.[13, 14] Today, the world population uses approximately 50% of total habitable land for agriculture. 77% of this land is used to raise animals (supplying 17% of our calories), through growing crops for animal feed and through the use of pastures as grazing land and 23% to grow crops for human consumption (supplying 83% of our calories).[15] The shift towards industrialised animal farming systems creates significant demand for grain and other plant proteins as feed for animals, as well as contributing to a host of other environmental impacts highlighted below.[13]

Animal-based foods are more resource-intensive than plant-based foods

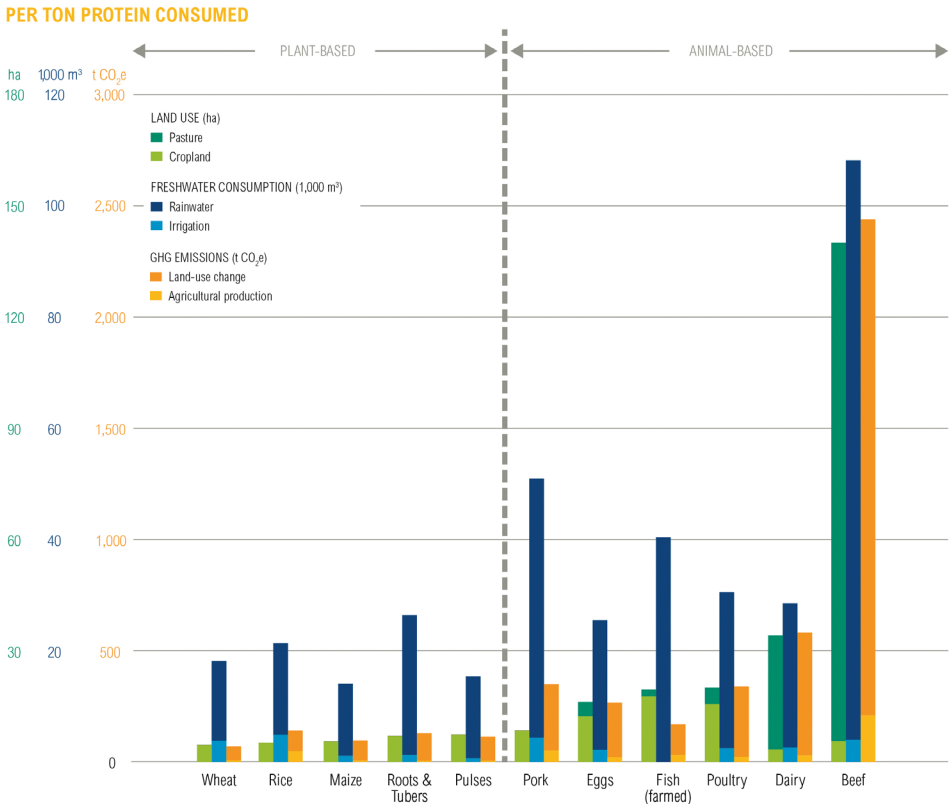


Figure 3 - From WRI, Shifting diets for a sustainable food future (2016)[16]

LIVESTOCK ARE INEFFICIENT FEED CONVERTERS

It takes much more grain, land and water to grow an animal to produce a kg of meat than it does to produce the same number of calories in the form of any grain or plant that is eaten directly. **The protein efficiency of meat and dairy production is defined as the percentage of protein inputs as feed effectively converted to animal protein**.

