



Nordic food systems for improved health and sustainability

Baseline assessment to
inform transformation



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Executive Summary

Governments around the globe, including the Nordics, have committed to prioritising sustainable development in line with the Sustainable Development Goals (SDGs). Well-functioning food systems are a critical determinant of sustainable development,^{1,2} and as such, they lie at the very heart of the 2030 Agenda.³ Yet currently, food systems are not on a trajectory to provide for healthy people, societies and ecosystems. Globally, food production is the largest driver of environmental change,^{1,4} and unhealthy diets are the leading cause of poor health.⁵ Without transformative changes to food systems, sustainable development is at risk.

Each Nordic country has a distinct food system, yet they share many strengths and challenges. In the Nordic countries, populations benefit from a safe and plentiful food supply, but unhealthy diets are a leading risk factor for poor health across the region, and these diets are a key driver of environmental damage, contributing to high overall environmental impact.⁶⁻⁹ For the Nordics to realize the 2030 Agenda, substantial change is needed to improve the links between people, planet and food. This would be aided by adopting a systems-based, resilience approach to understand the linkages between and feedbacks among food system components, and how they relate to health and environmental outcomes. Such an approach would enable action by people, businesses and policy.

The Nordics are in a unique position globally, where much work has already been initiated to improve food systems. For example, the Nordics have pioneered the incorporation of both health and environmental sustainability considerations into dietary guidance,¹⁰ and producers follow strict regulations on animal health, welfare and antibiotic use.^{11,12} Further, Nordic food systems are embedded in societies with strong social and institutional foundations, with high levels of innovation and multi-sector collaboration. As such, the ‘ingredients’ of transformation can be found in the Nordics, making it an ideal test ground to design food systems that serve sustainable development.

We propose four parallel tasks in achieving food systems transformations. While a broad range of actors will be needed to complete these tasks, this report contributes to these tasks by synthesizing existing knowledge on Nordic food systems (Task 1) and using that evidence to inform next steps of food system transformations (Tasks 2 and 3). We identify areas of action that need to be progressed to deliver on global goals and bring to light challenges of this transition (Task 4).

Task 1: Assess

– *what do current Nordic food systems look like?*

We conduct a baseline assessment of current Nordic food consumption, primary food production and waste. We shed light on the processes and practices that shape these activities and analyse the impacts of these activities on people and the planet. The assessment shows that despite good dietary guidance, early adoption of environmental considerations into the agricultural sector and policies to reduce food waste in-line with global goals, Nordic food systems are failing to meet several diet and environmental goals. Nordic diets are contributing to poor health, the food systems are placing pressure on the environment both domestically and abroad, and excessive food waste is leading to environmental and economic losses. Current food systems are not on track to deliver on the Nordic’s commitments to Agenda 2030 or the Paris Climate Agreement.

Task 2: Define

– *what do future desired food systems look like?*

Future Nordic food systems will need to provide for healthy people, prosperous societies and a sustainable planet. The EAT-Lancet Commission Report on Healthy Diets from Sustainable Food Systems provides global targets for diets that support health and for food production systems that support environmental sustainability.¹ These global targets can be downscaled to a national or regional level, making them useful tools to help define future desired food systems in a particular context. We highlight that normative decisions about social equity and justice¹³ as well as the resilience of food systems¹⁴ are inherent in the selection of an approach. Because of this normative aspect, we do not aim to set final Nordic food system boundaries, but rather indicate the scale of change needed based on one possible translation of global targets to the Nordic region.

Task 3: Compare

– *what is the gap between current and desired food systems?*

Using an equal per-capita approach to downscale the EAT-Lancet targets to the Nordic region, we show that there is a substantial gap between current and desired food systems. For example, the environmental impact of the Nordic population’s food consumption is three times the climate boundary and twice the land use boundary. Our report highlights that these environmental impacts are not just felt domestically, but also in countries from which the Nordic countries import foods. Looking at consumption patterns, Nordic populations need to increase their intake of

vegetables and legumes, swap refined grains for whole grains, substantially reduce consumption of red meat and limit sugar intake in order to meet the *EAT-Lancet* healthy eating targets.

Task 4: Act

– to transform Nordic food systems

There is sufficient evidence to take immediate actions toward food system transformations. Using the ‘leverage point’ approach,^{15,16} we outline three places to intervene in food systems. First are ‘no-regrets’ actions that may have relatively little leverage for systems change, but are moving the system in the right direction, e.g. establishing infrastructure to enable efficient data collection and information sharing. Next are innovative actions, which are largely untested, yet the existing evidence base supports trial of the intervention. Innovative actions such as concerted initiatives to decrease meat consumption will not, by themselves, change the core characteristics of the food system, yet can be an important part of desired future food systems. Finally, paradigm shifts are those changes with the most potential for transformation. These shifts involve fundamentally altering the embedded ideologies and lock-ins of current food systems. Such a shift could be adopting a global perspective to ensure that Nordic food choices do not diminish the capacity of other countries to reach their sustainable development goals.

There will be challenges to initiating these changes, such as adopting a ‘whole food system’ approach; addressing trade-offs among food system goals; and confronting prevailing forces and lock-ins. Yet these challenges should not be an excuse for inaction. Our analysis demonstrates that there are sufficient data on Nordic food systems to understand the crucial action areas and to begin taking immediate steps towards food systems transformations. A transformation implies a journey into aspects partly unknown and untested. Our report highlights the complementarity of scientific assessment and normative dialogue on this journey. Food system actors would benefit from building a common understanding of desired pathways towards transformation, which should be informed by the best available evidence. This can be achieved through sustained, cross-sectoral (e.g. policy, business, research, civil society, producer, consumer) stakeholder dialogues. It is particularly important to include stakeholders who are often marginalized in these types of collaborative decision-making processes.

Key messages

- Food systems should be a critical lever of change in the Nordics to reach global health and environmental sustainability commitments.
- The gap between current and desired food systems is substantial enough to require transformative change.
- An integrated food systems approach aligning agricultural, production, trade, manufacturing, retailing and consumption priorities must be taken.
- There is enough evidence on necessary food system changes to begin action in setting current food systems on a trajectory towards healthy and sustainable development.
- Sustained, multi-sectoral forums are needed to steer Nordic food system transformation.

Next steps

- Begin immediate action to transform Nordic food systems
- Initiate a multi-stakeholder scenario development process to define a common vision for Nordic food systems
- Develop strategies to handle the trade-offs of change
- Evaluate Nordic food systems in the global context

Introduction

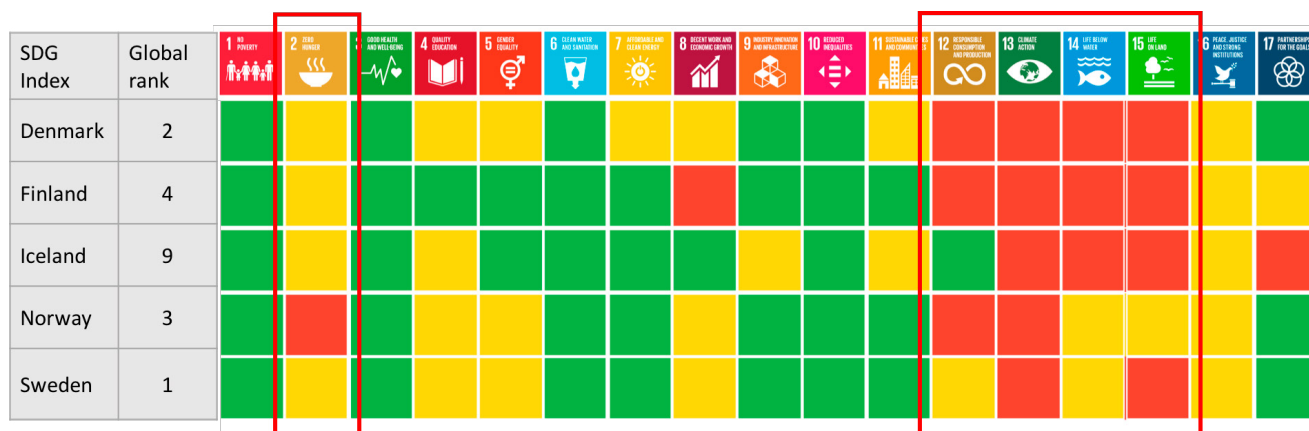


Figure 1. Global rankings of the Nordic countries using the SDG Index. Green boxes indicate that a country is on track to meet that SDG, or has already achieved the goal. Yellow and red indicate that a country risks not reaching or is seriously off course for achieving the goal, respectively. This image has been adapted from its original version and reproduced with permission from Sustainia & Nordic Council of Ministers.¹⁷

Commitments made by the global community, including the Paris Climate Agreement and the United Nations Sustainable Development Goals (SDGs), aim to guide the transition towards stewardship of the planet for sustainable development of the world’s growing global population. The Nordics have committed strongly to the SDGs and other global goals. The dramatic weather events across the world also affecting the Nordic region, such as the unprecedented heatwave over the summer months of 2018, underlined what is at stake – our agricultural systems, communities and livelihoods. Commitments to these goals are critical both as a global contribution to sustainability, as well as for ensuring regional environmental and economic security.

The Nordic countries are leading progress towards the 2030 Agenda. Analysis from the SDG Index – used to indicate how a country is performing compared to global targets – shows that Nordic countries occupy the top four rankings globally (Figure 1).^{7,17} Yet being a leader is not the same as reaching these goals. Even the Nordics are not immune to all global challenges, and more work is needed in the Nordics to achieve the ambitions of the 2030 Agenda.

The yellow and red boxes in Figure 1 indicate where more progress is needed before SDG targets are met. The red outlines highlight the SDGs that the Nordics are furthest from achieving, including SDG2 – zero hunger, due to the indicators for obesity and sustainable nitrogen management; SDG12 – responsible consumption and production; SDG13 – climate action; SDG14 – life below water; and SDG15 – life on land. These SDGs closely relate with the use of natural resources, stewardship of the environment, human health and lifestyle choices.

Food connects these environmental, health and social challenges. The advantage of using a food systems approach (Box 1) to tackling these global social, health and environmental challenges is two-fold. First, food systems provide an entry point to drive progress across a broad range of goals. The Food and Agricultural Organization has stressed that food and agriculture are not just part of the 2030 Agenda, they lie at the very heart of the Agenda and are linked to each of the 17 goals (Figure 2).¹⁸⁻²⁰ In other words, food system interventions could yield co-benefits across the SDGs. Second, food systems are a significant (rather than marginal) lever for progress towards the global goals. Yet currently, unhealthy diets are the primary driver of poor health globally⁸ and represent one of the largest drivers of environmental damage.¹ Turning food systems from problem to solution could mean major advancement of the SDGs. Box 2 further elaborates on the importance of well-functioning food systems for the future.

Turning to Nordic food systems, although each Nordic country has a distinct food system, they share key characteristics that give them the potential to deliver on multiple SDGs. From a production perspective, strict animal health and welfare legislation often exceeds European Union (EU) requirements;¹¹ the use of antibiotics in livestock production is amongst the lowest in the EU;¹² the introduction of measures to reduce mineral fertilizer use have been effective in driving decreases in nitrogen losses;²³ and rural development strategies offer incentives or training to increase environmentally efficient practices.²⁴ In terms of supporting health and wellbeing, the Nordics are home to some of the most science-based dietary guidelines in the



Figure 2. Food and agriculture and their connection to the 17 SDGs. Reproduced with permission, from FAO's report 'Food and Agriculture: key to achieving the 2030 Agenda for sustainable development'.¹⁸

world that incorporate both health and environmental sustainability criteria;¹⁰ there is an extremely low prevalence of undernourishment;²⁵ and school meals in several Nordic countries provide nutritious, sustainable, safe and enjoyable meals to students.^{26,27}

These positive characteristics demonstrate that the Nordics have been willing to lead and innovate to overcome the challenges posed by food systems. Yet formidable challenges still remain for Nordic food systems to support

the integrated agenda of the SDGs. Unhealthy diets are a leading risk factor driving poor health across the Nordics;⁹ high levels of food imports result in environmental footprints also outside of the Nordic countries; and despite much progress to increase the environmental efficiency of Nordic food production, a significant portion of national environmental impacts stems from food and agriculture.²⁴ There is still work to connect the dots between people, planet and food – particularly in adopting a ‘whole food systems’

Box 1. What is a food system, and why do we need to take a ‘food systems approach’?

Food systems can be thought of as “all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food.”²¹ In addition, food systems shape and are shaped by political, economic, socio-cultural, and health systems, and have impacts on health, sustainability, prosperity and wellbeing.

The basic tenet of a food systems approach is recognizing that these different aspects of food are inextricably linked.²² Understanding food as a system means acknowledging this web of connections, interactions, and feedbacks between different aspects of the food system and appreciating that the essential character of a food system emerges from the interactions of these various parts. Therefore, to achieve a particular goal, all aspects of the food system need to be aligned towards that goal. This can ensure that gains made in one part

of the food system are not offset by negative impacts in another part. For example, well-designed food-based dietary guidelines on healthy and sustainable diets will have less of an impact if healthy and sustainable food is not produced, imported and made available and accessible to individuals.

To provide a starting point, and more practically, to set reasonable boundaries to our work, this report focuses on primary food production (i.e. from soil or sea to farm gate), food consumption and food loss and waste. This scope aligned with the EAT-Lancet Commission. However, we also bring in elements of economics, employment, policy and governance to demonstrate how these different parts are intimately linked. We acknowledge that there are other parts of the food system, such as processing and marketing, that have impacts on health, and other activities, such as transport, that have environmental impacts. Further work is needed to fully incorporate all elements of food systems into ideas of food system transformation.

approach to understand the interconnections between and feedbacks among agriculture, environment, consumption patterns, economics, health and other social indicators. Although the ‘Task 2: Define’ section of this report discusses some social and resilience indicators of healthy and sustainable food systems, more work is needed to integrate a holistic suite of social indicators into the boundaries of a safe operating space for food systems presented in this report.