Poultry for example have an efficiency of about 20% (for every 5 kg of protein in, you get 1 kg out) and beef has an efficiency of about 3.8%[16] (see figure 4) although this does depend strongly on the type of production system (e.g. extensive vs intensive, organic vs inorganic etc.). The underlying cause is that beef cattle have multiple stomachs, geared to metabolize resistant lignins of grasses, rather than easily digestible carbohydrates from maize. For economic efficiency, they are fed maize to grow faster, but the caloric and protein efficiency is low. In fact, they cannot be fed maize for longer than about 3 months, for it turns them ill.[17]

Protein efficiency of meat and dairy production

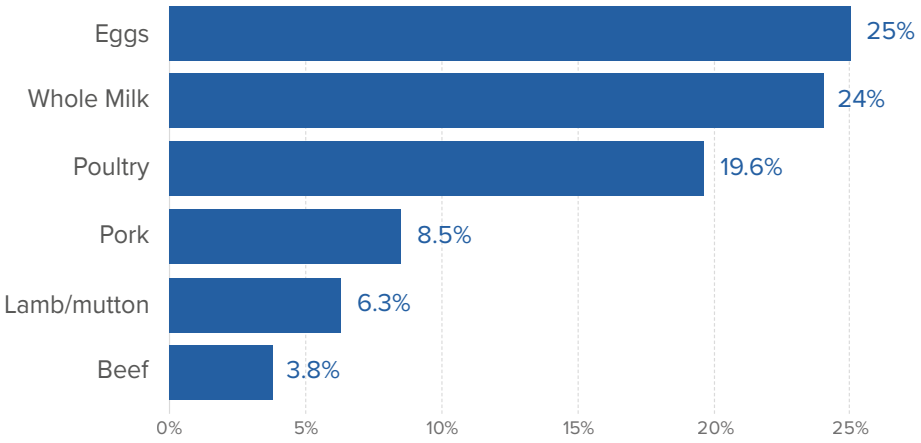


Figure 4 - From Alexander, P. (2016), Human appropriation of Land for Food: The role of diet[16]

CHANGES IN CONSUMER EXPECTATIONS

Driven by concerns about health, sustainability and animal welfare, many consumers across Europe and North America are turning towards more plant-based diets (flexitarian, vegetarian and/or vegan based diets) and are making conscious decisions to reduce quantities of meats within diets. For example, recent European research has shown that 57% of Germans, 55% of Poles and 45% of people in France and Italy consciously have meat free days.[18] All signs point to continued rapid growth in plant-based product sales in the long term, driven by the rise in flexitarian, vegetarian and vegan diets as consumers continue to look for products that reduce health and sustainability impacts.[19]


DISCOVER
Six Plant Based
Innovation
Trends for 2019

4. Planetary boundaries framework and our food system

In 2009, a group of 29 internationally renowned scientists, led by Johan Rockström, identified nine human impacts on processes that regulate the stability and resilience of the Earth system.[20]

1. Climate change
2. Biodiversity integrity
3. Land-use change
4. Freshwater use
5. Biochemical flows: nitrogen and phosphorus flows and cycle disruption
6. Ocean acidification
7. Atmospheric aerosol loading
8. Stratospheric ozone depletion
9. Chemical pollution and release of novel entities

Society's activities have already pushed climate change, biodiversity loss, shifts in nutrient cycles (nitrogen and phosphorus), and land use beyond the boundaries into unprecedented territory[21] and our food system is one of the most significant drivers behind the breaches of these planetary boundaries.[22] They were subsequently ranked, with the top 3 issues breaching environmental limits being biodiversity loss, nitrogen cycle disruption and climate change.[23,24,25] The global demand for meat and other livestock products is one of the most significant factors contributing to the breach of these limits.