Globally, no country has been able to take the final step to reach healthy and sustainable food systems, meaning truly innovative actions will be needed. The Nordics are well-positioned to tackle these challenges and be the first-movers in food system innovation. Nordic countries are economically prosperous, with highly educated populations, and benefit from well-established social welfare and efficient, highly-trusted public institutions. These strong social and institutional foundations, combined with a heritage of innovative policy-making, can be drawn on to think outside of the box. At the same time, the tradition of collaboration and stakeholder dialogue in the Nordics will be crucial to tackling the normative decisions needed to determine a pathway for transformation. And finally, the history of collaboration among the Nordic countries can be drawn on to demonstrate the amplified impact produced when working together to move towards healthy and sustainable food systems.

Objectives of this report

The Nordics are by-and-large evidence-based communities, with changes in policy often rooted in science. In this tradition, the Stockholm Resilience Centre at Stockholm University was approached by Livsmedelsverket to undertake an initial analysis of what food systems transformations might look like, based on the findings from the *EAT-Lancet* Commission Report on Healthy Diets from Sustainable Food Systems.¹ Described more in the following section, the *EAT-Lancet* Commission proposes targets against which ‘food solutions’ can be benchmarked. With the current report, we endeavor to gain a better understanding of how the *EAT-Lancet* Commission targets could be used in the Nordic region. Here ‘Nordic countries’ refer to Denmark, Finland, Norway and Sweden. Due to resource and time constraints, we relied on several previous analyses, which did not include Iceland. Expanding this analysis to include all Nordic countries should be a focus of future research.

The objective of the current report is to provide a scientific underpinning for the transformation of Nordic food systems. While we focus largely on transformation of what we eat (to align with the mandate of Livsmedelsverket), we adopt a systems perspective and also address other parts of the food system. We are deliberate in using the term ‘transformation’ to signal the need for fundamental change to the intrinsic nature of Nordic food systems.³⁴ History

Box 2. Why are food system transformations so important for our future?

Food systems underpin human health, environmental sustainability, economic prosperity and social wellbeing. Yet current food systems have eroded these foundations. Globally, 821 million individuals are chronically hungry,²⁵ 2 billion are deficient in critical micronutrients²⁸ and over 2 billion are above a healthy weight,²⁹ contributing to high prevalence of diet-related diseases. Poor diets are now the leading risk factor for poor health globally.⁸

Food production systems are also a main contributor of environmental damage, responsible for 26% of greenhouse gas emissions³⁰ and 70% of global freshwater use.^{31,32} Food production also drives deforestation, biodiversity loss, land degradation and air and water pollution. At the same time, changing environmental conditions are threatening the ability of food systems to produce enough nutritious food for the future global population.³³ Farmers are finding it increasingly difficult to sustain their livelihoods from the land and waters, let alone fulfil their role as environmental stewards.

These impacts may seem far from home, but the Nordics rely on well-functioning food systems around the world. From the

health and wellbeing of farmers around the world who produce foods consumed in the Nordics to the extreme weather events across the globe that reduce commodities used as inputs by Nordic businesses, these global trends matter to the Nordics.

On the current trajectory, negative health, environmental, economic and social impacts are predicted to worsen in the future. This is not the future envisioned in global frameworks such as the Paris Accord or Agenda 2030, nor a future where humans can thrive. Major changes in food systems will be essential to achieving health, sustainability and prosperity.¹ We make no claim that food system transformations are the single solution to global challenges – for example, transformation of the energy sector will be crucial to reaching global sustainability goals. While food system changes in isolation are insufficient for humanity to secure a future that supports health within environmental limits, because of their significant impacts across social, health, environmental and economic indicators, they are a crucial part of the solution.

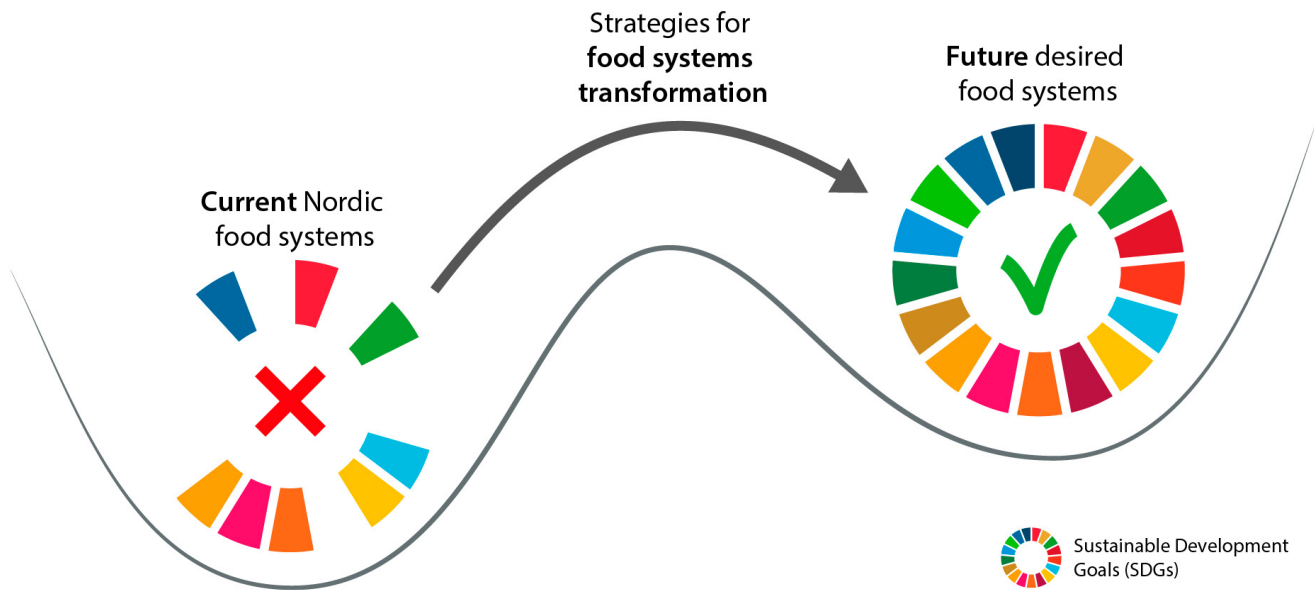


Figure 3. The Nordic food systems need transformation to reach the SDGs. Current Nordic food systems are stuck in a stable basin of attraction (left) and do not deliver on the integrated set of SDGs. To move to future desired food systems that deliver on global commitments (right), ambitious strategies will be needed to overcome the inertia of current food systems, illustrated as the 'bump' between the two stable basins.

proves that food systems can undergo transformations – e.g. the post-WWII transformation to dramatically increase productivity – albeit with significant unintended consequences.¹ The transformation we envision is different from previous food system transformations because it deliberately aims to provide healthy diets for all, within the limits of the earth system.

As illustrated in Figure 3, food systems are 'locked in' to the current position. The upward curve represents the unprecedented push – in terms of ambitious policies, business plans and social action – that will be needed to move to future desired food systems that deliver on the integrated set of global commitments. Additionally, transformation will need to embrace the idea that long-term sustainability includes dealing with inherent uncertainties in future food systems.¹⁴

We aim to provide evidence that can be used to shape these strategies for food systems transformations in the Nordics, while acknowledging that scientific knowledge can only take us so far. Sustained, multi-stakeholder dialogue will be needed to tackle normative decisions, and powerful and bold political and market strategies will be needed to accomplish real change. As a basis for the multi-stakeholder process, we synthesize existing knowledge on primary food consumption, production and waste in the Nordics. We explore the impacts of these food systems components on people and the planet. By downscaling the global targets from the *EAT-Lancet* to the Nordic scale, we provide an initial estimate of the gap between current and desired Nordic food systems. We identify priority action areas and bring to light challenges of this transition. This report should be seen as a starting point, since there are many aspects of food systems that are beyond the scope of this report. These gaps point to important areas of future research.

The EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems

The *EAT-Lancet* Commission brought together 37 international experts from diverse scientific disciplines to tackle the question – will it be possible to feed the global population in 2050 with a healthy diet that was produced sustainably? To help answer this question, the Commission undertook four streams of work. One stream aimed to propose global targets for healthy diets, and another stream aimed to propose targets for sustainable food production. Together, these global targets delineate a safe operating space that can be used to identify food systems that are good for people and the planet. A third stream modelled different scenarios of dietary shifts, food production improvements and reductions in food loss and waste to see if future food systems could operate within both sets of targets. A fourth stream developed strategies that would help shift food systems towards the safe operating space.

In the first work stream, the Commission proposed intakes of different food groups that promote good health and wellbeing (see Appendix 2). This includes intake values for food groups to encourage such as fruits, vegetables, whole grains, nuts, legumes and fish; and food groups to limit including red meat and starchy vegetables. It also details food groups that could fit within a healthy diet, but could be substituted with other foods, such as dairy, eggs or poultry. The Commission highlighted that some populations around the world (e.g. malnourished populations) could benefit from higher consumption of animal source foods while other populations should work to reduce consumption of these foods.

The Commission presented specific intake values for each food group as one example of an optimal diet that meets nutrient, micronutrient, vitamin and mineral requirements within a 2500 kcal diet. The Commission also presented intake ranges (rather than prescriptive amounts) for each food group. These ranges emphasize that there are different combinations of foods that could meet healthy eating requirements. The ranges allow for a diversity of diets that can be adapted to different cultural or regional preferences. It is important to note that the healthy diet proposed by the EAT-Lancet Commission is based on the best available evidence on healthy diets. The diet was not developed based on evidence of environmentally sustainable diets.

In the second work stream, the Commission proposed environmentally sustainable food production targets. An Earth system perspective was adopted, meaning that the focus was on the global impacts of food systems. While the impacts of some production practices are felt at the local level (e.g. eutrophication of lakes or overuse of freshwater), there is a growing recognition that there are global regulating functions that are being interfered with due to unsustainable farming and fishing practices. To capture the large-scale change of global regulating processes stemming from food production, the Commission proposed boundaries for six regulating processes most closely related to food,

based on the planetary boundary framework (Box 3). These are climate change, biodiversity loss, land-system change, freshwater use, and nitrogen and phosphorus flows.

The EAT-Lancet did not define targets for e.g. chemical and antimicrobial use in agriculture, acknowledging that more work is needed to set such targets. The environmental food production targets do not consider the healthiness of the diet (beyond providing enough food for all). In other words, the dietary and environmental targets were developed separately.

In the third work stream of the EAT-Lancet Commission, the scenario modelling, the dietary and environmental targets were combined. To see if global efforts could bring us within the safe operating space for food systems – or that ‘win-win’ space where both diet and environmental targets are met (Figure 5) – the Commission modelled different scenarios of dietary shifts, production improvements and food loss and waste reductions. To fall within the safe operating space, the scenarios had to meet both the dietary and environmental sustainability targets for food systems. Without considering the simultaneous impact of food systems on human health and environmental sustainability, food systems could produce ‘win-lose’ effects as seen in Figure 5, where food systems could support environmental sustainability but not human health, or vice versa.

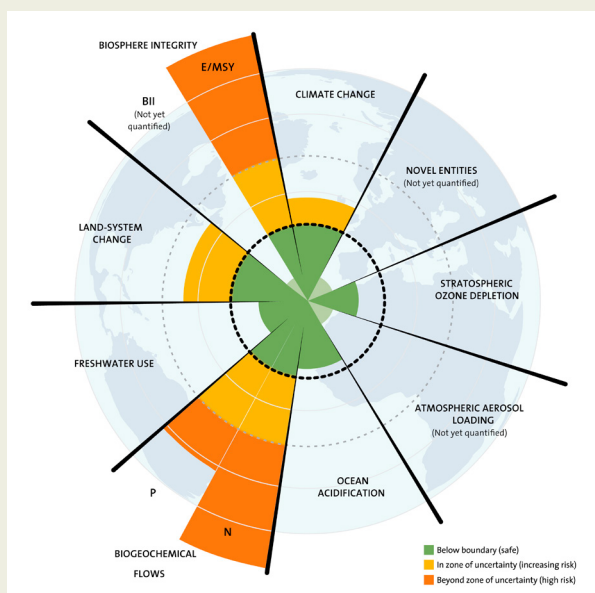


Figure 4. Figure credit: SRC/Azote.

Box 3. The Planetary Boundaries framework

The planetary boundaries were introduced by the scientific community in 2009.^{35,36} This framework outlines nine environmental processes that regulate the stability of the Earth system. The boundaries represent a safe distance from potential tipping points where transgression could lead to irreversible changes to the Earth system. In Figure 4 to the left, the green circle indicates the ‘safe operating space’ that supports the conditions for humanity to survive and thrive. The EAT-Lancet Commission proposed food systems’ share of these boundaries.

It is important to note that the Commission did not attempt to evaluate the environmental impact of different production practices (e.g. organic versus conventional systems, grain fed versus grass fed livestock systems, or agro-ecological approaches). Rather, it assessed the general need for improved production practices across all types of production systems. Assessments are needed at national and local scales to determine which production practices fall within the safe operating space.

The hopeful conclusion of the Commission was that it is possible to create ‘win-win’ food systems in the future. Yet this will only be achieved through the combination of dietary shifts with production improvements and reductions in food loss and waste. No single action will allow us to remain within the safe operating space.