The nine planetary boundaries

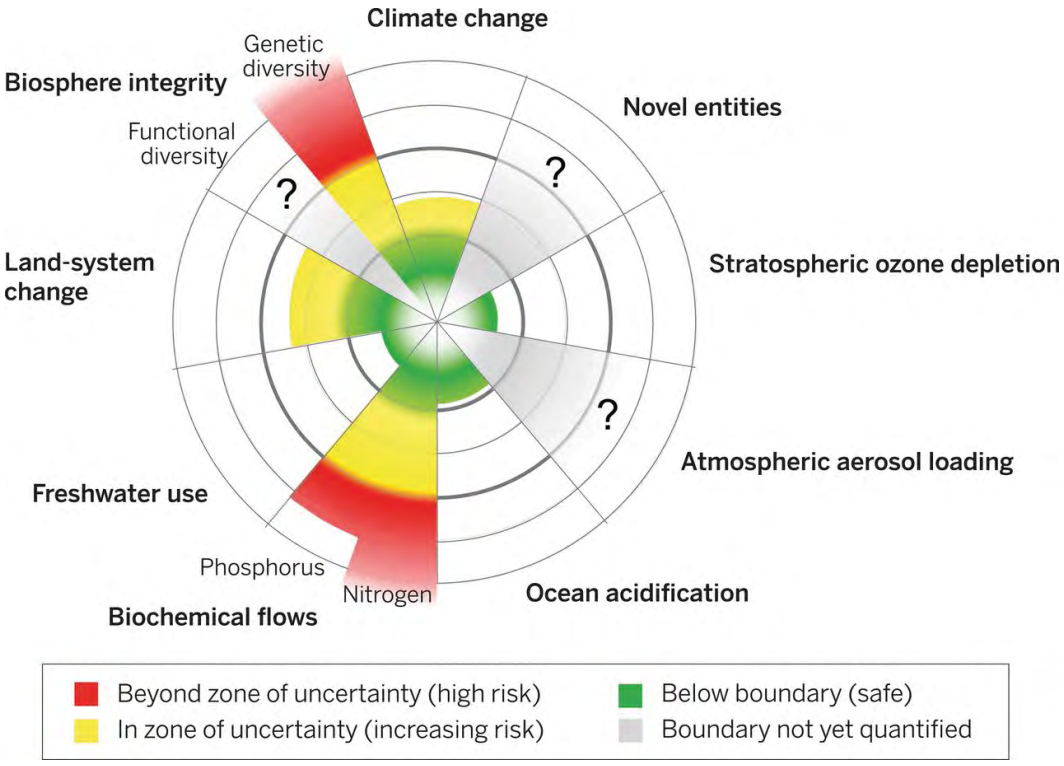


Figure 5 - From The Stockholm Resilience Centre[21]

5. International commitments - Sustainable Development Goals (SDGs), Paris Climate Change agreements and biodiversity commitments

In 2015, UN Member States endorsed two global agreements, which underpin the international interest in and the need to take a systemic approach to many of the health and sustainability opportunities and challenges associated with the food system. These include the Agenda for Sustainable Development[26] which identified **17 Sustainable Development Goals (SDGs) and the Paris Agreement on Climate Change**[27], which highlighted the need for urgent action to keep global warming below the 1.5 degrees threshold. Both agreements require far-reaching commitments and action from all countries of the world for their successful implementation, with a sustainable system key to the success of both of these agreements.

The Global Nutrition Reports 2017 & 2018[28], highlighted that the SDGs present an unprecedented impetus for universal and integrated change.

Johan Rockström and Pavan Sukhdev also noted that the delivery on the full range of SDGs is based first on achieving what they called 'biospheric' or ecological goals[29] (6, 13, 14, 15), i.e. it is a necessary but not sufficient condition of achieving social goals and the determinants of health (e.g. SDG 1 on poverty, SDG 4 on education, and SDG 10 on reduced inequalities) and economic goals that we have resilient and stable ecosystems. This is reflected in their 'wedding cake' structure in figure 7.

FOR MORE INFORMATION WATCH Johan Rockstrom 2018 TED talk

The 17 Sustainable Development Goals

Figure 6 - From Sustainable Development Goals[26]