The Commission identified five strategies needed to keep global food systems within a safe operating space. These strategies include winning international and national commitment to shift toward healthy diets; reorienting agricultural priorities away from producing more food and towards producing better food; sustainably intensifying food production; implementing coordinated governance of land and oceans; and at least halving food losses and waste. The Commission emphasized that these strategies will need to be tailored to specific contexts while encouraging global

progress toward a shared set of food system targets. Crucially, the analysis underscored that no single solution would be enough to achieve the global food system targets, and concerted action across food systems is needed.

Numerous scholarly articles have outlined the necessary steps towards healthy and sustainable diets, highlighting the fundamental transformation needed to change what we eat and how we produce those diets.³⁷⁻⁴⁷ The recommendations in the *EAT-Lancet* report are in-line with this growing consensus on priority action areas for food systems transformations.⁴⁸⁻⁵²

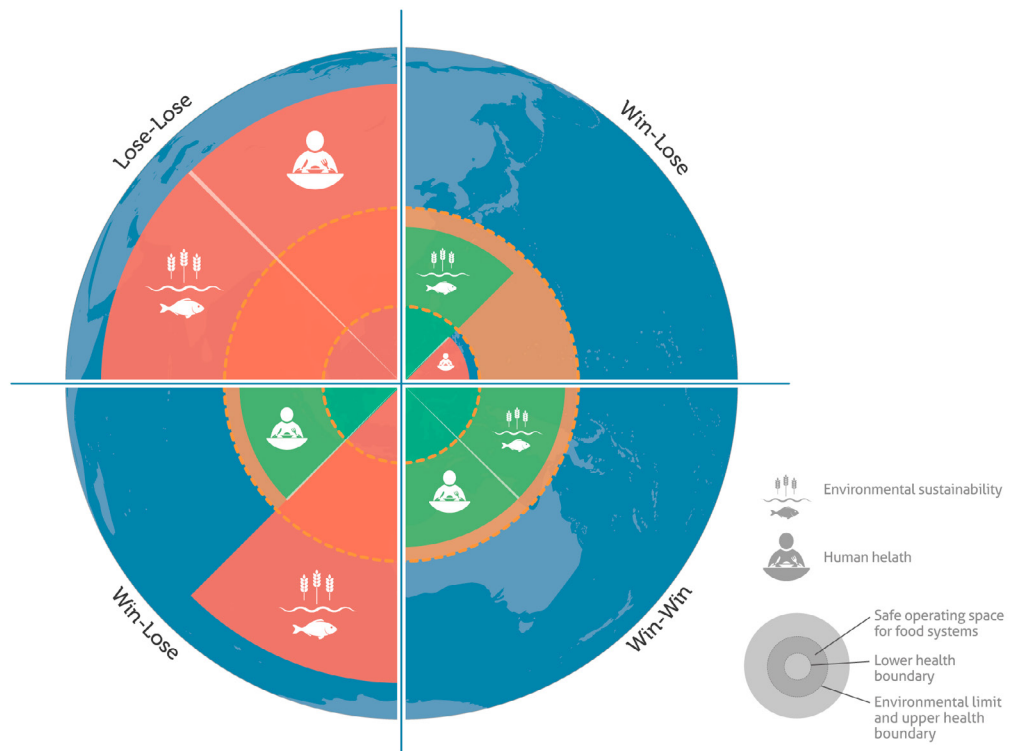


Figure 5. Dietary patterns and the safe operating space for food systems. The two wedges in each quadrant indicate the environmental impacts of food production and the health impacts of diets. Green indicates impacts within the safe operating space, while red indicates impacts outside of the safe operating space. Figure developed for the *EAT-Lancet* Commission by Azote.

Pathway to healthy and sustainable Nordic food systems

There are many possible pathways that could transform Nordic food systems in line with global goals. While the success of one path over another cannot be guaranteed, it is certain that Nordic actors – policy makers, researchers, producers, civil society groups and businesses – have enough evidence to diagnose major challenges within Nordic food systems. This report aims to provide an indication of focal action areas, while also presenting suggestions on how to act on those major challenges. Below we present four key tasks in the process to start food system transformation (Figure 6).

A first task is to assess the current state of Nordic food systems. This report undertakes a baseline analysis of Nordic food systems, focusing on the impacts of food production, consumption and waste on people and the planet.

The second task is to define a ‘safe operating space’ for Nordic food systems, i.e. the space where food is good for people and the planet. To do this, the global scientific targets for diets and environmentally sustainable food production proposed by the *EAT-Lancet* Commission will need to be downscaled to the Nordic region. We propose one possible approach that could be used.

A third task is to compare current and desired Nordic food systems. By doing so, the level of ambition needed for

food system transformation will become clear and action pathways can be envisioned. It is not always possible to foresee and understand the non-linear, cause-and-effect relationships of food systems components,⁵³ which means that both the targets and the action pathways will need to be assessed and adjusted over time. A resilience perspective – explored more in this ‘Task 3: Compare’ section – can allow for continuous learning and experimentation.⁵⁴

A fourth crucial task requires food systems actors to ensure that action pathways are implemented, monitored and refined until desired food systems are achieved.

The arrows in Figure 6 indicate that these tasks can and should progress in parallel. For example, while some actions may play out on a long-term horizon, the existing body of knowledge points to areas where food systems actors can take action now. Food system transformations will be a dynamic and iterative process. Food system actors should tackle these tasks informed by the best available evidence, and they should be prepared to innovate where no clear path exists.

Each subsequent section of this report explores these four tasks in greater detail.

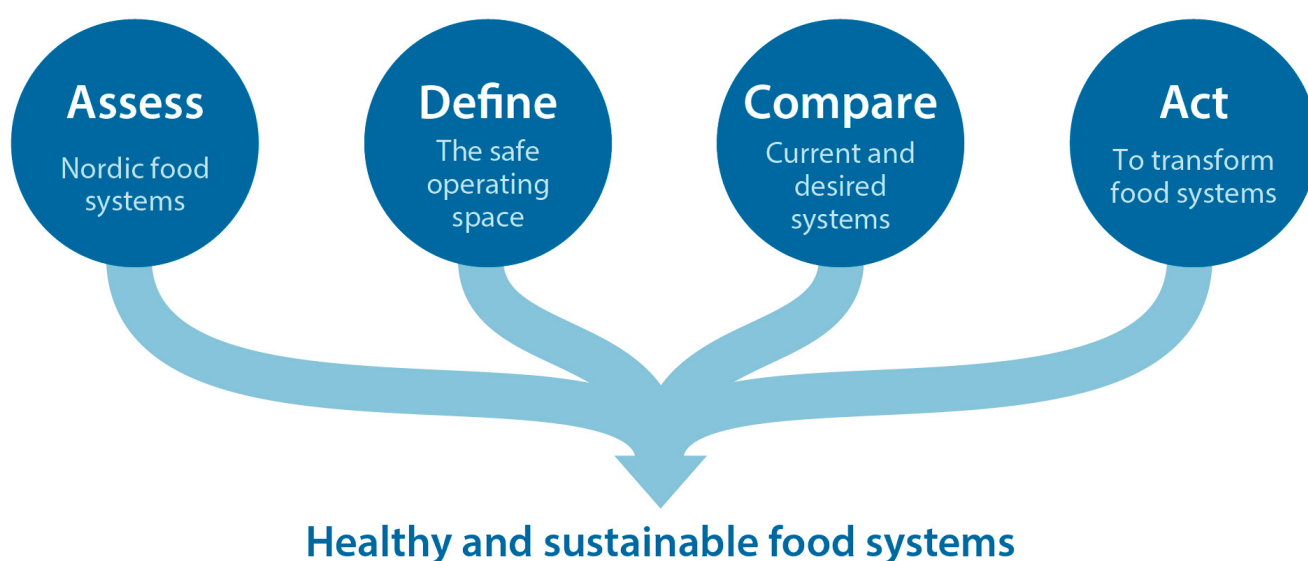


Figure 6. Four parallel steps in the transformation of Nordic food systems.

Task 1: Assess Nordic food systems and their impacts on people and the planet

In this section, we aim to summarize the defining characteristics of current Nordic 1) consumption, 2) primary food production and 3) food loss and waste. We then provide a baseline measure of the impacts of these food systems on people (i.e. health, social and economic impacts) and the planet (i.e. environmental impacts). Our assessment illustrates that each Nordic food system has distinct features, while also sharing many similar characteristics. Our analysis also highlights similar health and sustainability challenges posed by current food production and consumption across the Nordics.

Nordic food consumption

I. Nordic Nutrition Recommendations

Since the 1960s the Nordic countries have collaborated to set nutrition recommendations, published in the Nordic Nutrition Recommendations (NNR).¹⁰ The NNR is updated roughly every eight to ten years. The latest version of the NNR (NNR5) was released in 2012, and revisions for NNR6 will start in 2019 with an expected completion in 2022. A working group of over 100 scientists from the Nordic region is brought together by the Nordic Council of Ministers to develop scientifically rigorous nutrition recommendations.

The NNR includes nutrient intake requirements, physical activity recommendations and – for the first time in the NNR5 – advice on dietary patterns (i.e. food-based approaches) that reduce the risk of obesity and diet-related non-communicable diseases such as cardiovascular disease, type 2 diabetes and some cancers. Also included for the first time in the NNR5 is a chapter outlining sustainable food consumption, recognizing that “for food consumption to be sustainable it has to be safe and healthy in both amount and quality, and this has to be achieved through means that are economically, socially, culturally and environmentally sustainable.”¹⁰

All Nordic countries use the NNR as a base from which to build national dietary guidelines. All Nordic countries have issued food based dietary guidelines, and these guidelines fulfill underlying nutrient, vitamin and mineral recommendations. National guidance also recommends a

varied diet with an appropriate energy balance, along with regular physical activity.

In Sweden, an environmental impact assessment was commissioned to complement the NNR and guide their 2010-2011 national dietary guidelines.⁵⁵ The most recent Finnish Nutrition Recommendations 2014 also include, to a lesser extent, guidance on the environmental impact of food choices.⁵⁶ Both the Norwegian and Danish guidelines were updated in 2013 and have not substantively incorporated environmental considerations into their guidelines.^{57,58}

II. National food consumption patterns

Each Nordic country conducts dietary surveys to track the eating habits of their populations. The most recently published reports from these dietary surveys of adults are from the years 2010-2013.⁵⁹⁻⁶² Given the time-lag between national dietary surveys, other data, such as supply data, can be useful to give an indication of yearly changes in consumption habits. The ‘Task 3: Compare’ section further explores the complementarity of supply and consumption data.

The dietary surveys and methodologies used in each country vary, but a high-level analysis can be undertaken to compare consumption patterns across countries. In broad terms, while each Nordic country has distinct dietary patterns, the region shares many positive trends as well as similar healthy eating challenges. Notably, the findings from the dietary surveys indicate that several major improvements to dietary patterns are needed across the Nordics for current consumption to align with national guidance and Nordic recommendations (Table 1).

In several domains, progress is moving in the right direction. For example, vegetable consumption has increased in all Nordic countries (e.g. from 99 g/day to 151 g/day between 1997/8 and 2011/12 in Sweden), and fruit consumption has increased in all countries except Denmark, which reported a reduction in recent years.⁵⁹⁻⁶³ There are also positive trends of increased fish intake. Well-documented public policy interventions have also encouraged the switch from oils and spreads high in saturated fats to those with healthier unsaturated or polyunsaturated fats.⁶⁴ Additionally,

Increase	Exchange	Limit
Vegetables Pulses	Refined cereals → Wholegrain cereals	Processed meat Red meat
Fruits and berries	Butter → Vegetable oils Butter based spreads → Vegetable oil based fat spreads	Beverages and food with added sugar
Fish and seafood	High-fat dairy → Low-fat dairy	Salt
Nuts and seeds		Alcohol

Table 1. Summary of changes needed to align current Nordic diets with the Nordic Nutrition Recommendations. Originally printed in the NNR5.¹⁰ Reprinted with permission from the Nordic Council of Ministers.

most in the Nordics get enough vitamins and minerals, with few exceptions including vitamin D, iron, folate.

Despite these positive trends, Nordic diets often contain too few health promoting foods. In 2014, only about 13% of the Nordic adult population (including Iceland) reached the ‘5 a day’ goal for fruits and vegetables.⁶⁵ The average intake of fish (at population level) in all Nordic countries is at least the minimum amount of fish recommended by national dietary guidelines (recommended minimum intake is two times per week, which is roughly 200 g/week minimum). However, not all individuals may eat the minimum recommended amount of fish, and dietary guidelines encourage greater fish consumption.