SDG Wedding Cake

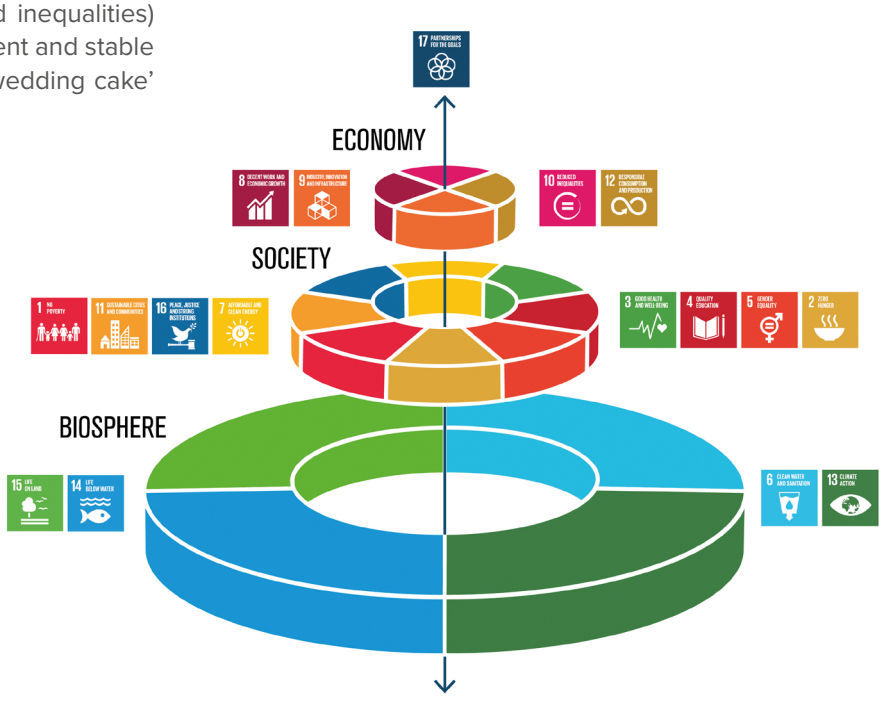


Figure 7 - From Stockolm Resiliance Centre[29]