It is more difficult to determine intakes of health-promoting foods such as legumes (beans, lentils, soybean, peanuts), nuts or seeds due to the classification of foods in the dietary surveys. Additionally, the Nordic countries generally do not have specific recommendations for these food groups. However, the best available evidence indicates that Nordic populations eat very small amounts of nuts, on average 5 or 7 g/day in Sweden and Norway, respectively. Whole grain intake is also quite low, around 40-60 g/day compared to the recommended 70-90 g/day in most Nordic countries.⁵⁹⁻⁶²

There has been progress to reduce intake of some unhealthy food and drinks – those that contain high amounts of sugar, salt and saturated fat – yet Nordic diets on average contain too many unhealthy foods such as candy, ice cream, pastries, pizza, pies and sugar-sweetened drinks. Excess intake of these unhealthy foods has contributed to higher than recommended levels of saturated fat and salt in all Nordic countries. Saturated fat accounts for about 13-16% of total energy intake across the region and has been increasing in many countries due in part to increased intake of meat and dairy products. The recommended level of saturated fat is <10% of total energy in Norway, with no specific advice in other countries beyond ‘replace saturated fats with healthier oils’. Salt intake across the Nordics is

above the 5-6 g/day recommendation, with an average intake of 8 and 11 g/day in females and males, respectively, in Denmark; 6.5 and 8.9 g/day in females and males, respectively, in Finland; 10 g/day in Norway; and 7.5 g/day in Sweden. Although sugar intake is not above the maximum average threshold of 10% of total energy intake, it is at the upper limit of the threshold in all countries (D: 9%, F: 10%, N: 7%, S: 9.6% of total energy) and national dietary guidelines in each Nordic country suggest limiting added sugars in the diet.⁵⁹⁻⁶²

Notably, red meat (beef, lamb, pork) consumption is high, ranging from approximately 105 g/day in Sweden to 140 g/day in Norway (estimates are ‘as consumed’, i.e. cooked).^{59,60} This is higher than the maximum amount recommended by national dietary guidelines, which advise no more than 500 grams of red or processed meat each week (about 70 g/day). Further, intake estimates from dietary surveys might be underestimations of actual intake, given underreporting. It is well acknowledged that meat provides many essential nutrients, but over-consumption, particularly of processed or fatty meat products, can increase risk of several diet-related diseases.⁶⁶

There are other foods, such as tea, coffee and alcohol, that are consumed in large quantities in Nordic countries and that have important implications for health and for the environment. However, these foods were beyond the scope of the EAT-Lancet Commission, and therefore the current report does not analyse these food groups. This signals an area of future work that is needed.

The analysis reported above should be interpreted as a broad comparison of current Nordic diets and dietary changes over time. As stated, the Nordic countries use different methodologies to collect and analyze dietary intake data, making precise comparisons difficult. In addition, the surveys capture self-reported data, meaning underreporting is a common problem, particularly of total energy intake⁶⁷ or unhealthy food intake (e.g. see⁵⁹, p 22).

III. Sourcing Nordic diets

The Nordic palate is increasingly international in flavor, and Nordic shoppers expect access to a variety of foods year-round. These consumer demands – coupled with domestic food supplies constrained by climatic and geographic conditions as well as both labour and agricultural regulations that may increase production costs (but vary across Nordic countries) – contribute to the demand for food imports to the Nordics. A large portion of food on Nordic plates is therefore from abroad. Across the Nordics, about 40% of food (in term of weight) is imported (Denmark: 38%; Finland: 36%; Norway 44%; Sweden 45%).⁶⁸ This includes foods not possible to produce in the Nordics. At the same time, Denmark is a major exporter of pig meat, Norway of fish and Sweden of cereals (see ‘Exporting Nordic food’ below).

The proportion of imported foods varies greatly among different food products. Nordic countries import relatively little (less than a third) cream, milk (including cheese, excluding butter), butter (except Denmark), eggs, cereals (except Norway), and potatoes,⁶⁸ reflecting those products that are easily grown/produced in the Nordic climate. On the other hand, certain components of Nordic diets – such as rice, vegetables, fruits, nuts, oil crops, seeds, spices, cocoa, coffee, tea and alcoholic drinks – are sourced almost entirely from the international market.⁶⁸ Processed and convenience foods are also imported in large quantities.⁶⁹

Animal production has a strong heritage in the Nordic region, and while most meat eaten in the Nordics is produced domestically, meat represents a significant import product. In Sweden, for example, meat is now the third largest import food product.⁶⁹ This reflects factors such as price differences, with imported meat often sold at a cheaper price than domestically produced meat.⁷⁰ The percentage of imports consumed varies across meat types, and both fresh and processed meats are imported. Meat imports also differ by country. For example, Norway imports less meat compared to the other Nordic countries – the highest proportion of imported meat is bovine meat (roughly one-fifth); however, these low percentages could reflect gaps in global statistics. Denmark and Sweden import roughly half of their bovine meat, while Finland imports just under a quarter. Roughly 60-75% of mutton and goat meat available in Sweden, Denmark and Finland is imported. Denmark, unsurprisingly, imports very little pig meat, while Sweden imports nearly 40% and Finland imports just under 20%. Sweden and Denmark are the highest poultry meat importers of the Nordics (roughly 40% and 30%, respectively), while Finland imports just over 10% and Norway imports very little (2%).⁶⁸ These import estimates do not account for products imported into the Nordics, processed, and then exported on to other countries.

In terms of fish and seafood, in Norway, most crustaceans, demersal and freshwater fish consumed are produced

domestically, while the other Nordic countries import a large proportion of their fish and seafood.⁶⁸ In Sweden, for example, approximately 75% of seafood is imported. Among the most commonly eaten species in Sweden such as salmon, cod and herring, Norway is a major supplier, and to a lesser degree, Denmark.⁷¹ In Denmark, over half of the total value of imported fish and fish products comes from Norway (salmon, trout, cod), Greenland (shrimp, halibut, cod) and the Faroe Islands (salmon).⁷² In Finland, most fish and fish products (by volume) were imported from Norway, and important import countries (by value) include Norway, Sweden, Denmark and Estonia.⁷³

The environmental impacts of such globally sourced diets will be discussed in a later section.

Nordic primary food production

I. Crop and livestock production

The Nordics produce a range of crops – particularly grass-clover leys, cereals, rapeseed and root vegetables – and animal production is embedded into Nordic agricultural systems. There are of course obvious climatic limitations to food production in Nordic countries – particularly in the northern reaches of Finland, Norway and Sweden. Norway also has a challenging, mountainous terrain for crop cultivation, yet has large coastal regions providing for extensive fishing grounds and aquaculture. Figure 7 provides an illustration of arable land use across the Nordics.

In Denmark and Finland, cereals are the dominant crop. Across the Nordics, approximately half of cereals produced are used for animal feed.⁷⁴ Up to 80% of plant crops in Denmark are used for feed.²⁴ The greatest proportion of arable land in Norway and Sweden is used for clover ley and green fodder, which are also used to feed animals. Other agricultural crops including oilseeds, legumes, roots and vegetables use a small proportion of land – just over 10% of arable land in the Nordic countries.

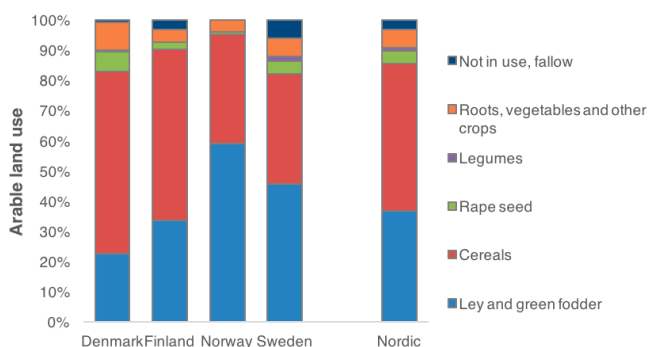


Figure 7. Arable land use (%) in Nordic countries. Average of years 2010-2015 for Denmark and Sweden, 2013-2015 for Finland, and 2010-2012 for Norway. Originally printed in Karlsson et al., 2017.⁷⁴

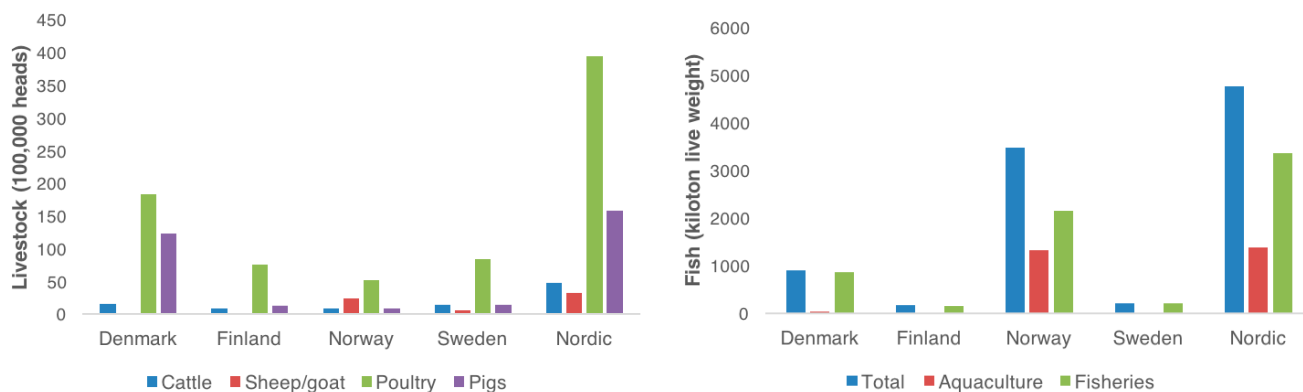


Figure 8. Livestock and fish production in Nordic countries, 2014 (*fisheries for year 2015). Originally printed in Karlsson et al., 2017.⁷⁴

Livestock and fish production are embedded into Nordic food production systems (Figure 8). Pig production is particularly important in Denmark, and while the number of pig farms has decreased over the past few decades, the size of the farms has increased.^{24,75} In Finland, beef production has decreased over the past three decades (overall), while poultry production has seen the biggest increase – more than tripling since 1990.²⁴ Fish dominate Norway’s animal production, particularly salmon and trout.⁷⁶ Beef production has decreased in Norway while pork and poultry production has increased in recent decades. In Sweden, beef and especially pork production has declined in recent decades, while poultry production is on the rise.²⁴ In all Nordic countries, farms have become fewer and larger⁷⁷ with increased specialization and mechanization.

In-line with the *EAT-Lancet* Commission, we do not assess the different production methods used across the Nordics. We acknowledge that different production practices are used across Nordic countries. For example, diverse animal husbandry systems are used within and across Nordic countries. We also acknowledge that there is an emphasis on certain production methods in the Nordics, e.g. the focus on organic agricultural production. However, our aim is not to prescribe certain production methods over others, but rather to understand the overall impact of production (detailed in a later section).

II. Agricultural employment and agricultural holdings

Agriculture supports nearly half a million jobs across the Nordic region (data from 2010).⁷⁷ Yet, agricultural employment represents a small proportion of the total workforce, (4.4% in Finland, 2.5% in Norway, 2.4% in Denmark and 2.1% in Sweden). This proportion would be much higher if the whole food system was considered (e.g. distribution, processing and retail). In line with other European countries, the agricultural workforce in the

Nordics has declined since 1990 (Figure 9),^{77,78} despite significant increases in agricultural incomes.

This decline coincides with an increase in productivity as a result of increased specialization and mechanization. As a result, the number of agricultural holdings is decreasing across the Nordics, with the steepest declines often seen in the smallest holdings. At the same time, utilized agricultural land remains relatively constant, and the largest holdings continue to grow in size (in terms of land area per holding).⁷⁷ This suggests that smaller holdings are being taken over by bigger holdings, which might be able to operate with fewer employees through larger levels of mechanization and efficiency. Also, the average age of agricultural workers is increasing while fewer younger people are finding agriculture to be an attractive livelihood.⁷⁷ In 2016, 34% of the agricultural labour force of Sweden was 65 years old or older.⁷⁹ Between 1999 and 2010, the share of producers under 50 years of age dropped by 31% in Sweden and 45% in Norway.⁸⁰ This trend is leading to a situation where more are leaving (i.e. retiring) agriculture than entering the sector.

Figure 10 shows the percentage of holdings by farm size. At an average farm size of 63 and 43 hectares (ha) per farm in Denmark and Sweden, respectively, these Nordic countries

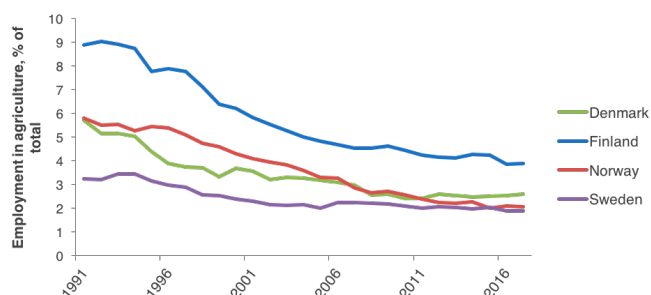


Figure 9. Employment in agriculture as a percentage of total employment.⁷⁸

are ranked among the highest in the EU for farm size (average EU-28 farm size: 16 ha), but smaller than some large agricultural producing countries such as the United States (170 ha), Canada (315 ha) or Argentina (590 ha).^{77,81} It should be noted that the largest farms (>100 ha) occupy the greatest proportion of utilized agricultural area in Denmark (66%) and Sweden (52%), while farms between 50 and 100 ha occupy the majority of utilized agricultural area in Finland (33%). The utilized agricultural area in Norway is more evenly distributed across farms between 10 and 100 ha.⁷⁷

III. National priorities for Nordic primary food production

Through analysis of a wider set of policy and sector-specific documents (e.g. sustainable development strategies, bioeconomy strategies, sustainable consumption and production strategies, agriculture and climate change analyses) it is clear that sustainable food production is a priority in all Nordic countries. Although there is no agreed definition for 'sustainable production', it typically refers to environmentally friendly production in terms of low environmental impact per hectare or kilogram of food produced.

The rural development strategies in Denmark, Sweden and Finland are linked to the Common Agricultural Policy and include measures and supports for sustainable primary production, such as payments for environmentally friendly farming and water protection or subsidies for biogas production. Norway also has supports (e.g. subsidies and payments) for environmentally friendly agriculture.⁸² Initiatives such as Greppa Näringen in Sweden – a collaboration of the Swedish Board of Agriculture, the Federation of Swedish Farmers, and country administrative boards – also support environmentally friendly farming (e.g. to reduce agricultural emissions, reduce eutrophication and promote proper use of pesticides) through education and counseling of Swedish farmers.

A large emphasis is put on organic production, although only 8%, 9%, 5% and 18% of arable land is used for organic production in Denmark, Finland, Norway and Sweden, respectively.⁸³ Several Nordic countries have established targets for increased organic food production in the coming years. Denmark aims to double the organically cultivated area from the 2007 level by 2020;⁸⁴ Finland aims for 20% of its cultivated arable land to be organic by 2020;⁸⁵ and Sweden has set a target for 30% of farmland to be organic certified by 2030⁸⁶. In Norway, the target of 15% organic production was dropped during summer 2018, replaced with the ambition that Norwegian producers meet consumer demands for organic products.

Two Nordic countries have national food strategies, which outline political priorities for domestic food production. The Finnish food strategy⁸⁷ emphasizes profitability, sustainability and competitiveness of primary production. The potential need to increase production in the future is considered alongside the need to reduce the environmental impact of production. In Sweden, the national food strategy⁸⁶ has explicitly named increased food production for both domestic and international markets as its primary objective. There is also a focus on the country's broader environmental goal to see the next generation as one in which the major environmental challenges have been overcome. Norway has an Action Plan for a Healthier Diet, which focuses on food consumption, but also mentions that food production should be environmentally friendly.⁸⁸

IV. Exporting Nordic foods

The Nordic countries differ in their export-orientation in terms of food products and agricultural commodities. For example, Denmark has a strong export-orientation, with agricultural and food products accounting for nearly one quarter (24%) of Denmark's export value.⁸⁹ This is mostly due to pig meat exports, with Denmark exporting approximately 90% of the pig meat it produces.⁹⁰ After pig products, fish and fish products are Denmark's highest value

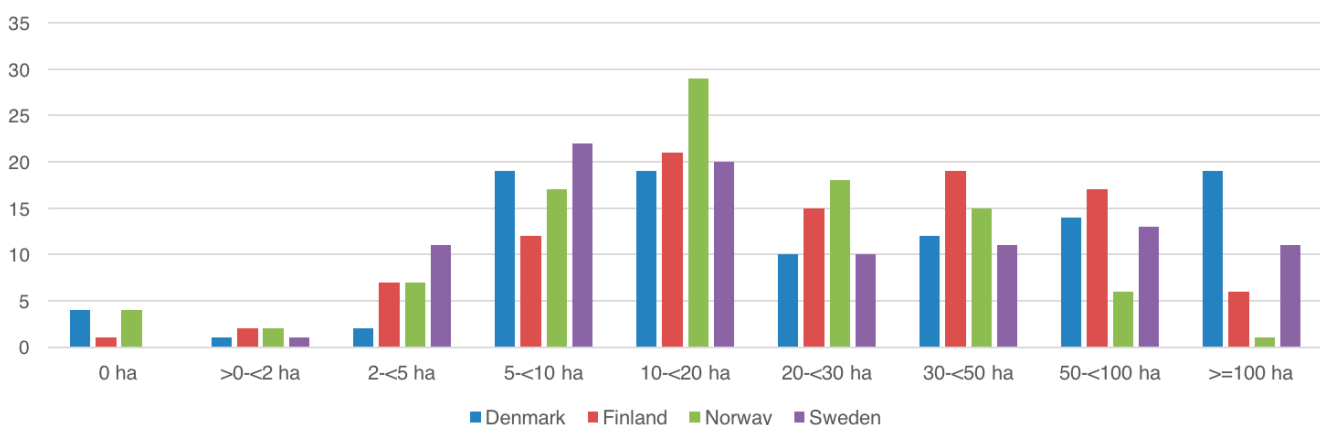


Figure 10. Percentage of agricultural holdings by farm size in Denmark, Finland, Norway and Sweden.⁷⁷

animal product export, with Denmark being among the top ten global exporters of fish and fish products in 2016.^{89,91}

In Norway, fish and seafood products dominate agricultural exports. Norway is the largest exporter of salmon and the second largest seafood exporter in the world (after China).⁹¹ Nearly all (95%) of the salmon produced in Norway is exported, with the export value of Norwegian salmon alone worth 61.3 billion NOK (6.3 billion EUR) in 2016.⁷⁶ Agricultural and food products together accounted for roughly 13% of Norway's annual export value in 2016.⁸⁹

In Sweden, cereals are the largest agricultural export (by weight).⁹² In terms of value, seafood is Sweden's highest value export,⁹² although the majority of this is imported from other countries, processed, and re-exported. For example, 95% of all imported salmon is then re-exported after processing.⁷¹ Cereals, dairy, eggs and other processed foods are also high-value Swedish exports. Together, agricultural and food products account for approximately 5% of Sweden's annual export value.⁸⁹

The Finnish food and agricultural sectors do not have a strong export orientation. Agricultural and food products account for approximately 3% of the total annual export value.⁸⁹ In the Finnish national food strategy,⁸⁷ increased exports are promoted as a means of growth, given that the domestic market is not forecasted to grow in its demand. The focus is geared towards exporting high quality and high value goods (e.g. processed goods).

As previously noted, products such as alcohol are beyond the scope of this report. However, given the large export quantities of alcohol (particularly in Sweden), future work and discussions on food system priorities should account for these products.

Food loss and waste in Nordic countries

I. Baseline assessment of food loss and waste in the Nordic region

Globally, around one-third of edible food produced is lost (loss of edible food during food production, post-harvest handling and processing stages) or wasted (activities during retail and consumer handling that reduce the amount of edible food available for consumption).^{93,94} There is no universal definition of food loss and waste (FLW), meaning that different stages of the food system and different food components (e.g. edible versus inedible, food used as animal feed) may or may not be accounted for in quantifications of FLW.⁹³ Where quantifications are presented with ambiguous definitions of FLW, it can be difficult to discern exactly where food is lost or wasted within a food system and can limit comparisons across jurisdictions. However, the best available evidence suggests that a higher proportion of food is wasted at retail and consumer levels in highly industrialised regions than in developing regions. Yet still, the bulk of food loss (roughly 60%) occurs in the production to retailing stage in highly industrialised countries.⁹⁴

Across the Nordic countries, 3.5 million tonnes of food are wasted each year,⁹⁵ although it is unclear what stages of the food systems are included in this calculation (e.g. primary production, processing, retail, preparation and consumption). Looking at primary production within Nordic countries (i.e. not including production of imported foods), available data indicate that a small amount of edible food is lost at the primary production stage (3.7% of the total Nordic production of edible food, or 0.9 million tonnes, including animal rearing).⁹⁵ Yet large data gaps exist, meaning this could be a significant underestimation. In-depth case studies of Nordic production suggest that there is significant loss in the primary production of certain foods. For example, up to 31% of carrots, 23% of cereals, 21% of green peas, 18% of peas and 17% of onions are lost before leaving the farm.⁹⁶ More research is needed to accurately calculate food loss in Nordic primary production.

Post-production, comparisons between the Nordic countries should be done with caution, since different methodologies are used in the calculations (e.g. including different stages of the value chain in food waste estimates). That said, in Denmark, avoidable waste (excluding primary production) is estimated at more than 600,000 tonnes per year from households (42%), the wholesale and retail sector (26%), the processing sector (22%) and the food service sector (10%).⁹⁷ The total food waste estimate is much higher than the estimates of either Finland or Norway (below), which, given similar population sizes and socio-economic characteristics, is surprising. However, this could be due to different methods used to estimate food waste – e.g. including inedible portions in 'avoidable waste' – inclusion of different sectors (e.g. food service), or underreporting/less accurate measurement in other countries.

In Finland, Katajajuuri and colleagues estimated avoidable food waste from households, restaurants, the food industry and the retail sector.⁹⁸ They estimated that 335,000-460,000 tonnes of avoidable food waste is generated across these food system stages each year in Finland, which would account for 10-15% of food in the entire Finnish food chain. Most of this avoidable waste resulted from households and the food industry, while restaurants and retail accounted for less avoidable food waste.⁹⁸

In Norway, it is estimated that 355,000 tonnes of avoidable food waste is generated from the food industry, wholesale, retail, and households.⁹⁹ It does not appear that the food service sector is included in these estimates, which could also be a reason why these estimates are so different from those of Denmark. Of the four stages of the food system included in the analysis, over 60% of avoidable food waste can be attributed to households, while industry is responsible for 21%, retail for 17% and wholesale for 1% of avoidable food waste.

In Sweden, estimated avoidable food waste from retail, food service (restaurants and large scale catering) and

households totals nearly 500,000 tonnes per year.¹⁰⁰ Food waste is highest for households (90%), and much less for the food service sector (8%) or retail (2%). It is notable that waste from the food industry and wholesale is not included in this total estimate, since an estimate for the share of avoidable waste was not produced for the food industry. Given that 75,000 tonnes of waste (both avoidable and unavoidable) are generated by the food industry each year,¹⁰⁰ this could increase the post-production food waste estimate for Sweden and decrease the proportion of post-production waste attributed to households.

In summary, there are many uncertainties when it comes to interpreting FLW data in the Nordic region. While it is estimated that a large portion of avoidable food waste is generated by consumers in all Nordic countries, few studies look across the food system and include primary production in their estimates. Significant data gaps exist in FLW calculations within primary food production, meaning it is difficult to come to certain conclusions. Additionally, it is difficult to assess food loss and waste across the food chain for all foods consumed in the Nordic countries – many foods consumed in the Nordics are imported, and losses in the

producing country would need to be estimated. Finally, different methods of categorizing and quantifying FLW across Nordic countries makes comparisons difficult.

II. Current and future priorities to reduce food loss and waste

The Nordic Prime Ministers brought attention to food waste reduction in the Nordic region by creating a food waste reduction project under the Nordic-wide ‘Green Growth’ initiative, although no specific reduction target was set.¹⁰¹ However, in Denmark, the national ‘Danmark mod Madspild’ (‘Denmark against food waste’) initiative brings together food companies, retailers and civil society groups to halve food waste by 2030, in line with SDG12.3.¹⁰² The government of Norway has signed an agreement with the food industry aiming to halve food waste by 2030.¹⁰³ In Finland, the National Waste Plan includes a target of halving food waste by 2030,¹⁰⁴ and the government of Sweden has produced an action plan also committed to halving food waste by 2030.¹⁰⁵

There is already much work underway – in terms of political focus,⁹⁵ public sector initiatives¹⁰⁵ and NGO

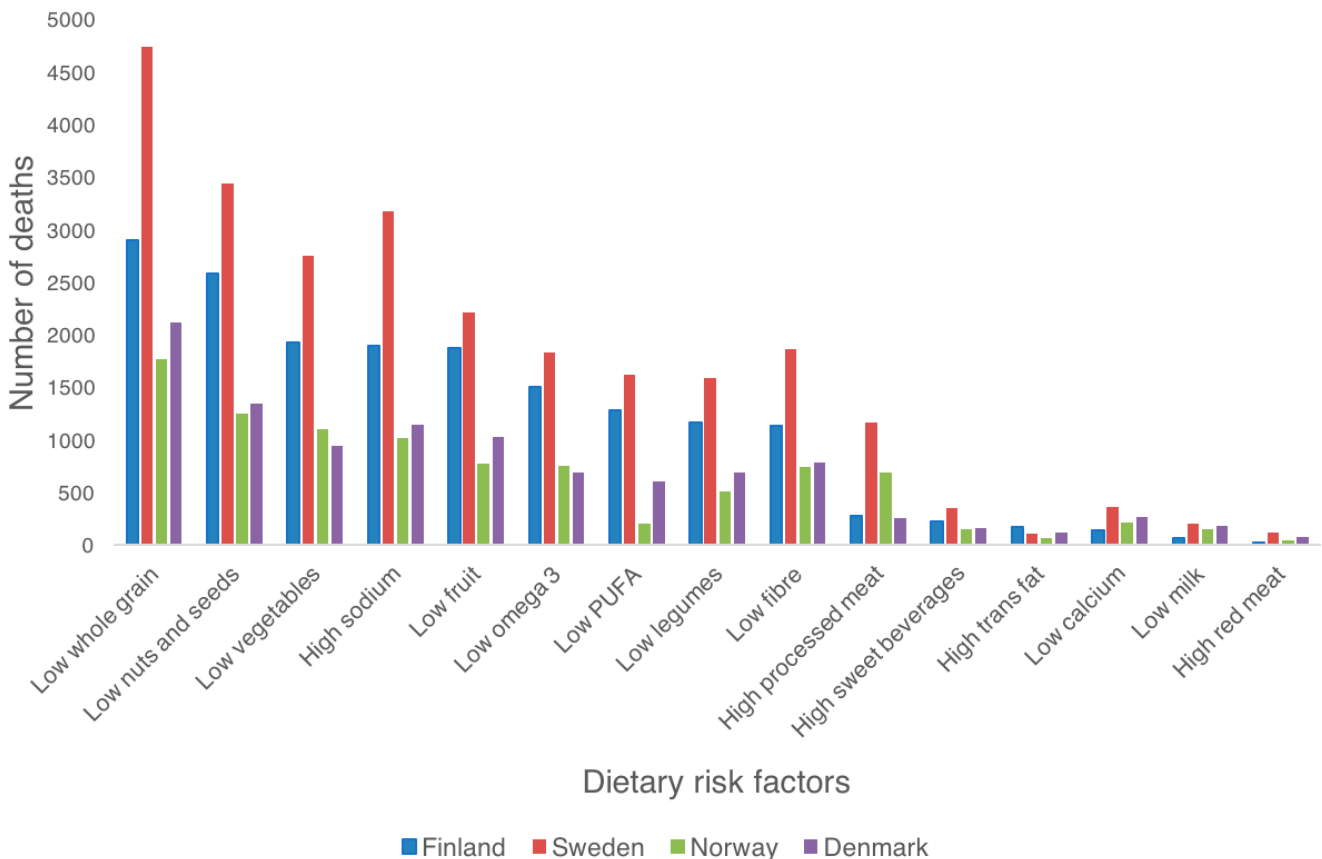


Figure 11. Deaths attributable to different dietary risk factors in the Nordic region in 2017 (adapted from original data of the Global Burden of Disease database, IHME).⁸ This figure illustrates the absolute number of deaths. Due to different population sizes across countries (e.g. larger population size in Sweden relative to other Nordic countries), these estimates should not be used to compare the proportion of deaths across countries.

efforts¹⁰⁶ – to reduce food waste in Nordic countries. However, policy makers and civil society groups should be aware of potential unintended ‘rebound’ effects of food waste reduction strategies. Rebound effects can occur, for example, when the money saved buying only the amount of food that will be consumed is then spent on more greenhouse gas intensive goods and experiences (e.g. travel and transport).¹⁰⁷

Further, structural drivers of waste should be addressed, recognizing that food waste goes beyond an issue of personal responsibility. Again, much work is already underway in the Nordics, including food redistribution programs,¹⁰⁸ work to identify food losses and waste in primary production,⁹⁶ and working with producers to develop date-labelling that minimizes waste.⁹⁵ However, other systemic drivers of food waste, such as frequency of food shopping,¹⁰⁹ ‘buy one get one free’ offers, a culture of ‘storhandla’ (a big shop), large portion sizes or losses at retail level or in public institutions should be analysed in more detail.