References

1. Pollan, M. In Defence of Food: An Eater's Manifesto. Penguin Press, New York, 2008.
2. Brundtland Report (1987). Our Common Future http://www.un-documents.net/wced-ocf.htm
3. United Nations General Assembly (2005). World Summit Outcome, Resolution A/60/1, adopted by the General Assembly on 15 September 2005.
4. Adapted from: http://foodsustainability.eiu.com/whitepaper-2018/
5. FAO (2018). Sustainable food systems Concept and framework What is a sustainable food system? Why take a food systems approach?
6. UN (2015), World Population Prospectus – Revision ESA/P/WP.241 https://esa.un.org/unpd/wpp/Publications/Files/Key_Findings_WPP_2015.pdf
7. http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf
8. Tomlinson, I. (2013). Doubling food production to feed the 9 billion: A critical perspective on a key discourse of food security in the UK. Journal of Rural Studies, 29, 81–90.
9. FAO (2012), 'World Agriculture Towards 2030/2050: the 2012 Revision', ESA Working Paper No. 12-03 (Rome: FAO).
10. OECD-FAO Agricultural Outlook 2018-2027 (2018), OECD Publishing, https://doi.org/10.1787/agr_outlook-2018-en
11. World Economic Forum (2018) https://www.weforum.org/agenda/2018/08/these-countries-eat-the-most-meat-03bdf469-f40a-41e3-ade7-fe4ddb2a709a/
12. https://ourworldindata.org/meat-production
13. World resources Institute (2016). Shifting Diets for a Sustainable Food Future.
14. Forum for the Future. (2016) Shaping the Future of Protein -The Protein Challenge 2040: Accelerating Innovation and Action https://www.forumforthefuture.org/Handlers/Download.ashx?IDMF=6985b5f7-ee65-4862-893e-53a6355984fb
15. https://ourworldindata.org/uploads/2013/10/Land-use-graphic-01-01-01.png
16. Alexander, P. (2016), Human appropriation of Land for Food: The role of diet. Global Environmental Change, 41, 88-98.
17. Aiking, H. (2011). Future protein supply. Trends in Food Science & Technology, 22, 112-120.
18. Mintel (2018); Summer and Food Drink Trends https://downloads.mintel.com/private/zgXKu/files/688043/
19. https://www.europeandatajournalism.eu/eng/News/Data-news/Europe-is-going-veg
20. https://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html
21. Steffen, W et al. (2015). Planetary boundaries: Guiding human development on a changing planet. Science, 347, 1259855-10.
22. Springmann M, et al (2018). Options for keeping the food system within environmental limits. Nature, 562, 519–525.
23. Friel S., et al., (2009): Public health benefits of strategies to reduce greenhouse-gas emissions: food and agriculture. Lancet. 12;374(9706):2016-25.
24. Mertens E., et al. (2017) Operationalising the health aspects of sustainable diets: a review. Public Health Nutr., (4):739-757
25. Reynolds CJ., et al. (2014) Are the dietary guidelines for meat, fat, fruit and vegetable consumption appropriate for environmental sustainability? A review of the literature. Nutrients. 6(6):2251-65.
26. https://sustainabledevelopment.un.org/
27. https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement
28. https://globalnutritionreport.org/
29. http://www.stockholmresilience.org/research/research-news/2016-06-14-how-food-connects-all-the-sdgs.html
30. Tukker, A., et al. (2011) Environmental impacts of changes to healthier diets in Europe. Ecol Econ 70:1776–1788.
31. Thomas N., et al. (2016) Environmental impacts of food consumption and nutrition: where are we and what is next?
32. UN. Fact sheet 34 - The Right To Adequate Food. (United Nations, 2010).
33. FAO (2003). Trade Reforms and Food Security: Conceptualizing the Linkages.
34. https://globalnutritionreport.org/reports/2017-global-nutrition-report/
35. Aiking, H. (2014). Protein production: planet, profit, plus people? Am J Clin Nutr, 100, 483S-489S.
36. Vermeulen SJ., et al. (2016) Climate Change and Food Systems. Annual Review of Environment and Resources 2012 37:1, 195-222.
37. Gerber, P.J., et al. (2013). Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome.
38. Pradhan P, et al. (2013). Embodied greenhouse gas emissions in diets. PLoS ONE 8(5):e62228.
39. Aiking et al. (2006) Sustainable Protein Production and Consumption: Pigs or Peas? Springer, Dordrecht (NL), ISBN 1-4020-4062-8, pages 171-172.
40. http://www.regenerativeagriculturedefinition.com/
41. World resources Institute (2016). Protein scorecard.
42. Swinburn BA., et al. (2019) The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report. 393, 10173, P791-846.
43. Matthew R. et al. (2018) Impact of anthropogenic CO2 emissions on global human nutrition, Nature Climate Change (2018).
44. https://ourworldindata.org/yields-and-land-use-in-agriculture
45. Westhoek, H., et al. (2011), The Protein Puzzle: The Consumption and Production of Meat, Dairy and Fish in the European Union (The Hague: PBL Netherlands Environmental Assessment Agency).
46. https://knowledge.unccd.int/sites/default/files/2018-06/GLO%20English_Full_Report_rev1.pdf
47. World resources Institute (2018). Creating a sustainable food future.
48. https://www.ipbes.net/article/press-release-ipbes-launches-new-assessment-biodiversity-and-ecosystem-services
49. https://www.wwf.org.uk/updates/living-planet-report-2018
50. Pelletier N., et al. (2011), Energy Intensity of Agriculture and Food Systems. Annu. Rev. Environ. Resour. 36, 223-246.
51. https://www.unwater.org/water-facts/scarcity/
52. Mekonnen, M.M. and Hoekstra, A.Y. (2012), 'A Global Assessment of the Water Footprint of Farm Animal Products', Ecosystems, 15, pp. 401–15.
53. Vanham D., et al (2018) The water footprint of different diets within European sub-national geographical entities. Nature Sustainability, 1, 518–525.
54. FAO (2017) 'Water Pollution from Agriculture - A global review' - http://www.fao.org/3/a-i7754e.pdf
55. http://www.fao.org/save-food/resources/keyfindings/en/
56. http://www.fao.org/3/i3347e/i3347e.pdf
57. https://www.unenvironment.org/news-and-stories/press-release/plastic-waste-causes-financial-damage-us13-billion-marine-ecosystems
58. https://www.wur.nl/en/Research-Results/Research-Institutes/food-biobased-research/Research-themes/Sustainable-Food-Chains/Extending-shelf-life-via-packaging.htm