Nordic food system impacts on people

I. Health impacts of Nordic diets

A number of serious health concerns stem from dietary habits in the Nordics. In fact, diet is one of the leading risk factors driving death and disability in the region – in 2017, it ranked second in Sweden (after tobacco smoking) and Finland (after high blood pressure), and third in Denmark and Norway (after high fasting plasma glucose and tobacco smoking).⁹

Across all four Nordic countries, low intake of whole grains, as well as low consumption of nuts and seeds emerge as the two main dietary risk factors (Figure 11). Ranking third in Sweden and Denmark is high intake of sodium, and in Finland and Norway is low intake of vegetables.

Across all dietary risk factors, cardiovascular diseases (mainly ischemic heart disease and stroke) are the largest cause of death in all four countries, more predominant than neoplasms, diabetes and kidney diseases.

Overall, poor diets were responsible for 43,000 deaths across the Nordics in 2016, and 659,000 Disability-Adjusted Life Years (DALYs). One DALY is the equivalent to the loss of one year of ‘healthy’ life, and indicates the gap between current and ideal health status.

Overweight and obesity (OW and OB) are a primary health concern in the Nordics, as their prevalence has risen in recent years. For example, obesity in Sweden has tripled since 1980 and has nearly tripled in Finland in that same time period.^{110,111} According to the Nordic monitoring data, nearly half of Nordic adults (47%, including Iceland) are above a healthy weight (Figure 12).¹¹² This is slightly lower than the EU average (51.6% OW and OB in 2014). However, differences in methodology used to assess OW and OB prevalence at the Nordic and EU level should be noted. Using the EUROSTAT database, estimates of Nordic OW/OB

prevalence are higher in all Nordic countries (D: 48%, F: 55%, S: 50%, Norway: 49%) than Nordic estimates.¹¹³ Comparison to country specific data also indicates that the Nordic monitoring estimates could be an underestimation.¹¹⁰

In addition to overweight and obese adults, more than one in seven Nordic children were overweight or obese in 2014 (Figure 12).⁶⁵ Evidence suggests that child overweight and obesity rates have plateaued in some parts of the Nordic region (e.g. Norway).¹¹⁴ This is encouraging, given that few countries or regions in the world have been able to halt the rise of child overweight and obesity.¹¹⁵⁻¹¹⁷ However, this trend is not seen in all Nordic countries. For example, child overweight and obesity is still on the rise in Sweden.¹¹⁰

Diabetes is also a major diet-related health concern in the Nordics. In 2017, unhealthy diets accounted for 31% (D), 32% (F), 34% (N), 32% (S) of deaths caused by diabetes type 2.⁸ In 2016, over 1.6 million individuals were living with diabetes across the Nordic region (D: 301,000; F: 340,000; N: 278,000; S: 707,000). Although prevalence of type 2 diabetes in the Nordics is lower than in other highly-developed countries, data indicate that it has been increasing over several decades (though incidence may have leveled off in some countries).¹¹⁸⁻¹²¹

Unhealthy diets are also a key driver of all cardiovascular diseases (CVD). Approximately 40% (D), 48% (F), 41% (N) 43% (S) of deaths from cardiovascular disease in 2017 were attributed to dietary risk factors.⁸ However, mortality rates from CVD have been steadily declining since 1990, when they amounted to 45-49% of all deaths in the region. More specifically, in all four Nordic countries, diet is an even

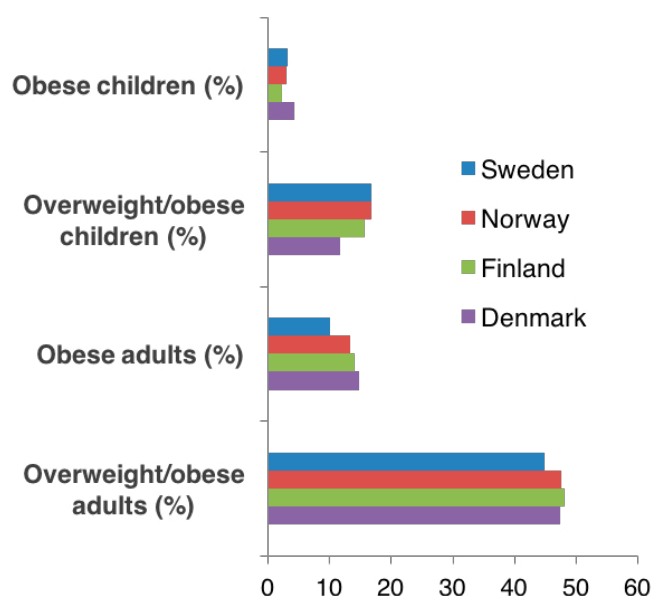


Figure 12. Prevalence of overweight/obese adults and children in the Nordic countries.⁶⁵ Note that these data are from the Nordic monitoring survey, and values may underestimate prevalence.

stronger driver of ischemic heart disease, which is the number one cause of death – both total and premature – in the region. Dietary risk factors accounted for 65% (N), 66% (S), 68% (F), 64% (D) of deaths from ischemic heart disease in 2017.

Cancer is yet another common disease in the Nordics that is underpinned by diet. In 2017, unhealthy diets accounted for 25% (D), 24% (F), 29% (N), 27.5% (S) of deaths due to colorectal cancer⁸ – a cancer type for which the scientific evidence points to high red and processed meat intake as a key risk factor.

II. Health costs related to poor diets

In addition to the personal suffering, unhealthy diets come at a high cost to society. While few analyses have quantified health care costs of unhealthy diets in the Nordic region specifically, results from a Norwegian analysis indicated that adoption of healthy diets could result in savings of approximately 154 billion NOK per year (16 billion EUR) from accumulated health benefits, reduced health care costs and increased productivity.¹²²

Looking at the health implications of poor diets, obesity alone comes at an estimated global cost of 2 trillion USD (1.8 trillion EUR), or just under 3% of global GDP.¹²³ In the Nordic region, the cost of overweight and obesity (direct healthcare costs, sick leave, early retirement and premature mortality) is a significant economic burden, estimated to amount to 4.7 billion EUR each year.¹²⁴ However, this might be an underestimate, given that the societal costs of obesity in Sweden alone were estimated to reach approximately 70 billion SEK (6.8 billion EUR) per annum.¹¹⁰ The discrepancy could also result from different inclusion criteria in the calculation of costs. Regardless, costs are high and projected to increase – researchers in Sweden estimated that if the rate of overweight and obesity continued to follow recent trends, then health care costs (in 2005) would more than double by 2030.¹²⁵

Diabetes is also responsible for significant costs. In Denmark, it is estimated that diabetes-attributed costs totaled 4.27 billion EUR in 2011.¹²⁶ Finnish researchers have estimated the medical costs of diabetes in Finland in 2007 to be 833 million EUR, with the additional cost of lost productivity totaling 1.33 million EUR.¹²⁷ More recent estimates showed that the loss of productivity due to diabetes could be as high as 5 billion EUR in Finland in 2011.¹²⁸

The lack of the quantified costs of poor diets and their health impacts, particularly recent analyses, indicates a significant evidence gap.

III. Diet-related and health inequality in the Nordic region

Overall, the Nordic countries have achieved high levels of public health and wellbeing¹²⁹ and relatively low income

disparity¹³⁰. Yet substantial health inequalities do exist among social groups and are on the rise in the Nordic countries.¹²⁹ In particular, large diet-related inequalities exist – as of 2014 the variation between social groups with respect to meeting healthy diet recommendations was over 50%.⁶⁵ Given that the Vision 2021 target for social variation of meeting dietary guidelines is 20%,¹²⁴ the Nordics still have work to do.

Clear differences in dietary trends can be seen across demographic groups in the Nordic region. In general, people with a higher level of education commonly consume more foods considered inputs of a healthy diet (fruits, vegetables, grain products).^{59,62} In Sweden, those with higher incomes ate more vegetables and less sweets and snacks; yet they also consumed more animal products.⁵⁹ There were also significant regional differences – for example, vegetable consumption in Sweden was highest in Stockholm and lowest in rural areas.⁵⁹ Although dietary trends differ quite substantially across demographic groups of adults, these inequalities have not appeared to increase between 2011 and 2014.⁶⁵

Of concern, younger generations often have the most unhealthy food habits, with high intakes of unhealthy foods such as sweets,⁶⁰ soda,⁶² pizza or pies.⁵⁹ The Nordic monitoring initiative found that youth with unhealthy diets were more likely to have less-educated parents.⁶⁵ Other research showed that younger people in more affluent families were more likely to eat fruits and vegetables every day, but family affluence had no association with sweets or sugary drink consumption.¹³¹ Longitudinal data from the Nordics indicates that – unlike adults – inequality in diet is growing among children.⁶⁵

Differing dietary trends across social groups can contribute to health inequalities. For example, in 2014 there was a 31% variation among social groups in terms of adult obesity and overweight. While this inequality has decreased in recent years, it is due to increased overweight and obesity among more highly-educated populations (rather than a more desirable decrease in less-educated populations). There has been a drastic decline in the variation of overweight and obesity among different social groups in children, decreasing from 98% in 2011 to under the Vision 2021 target of 20% in 2014. However, it is difficult to determine whether this was due to an increase in obesity within certain groups (e.g. those with previously healthy weights). The gap between social groups in children does persist, meaning there is room for improvement.⁶⁵

In the Nordics, overweight and obesity vary with age, gender, education and income. A recent analysis conducted in 2016 by the Public Health Agency of Sweden (Folkhälso-myndigheten) showed that 65% of adults with no high-school education were overweight or obese, while only 44% of adults with some higher education were above a healthy weight.¹³² A survey conducted by Swedish municipalities

showed that only 5% of children in high-income areas of Stockholm are overweight or obese, while in vulnerable, low-income areas the rate is six times as high, which could be attributed to disparities in income as well as education level of the parents.¹³³ Age is also a factor, where 61% of adults 45-84 years old were overweight or obese in comparison to 9% among 16-29 year olds. Gender also contributes to differences, among 16-84 year olds, 57% of men and 44% of women were overweight or obese.¹³²

Despite significant and persistent inequalities, one assessment¹¹⁰ of Nordic assessment found that efforts aiming to reduce social inequalities in diet and physical activity were lacking across the Nordics, as well as evaluation of effects of various interventions on equality.

Nordic food system impacts on the planet

To look at the impact of Nordic food systems on the environment, we must recognize that Nordic food systems are truly global food systems. Nordic food is exported all around the world – sharing ‘virtual water’ and land use embodied in exported foods and moving nutrients across regions. Similarly, foods from around the world comprise Nordic diets, and the ‘outsourced’ environmental costs of these imported foods need to be internalized.

To account for the impacts of both what is eaten in the Nordics and what is grown, we take both a consumption and production perspective (Box 4). The former focuses on the impacts of what people eat, and accounts for environmental impacts of food sourced globally. The latter approach focuses on the impacts of producing food in the Nordic region. Some of this impact will be ‘consumed’ domestically, and a portion will be ‘exported’ to the global market. By taking these two

complementary approaches, impacts of both national consumption habits and production practices can be more easily determined.

I. Environmental impacts of Nordic primary food production

We first take a production perspective, focusing only on the environmental impacts of primary food production occurring within the Nordic region (Figure 13 boxes I and III). Food production in the Nordic countries gives rise to several negative environmental impacts including nutrient losses to air and water, pesticides residues in surface and ground water, over-harvesting of fish stocks and emissions of greenhouse gases. The production of food also uses considerable amount of resources such as energy, land, minerals and water.

There are also positive effects of agriculture and aquaculture. Several red listed species are dependent on open agricultural landscapes and grazing animals that maintain semi-natural pastures help preserve biodiversity.^{134,135} Other ecosystem services include provision of healthy and safe food, provision of raw materials for e.g. biofuels or other industries, regulation of air quality, carbon sequestration, pollination, and a key to rural development. Moreover, farming filter feeders can reduce the concentration of nutrients in the water body and prevent marine eutrophication.¹³⁶

The primary food production sectors of each Nordic country vary considerably in terms of level and type of crop production, livestock production and export orientation. As such, the environmental impact of agriculture varies across countries, yet Table 2 below illustrates that there is a significant environmental impact of food production in the Nordic countries (NB environmental impacts from

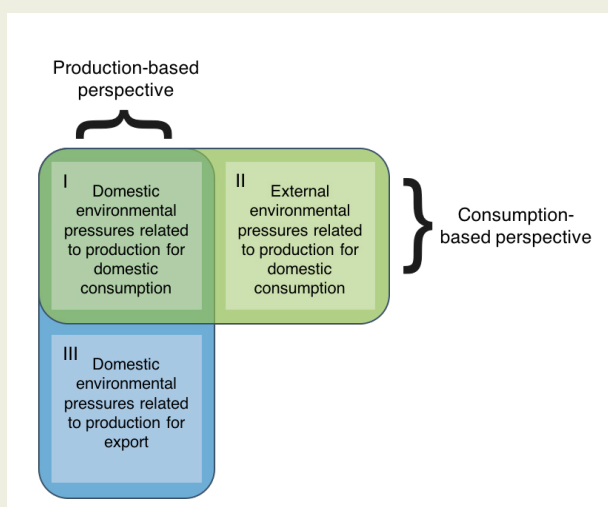


Figure 13. Production and consumption perspectives. Reproduced with permission from Häyhä et al., 2018.⁶

Box 4. Consumption- and production-based approaches to evaluating environmental impacts of food systems

Environmental impacts of Nordic food systems can be assessed in two complementary ways. A production-based (or territorial) approach focuses on environmental impacts caused by food production in the Nordic countries – that is, food produced for domestic consumption (I) as well as food for export (III). A consumption-based approach, on the other hand, accounts for all environmental impacts of foods consumed in the Nordics, both those foods produced domestically (I) as well as those that are imported (II).⁶

	Unit	Denmark	Finland	Norway	Sweden
Annual agricultural GHG ¹ (% total national emissions)	Million tons CO ₂ -eq	10 (18%)	5.5 (9%)	4.7 (9%)	6.5 (12%)
Annual agricultural GHG including energy use ² (% total national emissions)	Million tons CO ₂ -eq	14 (26%)	8.0 (13%)	8.9 (17%)	8.1 (15%)
Agricultural land use ⁷⁸ (% land area)	Km ²	26110 (62%)	22734 (7.5%)	9861 (2.7%)	30398 (7.5%)
Annual agricultural freshwater withdraw als ³ (% total water withdrawal)	million m ³	149 (25%)	50*	826*	113 (4%)
N application ⁴⁺	kg N per ha cropland	81	63	122	67
P application ⁴⁺	kg P per ha cropland	5.9	2.1	11	4.6

Table 2. Environmental impact of agricultural production in the Nordic region. Note that impacts from aquaculture and fisheries are not included.

1 Emissions from enteric fermentation, manure management, synthetic fertilizers, manure applied to soils, manure left on pasture, crop residues, cultivation of organic soils, and burning of crop residues. From FAOSTAT, average between 2012-2016. Total national emissions are according to national GHG inventories submitted to the UNFCCC (excl. LULUCF) for the years 2012-2016.

2 Emissions as in 1) as well as emissions from energy use in agriculture and from the production of mineral fertilizers. From FAOSTAT, average between 2008-2012.

3 From AQUASTAT, average 2000-2015.

4 From FAOSTAT, average 2008-2012.

* No data for years 2008-2012. In 2006-7, agricultural freshwater withdrawals in Norway were 28% total water withdrawals, and in 2005-6, agricultural freshwater withdrawals in Finland were 1% of total water withdrawals.

+ For comparison, the average EU application is 93kgN/ha and 22kgP/ha. The average in African countries, where vast areas of land are degraded and in need of nutrients, is 13 kg N/ha.

aquaculture are not included in our analysis). Production-side reductions in emissions are important to reach climate targets, for example the Swedish Board of Agriculture estimates that Swedish agricultural emissions of greenhouse gases can potentially be reduced by up to 20% by improved resource efficiency and technical solutions.¹³⁷

II. Environmental impacts of Nordic food consumption

Here we discuss environmental impacts from a consumption perspective (i.e. impact of Nordic diets, including environmental impacts resulting from domestically grown and consumed food and imported food, Figure 13 boxes I and II). Quantitatively assessing the environmental impacts of Nordic food consumption is complex due to several reasons. As food production affects the environment in many different ways, ideally diets should be assessed using a range of environmental indicators including such as climate impact, eco-toxicity, eutrophication potential, acidification potential, land, water and energy use. However, data availability is a major limitation as there are thousands of food products available from all over the world. Here we summarize the existing evidence aiming to quantify the environmental impact of Nordic food consumption and present some new evidence to corroborate these existing findings.

Most studies on the environmental impact from Nordic diets have been limited to climate impact, estimating yearly per capita emissions for Nordic diets to be 1.9-2.0 t CO₂eq

for Sweden^{138,139}; 1.2t CO₂eq for Norway¹⁴⁰; 1.9t CO₂eq for Denmark¹⁴¹ and 1.2t CO₂eq for Finland¹⁴² (t CO₂eq = tonnes CO₂ equivalents). However, results from different studies should be compared with care as methods (including system boundaries and data collection strategies) might differ considerably. Therefore, we calculated the climate impact of the Nordic diets in a consistent (but potentially coarser) way

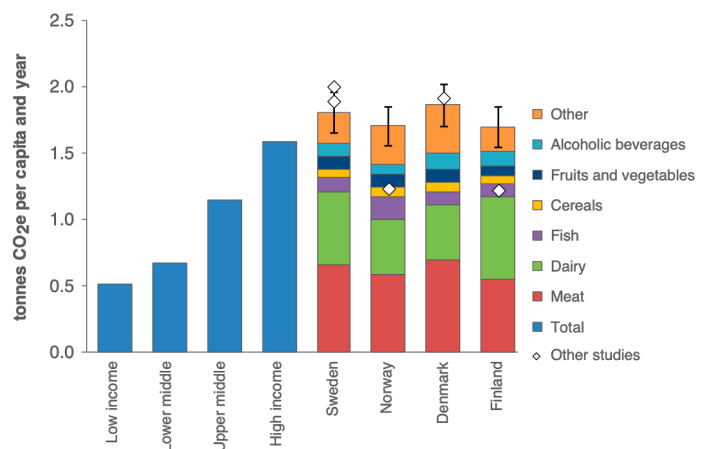


Figure 14. Climate impact of average Nordic diets (per-capita) in comparison with the climate impact of average diets of low-, middle- and high-income country populations. Based on consumption for the years 2011-2013 and average carbon footprints of different food items. The error bars show the standard deviation due to variations in estimated carbon footprints of different food items.

using food supply data from FAOSTAT for the years 2010-2013 and average data on the climate impact from Clune et al.^{83,143} Results are displayed in Figure 14.

Figure 14 also illustrates that the average per capita emissions of Nordic consumption are above the average for high income country populations. It can be concluded that the climate impact of the Nordic diets is high. Animal products are responsible for a large share of these emissions (65–75%)^{138,139,141} – and several global assessments of the environmental impacts of diets have highlighted that the reduction of meat in the diet is the primary leverage for reducing diet-related greenhouse gases.^{39,144} Production-side reductions in emissions are also important to reach climate targets, as discussed above.

Bryngelsson et al. (2016) studied how a combination of technical advances, waste reductions and dietary shifts would reduce emissions from the Swedish diet and came to the conclusion that under optimistic assumptions, emissions of methane and nitrous oxide could be reduced by 50% to 2050.¹⁴⁵ However, this was not sufficient to meet the EU climate target (i.e. reduce total GHGe by at least 80% by 2050, relative to 1990 levels) – large reductions (>50%) in ruminant meat consumption were found to be essential if climate targets were to be met.^{38,145}

As for environmental impacts beyond climate impact, few studies on the dietary level exist. Martin and Brandão (2017) estimated, in addition to the climate impact, acidification and eutrophication potential, land use and human- and ecotoxicity from the average Swedish diets and a set of alternative diets.¹³⁹ They found that all impacts except toxicity impacts were drastically reduced for diets lower in animal products. However, human- and ecotoxicity impacts were slightly increased for vegetarian and vegan diets. This highlights the need to also change production practices to those that require less input of chemical pesticides. Similar results can be expected for water use. This highlights the importance of more research on potential goal conflicts between environmental impact categories in order to design diets that are optimal from many perspectives.

Chaudhary et al. (2018) used a multi-indicator assessment tool to assess national food system performance in 156 countries.¹⁴⁶ The authors estimated diet-related carbon, blue water, land and biodiversity footprint. The study also shows a high blue water footprint of Nordic consumption, although the consumption of North America, parts of Europe, Australia and parts of the Middle East are even more water demanding.

III. Outsourced environmental impact of Nordic food consumption

Globalisation and international trade have, for example, allowed for production of foods where they are produced most cost-effectively. Yet this has also led to increasing spatial separation between food production and

consumption, which has resulted in displacement or “outsourcing” of environmental and social impacts.^{147,148} Multi-regional input-output models (MRIOs) are used to account for environmental impact associated with global trade. They complement monitoring of domestic environmental pressures within a country’s own territory. MRIOs track flows of commodities in international trade and link them to potential environmental pressures and impacts for different world regions.¹⁴⁸ In this report, we used the EXIOBASE model (v3.4), which includes supply and use data from 44 countries (28 EU member states plus 16 major economies) and five rest of the world regions¹⁴⁷ to assess three environmental indicators – cropland use, blue water use (i.e. fresh surface and ground water use) and greenhouse gas emissions (in the form of CO₂, CH₄ and N₂O emissions, excluding deforestation) associated with domestically produced and imported food products consumed in the Nordic countries. For more information about the method used to assess the outsourced environmental impact of Nordic food consumption, see Appendix 1.

Only half of the cropland used for current Nordic food consumption is located within the Nordic countries. Out of this, cultivation of cereal grains and oil crops is responsible for the largest cropland use. In Denmark, roughage fodder such as maize silage plays a big role as well. The other half is shared between Europe (22%), Asia-Pacific (17%), Africa (7%) and South America (6%). The most important imported food commodities in terms of land use include oil crops (e.g. soybean) and wheat, as well as vegetables, fruits and nuts.

Approximately 90% of blue water use (related for example to irrigation) takes place outside the Nordic countries, most importantly in Asia-Pacific (32%), Middle East (24%) and Europe (16%). This “virtual water” is particularly associated with vegetables, fruits and nuts from Middle East and Spain and wheat from Kazakhstan, and potentially contributes to water scarcity in the production regions.

Almost half (around 46%) of the greenhouse gas emissions related to Nordic food consumption are taking place within the Nordic countries. The largest causes of GHG emissions are from cattle and milk production systems. The biggest share of emissions outside the Nordic region comes from Latin America, Ireland, Germany and South Africa and is due to cattle farming.

Our findings suggest that the environmental impacts of the Nordic food system are largely outsourced far beyond the Nordic territory (Figure 15). This demonstrates the importance of going beyond a territorial focus. The large outsourced impacts also imply dependency on resources, particularly land, for meeting Nordic food demand with impacts on both climate and biodiversity. Commitment to the 2030 Agenda means we can no longer overlook the fact that many intensive production systems are highly dependent on

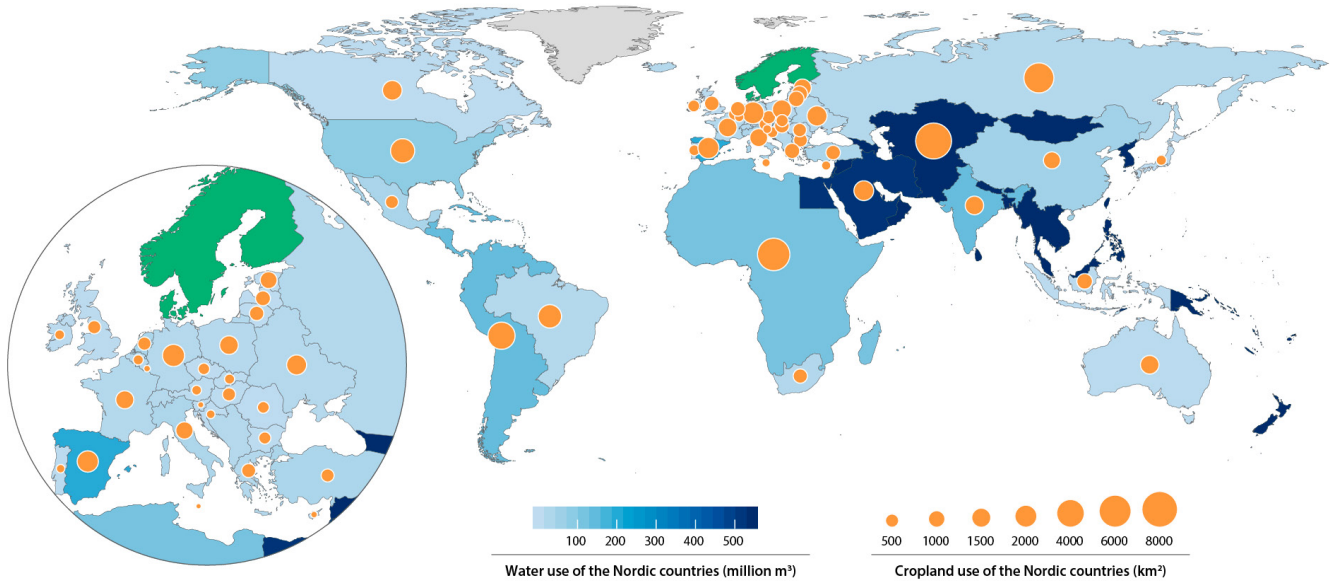


Figure 15. Cropland area and blue water used around the world by Nordic food consumption in 2015.

inputs from supporting systems in other geographic regions.¹⁴ These externalized environmental pressures need to be included as a part of assessing a nation's global responsibility for transgressing planetary boundaries. For example, in calculating the climate impact of Nordic diets (previous section), these externalized environmental pressures were accounted for by taking a consumption-based approach. This analysis brings to the fore the need to consider the benefits and burdens of global food systems. Due in part to patterns of global food trade, longer food supply chains, and the rise of transnational food actors, food systems around the world are becoming more and more interconnected.^{149,150} The interconnectedness of food systems has increased the food security and resilience of certain actors and regions at the expense of others. Increasingly, high-income countries are

relying on the agricultural commodities produced in low-income countries, meaning these producing regions also bear the environmental cost of production, including land degradation and biodiversity loss.¹⁵⁰ This vulnerability is exacerbated by low transparency in global food chains and trade flows, hiding these 'outsourced impacts' from the final consumer of a food product.¹⁴⁹ In short, care should be taken to ensure that the resilience of food systems around the world is not diminished due to Nordic (or other country) demands.