59. Fitzpatrick, I., et al., Sustainable Food Trust (2017), The Hidden Cost of UK Food, https://sustainablefoodtrust.org/articles/hidden-cost-uk-food/

60. http://teebweb.org/agrifood/about/

61. https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/how-the-world-could-better-fight-obesity

62. Bommer C, et al. (2018) Global Economic Burden of Diabetes in Adults: Projections From 2015 to 2030. Diabetes Care, 41(5): 963-970

63. van Dooren, C., et al (2015). Combining low price, low climate impact and high nutritional value in one shopping basket through diet optimization by linear programming. Sustainability, 7, 12837-12855.

64. Reynolds CJ, Horgan GW, Whybrow S, Macdiarmid JI. Healthy and sustainable diets that meet greenhouse gas emission reduction targets and are affordable for different income groups in the UK. Public Health Nutr 2019; %20:1-15.

65. De Boer, J., & Aiking, H. (2018). Prospects for pro-environmental protein consumption in Europe: Cultural, culinary, economic and psychological factors. Appetite, 121, 29-40.

66. https://www.efsa.europa.eu/en/press/news/120209

67. Sabate, J. (ed.) Environmental Nutrition - Connecting Health and Nutrition with Environmentally Sustainable Diets, Elsevier.2019.

68. https://www.fcrn.org.uk/fcrn/publications/fcrn-discussion-paper-what-sustainable-healthy-diet

69. Willett et al. (2019). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. 393, 10170, P447-492.

70. Dernini S, et al. (2016) Med Diet 4.0: the Mediterranean diet with four sustainable benefits. Public Health Nutr. 12, 1–9.

71. Sáez-Almendros S, et al. (2013) Environmental footprints of Mediterranean versus Western dietary patterns: beyond the health benefits of the Mediterranean diet. Environ Health.12, 118.

72. da Silva R, et al (2009) Worldwide variation of adherence to the Mediterranean diet, in 1961-1965 and 2000-2003. Public Health Nutr.9A, 1676–84.

73. Vareiro, Bach-Faig, et al. (2009). Availability of Mediterranean and non-Mediterranean foods during the last four decades: comparison of several geographical areas. Public Health Nutr. 9A, 1667–75.

74. Sofi F, et al. (2014) Mediterranean diet and health status: an updated meta-analysis and a proposal for a literature-based adherence score. Public Health Nutr. 12,2769–82.

75. Germani A, et al. (2014) Environmental and economic sustainability of the Mediterranean Diet. Int J Food Sci Nutr. 65(8), 1008–12.

76. Adamsson V. et al, (2012) What is a healthy Nordic diet? Foods and nutrients in the NORDIET study. Food Nutr Res. 56.

77. van Dooren C, et al (2014). Exploring dietary guidelines based on ecological and nutritional values: A comparison of six dietary patterns. Food Policy. 44, 36–46.

78. Ndanuko RN, et al. (2017) Associations between Dietary Patterns and Blood Pressure in a Clinical Sample of Overweight Adults. J Acad Nutr Diet 117 (2) 228–39.

79. Poulsen SK, et al. (2014) Health effect of the New Nordic Diet in adults with increased waist circumference: a 6-mo randomized controlled trial. Am J Clin Nutr. 99(1):35–45.

80. Saxe H. (2014) The New Nordic Diet is an effective tool in environmental protection: it reduces the associated socioeconomic cost of diets. Am J Clin Nutr., 99(5):1117-25.

81. Health Council of the Netherlands (2011). Guidelines for a healthy diet: The ecological perspective. Report 2011/08E, available at http://www.gr.nl. The Hague: Health Council of the Netherlands / Gezondheidsraad.

82. Mason, P., & Lang, T. (2017). Sustainable diets - How ecological nutrition can transform consumption and the food system. Oxon, UK: Routledge.

83. RLI (2018). Sustainable and healthy: Working together towards a sustainable food system. Report RLI 2018/02. https://en.rli.nl/publications/2018/advice/sustainable-and-healthy Accessed 20 June 2018. The Hague, The Netherlands: The Council for the Environment and Infrastructure (Raad voor de Leefomgeving en Infrastructuur).

84. http://www.fao.org/3/a-i5640e.pdf

85. https://ec.europa.eu/jrc/en/health-knowledge-gateway/promotion-prevention/nutrition/food-based-dietary-guidelines

86. Behrens, P. et al. (2017) Environmental impacts of dietary recommendations, Proceedings of the National Academy of Sciences Dec 2017, 114 (51) 13412-13417.

87. Blackstone NT et al. (2018) Linking sustainability to the healthy eating patterns: a systematic analysis of the Dietary Guidelines for Americans. Lancet Plan Health. 2: e344-e352.

88. Audsley et al. (2018). Assessing the environmental impacts of healthier diets - Final report to Defra on project FO0427 Cranfield University.

89. Hallström, E, et al. (2015). Environmental impact of dietary change: a systematic review. Journal of Cleaner Production, vol. 91, pp. 1-11.

90. Tilman D & Clark M (2014) Global diets link environmental sustainability and human health. Nature 515(7528):518–522.

91. Hedenus F, et al. (2014) The importance of reduced meat and dairy consumption for meeting stringent climate change targets. Clim Change 124(1-2):79–91.

92. Popp A, et al. (2010) Food consumption, diet shifts and associated non-CO2 greenhouse gases from agricultural production. Glob Environ Change 20(3):451–462.

93. https://www.researchgate.net/profile/Janet_Ranganathan/publication/301541772_Shifting_Diets_for_a_Sustainable_Food_Future/links/5717b3dd08ae986b8b79e1a8/Shifting-Diets-for-a-Sustainable-Food-Future.pdf

94. Alexander et al. (2017). Losses, inefficiencies and waste in the global food system. Agricultural Systems 153, 190-200.

95. Aiking, H., & De Boer, J., (2019). The Next Protein Transition. Trends in Food Science & Technology. https://www.sciencedirect.com/science/article/abs/pii/S0924224418301213

96. De Boer, J., & Aiking, H. (2019). Strategies towards healthy and sustainable protein consumption: A transition framework at the levels of diets, dishes, and dish ingredients. Food Quality and Preference, 73, 171-181. https://doi.org/10.1016/j.foodqual.2018.11.012

97. Springmann M., et al. (2018). Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. The Lancet 2 (10) Pe451-e461.

98. van de Kamp ME., et al. (2018). Healthy diets with reduced environmental impact? – The greenhouse gas emissions of various diets adhering to the Dutch food based dietary guidelines. Food Research International. 104, 14-24.

99. Pollard J (2003) Dietary Reference Intakes. in Encyclopedia of Food Sciences and Nutrition (Second Edition).

100. Temme EHM, et al. (2013) Replacement of meat and dairy by plant-derived foods: estimated effects on land use, iron and SFA intakes in young Dutch adult females. Public Health Nutr., 16:1900–1907.

101. Temme EHM., et al. (2014) Greenhouse gas emission of diets in the Netherlands and associations with food, energy and macronutrient intakes. Public Health Nutrition: 18(13), 2433–2445.

MORE INFORMATION ON

www.alprofoundation.org

LinkedIn@AlproFoundation

alpro Foundation

Knowledge in plant-based nutrition

Extracted from 'More plant-based eating for the planet'

Text by Mark Driscoll, Founder and Director, Tasting the Future, UK.
Reviewed by Prof. Em. Harry Aiking, Institute for Environmental Studies, VU University, The Netherlands.
This review is fully supported by the Scientific Advisory Committee of the Alpro Foundation.
Date: July 2019

alpro Foundation
Knowledge in plant-based nutrition