That said, there are some environmental impacts that are global in nature. For example, greenhouse gases produced anywhere in the world contribute to global warming, whereas biodiversity is mostly spatially explicit and not as transferable across regions.

Task 2: Define the safe operating space for Nordic food systems

It is clear that despite evidence-based dietary guidance, early adoption of environmental concerns into the agricultural sector and policies to reduce food waste in-line with global commitments, Nordic food systems are failing on several health and environmental goals. Nordic diets are contributing to poor health and are placing pressure on the environment, both domestically and abroad. Additionally, excessive food waste is leading to environmental and economic losses. In short, current food systems are not on track to help deliver on the Nordic's commitments to global goals. But what would a 'safe operating space' look like for future Nordic food systems? This section takes the first step in downscaling the global *EAT-Lancet* food system targets in order to compare current Nordic food system performance.

Defining healthy and sustainable Nordic food systems

The targets proposed by the *EAT-Lancet* Commission indicate the sum of global efforts needed to keep food systems within a safe operating space. To guide policy and

practice at the national or regional level, these targets need to be translated to a meaningful safe operating space for specific countries. Again, more work is needed to extend the *EAT-Lancet* framework to include other important indicators, such as chemical use in agriculture.

Dietary boundaries for Nordic countries

The *EAT-Lancet* targets for healthy diets are presented in the Commission report as intakes per capita per day, and include intake ranges for different food groups. These ranges allow for flexibility to accommodate various food preferences and food types.

As discussed in the previous section, the Nordic countries have existing Nordic and national dietary guidance. A comparison of the *EAT-Lancet* targets and Nordic guidelines (presented in Appendix 2) highlights the overall alignment between the two. In defining dietary boundaries for Nordic countries, the *EAT-Lancet* targets can complement existing guidelines in two ways. First, the *EAT-Lancet* targets could point to food categories where explicit national advice is currently lacking but could be developed, such as with pulses, nuts or poultry. Second, where discrepancies between the two sets of recommendations exist, further scientific investigation could be commissioned or incorporated into the Nordic Nutrition Recommendation revisions.

Environmental boundaries for Nordic food systems

The *EAT-Lancet* targets for environmentally sustainable food production are global in nature, and they need to be downscaled before they can be used to guide national policy and practice. Developing downscaled boundaries for Nordic food systems helps to integrate the global environmental perspective into local, national and regional contexts and decision-making.

Several different methods could be used to derive country- or regional-level boundaries from the global *EAT-Lancet* targets. The translation process of defining Nordic boundaries essentially divides up the global safe operating space for the food sector, ensuring that policy targets are coherent between scales. However, there are different ways to share the global safe operating space. These can be based on principles of equality, capability, sovereignty or efficiency,

Box 5. Targets, boundaries and safe operating spaces

The *EAT-Lancet* Commission proposed two sets of targets – targets for healthy diets and environmental targets for food production.¹ The targets proposed by the Commission represent thresholds or boundaries for how little or how much we should eat of certain food groups to promote good health and wellbeing, and boundaries for the amount of environmental damage that can result from food systems. Together, these two sets of boundaries delineate the 'safe operating space' for food systems, i.e. the space where humanity is able to feed its growing population a healthy diet within Earth's limits. The *EAT-Lancet* Commission notes that 'boundaries serve as guides for decision makers on acceptable levels of risk.'¹ Therefore, while we refer to the *EAT-Lancet* 'targets', we use the term 'boundary' to signal our aim to develop values that can be used by Nordic policy makers to indicate levels of acceptable risk. These values are based on science, but as stressed throughout this report, it will require normative decisions to determine boundaries that can be agreed on by food system stakeholders.

and calculated according to population, land area, economic output, resource efficiency or historic responsibility.^{13,151} These different approaches lead to very different outcomes¹⁵¹ and consequently to different development pathways for humanity.¹³ A more equal sharing, for example in nitrogen application, could lead to socio-economic and environmental co-benefits.¹⁵²

In this report we adopt an “equal per capita” allocation because the notion of equal rights for all is globally accepted, and due to its conceptual simplicity. This kind of allocation of resource use and pollution can be usefully applied to environmental issues that are evident at global level, such as greenhouse gas emissions leading to climate change.

However, for environmental issues that are more apparent at local or regional level and that differ in different parts of the world, this allocation is not always sufficient. Additionally, local sustainability criteria need to be considered. These include for example, local scarcities (e.g. water scarcity), vulnerabilities (e.g. N and P leakage), environmental hotspots (e.g. biodiversity). However, as international trade plays an important role in the global economy, geographically separating production and consumption, these more local issues have global causes and global responsibility.

The process of translating global environmental targets to relevant national or regional level requires iterative dialogue and ongoing cooperation among scientists and policy makers.⁶ Application of the *EAT-Lancet* targets involves normative decisions about common but differentiated responsibility for responding to and reducing environmental harms, as well as about fair allocation of the global safe operating space. Collaboration between researchers and other food system actors could provide a democratic, inclusive and transparent process to inform the normative decisions inherent in food system transformation.¹⁵³

Defining the ‘safe operating space’ for Nordic food systems

Food systems in the Nordics need to operate within both sets of dietary and environmental boundaries in order to fall within the safe operating space. Returning to Figure 5, food systems can deliver on health goals but not sustainability goals, or vice versa. Examples of such ‘win-lose’ diets would be those rich in vegetables, fruits, nuts and legumes that were grown through unsustainable practices (e.g. nuts grown in water scarce areas, vegetables from fossil-fuel heated greenhouses, etc.), or alternatively, unhealthy diets such as monotonous starch-heavy diets that have little environmental impact.

It is important to keep in mind that the *EAT-Lancet* healthy eating targets were developed to improve health, and environmental sustainability was not factored into these targets. As a result, it is possible that not all diets within the healthy eating ranges meet environmental targets on the global scale, also depending on the other actions taken (e.g. level of production improvement, reductions in food loss and

waste). For example, if all individuals eat at the upper limits of all foods with high climate impact (e.g. animal based foods) with no reductions in food loss and waste and no improvements in food production practices, there is a chance that environmental targets won’t be met. That is why the scenario development exercise of the *EAT-Lancet* was important. A model was used to test different scenarios of dietary shifts within the healthy diet recommendations, production improvements and waste reduction to identify actions that satisfy both sets of targets. There may be compromises between health and the environment that need to be considered when defining this safe operating space.

Ensuring the wellbeing of people and the resilience of future food systems

Food systems are more than farms and forks. Food systems affect social equity, gender equality, individuals’ livelihoods, cultural diversity, and a broad spectrum of other social indicators.^{3,21,154} Such aspects can prove more difficult to measure and define than the quantitative biophysical boundaries of diets and environmental impacts, although frameworks exist.^{154,155} To truly adopt an integrated approach to food systems, while also ensuring that social wellbeing is not compromised, these social aspects must be taken into account.

Further, agricultural production systems are part of larger social-ecological systems. The functioning of food systems relies on a number of regulating and supporting services of social-ecological systems (e.g. water regulation processes, pollination).²⁰ At the same time, food systems contribute other services needed for human wellbeing, such as clean water and nutritious food.²⁰ In order to provide healthy food in the long run, social-ecological systems must be managed in a way that preserves their functioning in the face of change and unpredictability.^{156,157}

Resilience theory can provide a powerful framing tool where future uncertainties exist, since it focuses on the capacity to handle disturbances, be it inherent variability or increased frequencies and magnitudes of disturbance resulting from human impacts.^{14,156} Resilience is the capacity of a social-ecological system to sustain a desired set of services, to adapt these services, or to transform in the face of disturbance and ongoing evolution and change.¹⁵⁸

Two important features of resilience thinking are diversity and scale. With respect to diversity, there are two aspects of diversity to consider. First is response diversity, which describes the range of responses among components of a system to stress. Second is the concept of functional redundancy, which is the capacity of a component to replace another if one is lost. It is essential for a food system to have both response diversity and functional redundancy. As an illustration, even if most species in a system (e.g. different agricultural crops) are able to cope with some perturbation (i.e. response diversity is high), resilience will nevertheless be

low if those remaining species are unable to functionally replace the one(s) being lost.

Scale is also a critical feature of resilience thinking, both in terms of geographical scale as well as timescale. Regarding geographical scale, it is important to consider the local impact of external (i.e. international) inputs into our Nordic food system in order to avoid the ‘leakage effect’ where Nordic food system goals erode wellbeing somewhere else.¹⁵⁹

This is particularly true when developing trade priorities. Through a resilience lens, the connectivity that trade creates needs to be managed with awareness. On one hand, sourcing food from a diversity of regions and production systems can increase resilience of the Nordic food supply by not “placing all eggs in one basket”, provided the exchange is fair and does not compromise the opportunity to achieve social or ecological sustainability in other parts of the world. Particularly in times of crisis, such as severe weather events that impact Nordic food production, food imports can ensure a steady and adequate food supply. Trade may also give the opportunity to produce different foods where production is most ecologically efficient.

On the other hand, as discussed in the ‘Assessment’ section, import of vegetables, fruits and nuts from the Middle East and Spain could potentially contribute to water scarcity in the source region. In addition, even though a relatively small amount of cropland use for Nordic consumption occurs in South America, this could be particularly harmful if biodiversity-rich areas are being deforested to make way for cropland. Again, equality is a key consideration, in terms of who benefits and who ‘loses’ from certain arrangements.¹⁶⁰ In addition, there could be an increased risk of food insecurity in the Nordics if the imports relied upon to feed its populations fail due to conflict, crisis or severe weather events in the producing country.

Resilience thinking also highlights timescale in the sense that inputs, outputs or production methods should not diminish options for the future. The Nordics have a strong political drive “to take decisive steps towards a sustainable future that offers a good quality of life for current and future generations,” as stated in the Nordic-wide Generation 2030 initiative.¹⁶¹ Incorporating resilience thinking into food system management could therefore help achieve this goal.

Summary

The *EAT-Lancet* global targets can provide a starting point for developing the boundaries of a safe operating space for Nordic food systems. While it is rather straightforward to adapt the healthy eating targets to the Nordic region, given their per-capita presentation, it is more complex to translate the *EAT-Lancet* environmental targets to the Nordic region. Several methods can be used to translate these targets, but this will require collaboration of researchers and non-academic food system actors in order to address the normative decisions inherent in any translation of the global targets. Effort should be made to engage actors representing diverse perspectives in these collaborations, particularly those who are often marginalized in these types of collaborative decision-making processes.

Above all, we stress that efforts to define quantitative boundaries binding the safe operating space should not be used to delay policy, business, and civil society action. While the boundaries of the safe operating space for Nordic food systems may take time to establish, given the normative discussions that will be needed, current knowledge can guide immediate action. The next section undertakes a first attempt to characterize the ‘gap’ between current and desired future food systems. As the boundaries of the safe operating space are agreed upon, current actions can be recalibrated to match the necessary level of ambition, and future actions can be designed based on this safe operating space.

Task 3: Compare current and desired food systems

This section aims to provide an initial comparison of current Nordic food system impacts to Nordic food system boundaries for diets and environmental impact. Given that there are several ways to downscale the global EAT-Lancet targets for comparison to national or regional-level impacts, our aim is not to set final Nordic boundaries, but rather to indicate the scale of change needed based on a possible translation of global targets to the Nordic region. We stress that the vision of desired future food systems (and thus, Nordic food system boundaries) should be determined through a complementary approach incorporating both scientific assessment and stakeholder dialogue. As such, the size of the ‘gap’ between current and future desired food systems might change as multi-stakeholder dialogues progress.

Comparison of Nordic food consumption to EAT-Lancet dietary targets

We begin with a comparison of current food consumption to the dietary targets proposed by the EAT-Lancet Commission. The EAT-Lancet dietary targets are detailed in Appendix 2 and described in detail in the EAT-Lancet Commission report.¹ To estimate current Nordic food consumption, we use data from national dietary surveys. To enable

comparison, we reaggregate the dietary survey data to align with the EAT-Lancet food groups. We also adjusted certain consumption estimates from cooked to raw/dry weight to enable comparison to the EAT-Lancet recommendations, which are based on raw/dry weight. For example, dietary survey data provide meat estimates in cooked (i.e. as consumed) values. To compare with the EAT-Lancet recommendation, given in raw weight without bones, we used published raw to cooked ratios to adjust the meat intake estimates of the dietary surveys. Details are provided in Appendix 2.

There are challenges with using dietary survey data for comparison to the EAT-Lancet targets. First, the level of resolution needed to reaggregate dietary survey data to the EAT-Lancet food categories was not always available. For example, estimating current Nordic consumption of legumes was particularly challenging, given that legumes were included in different food categories in each national dietary survey. In addition, the definition of ‘legumes’ differed across countries – some countries include nuts in this category, and others do not. As a result, our estimates should be interpreted as just that – based on the best available information.

Second, dietary survey data underestimates Nordic food consumption of some food categories (especially foods

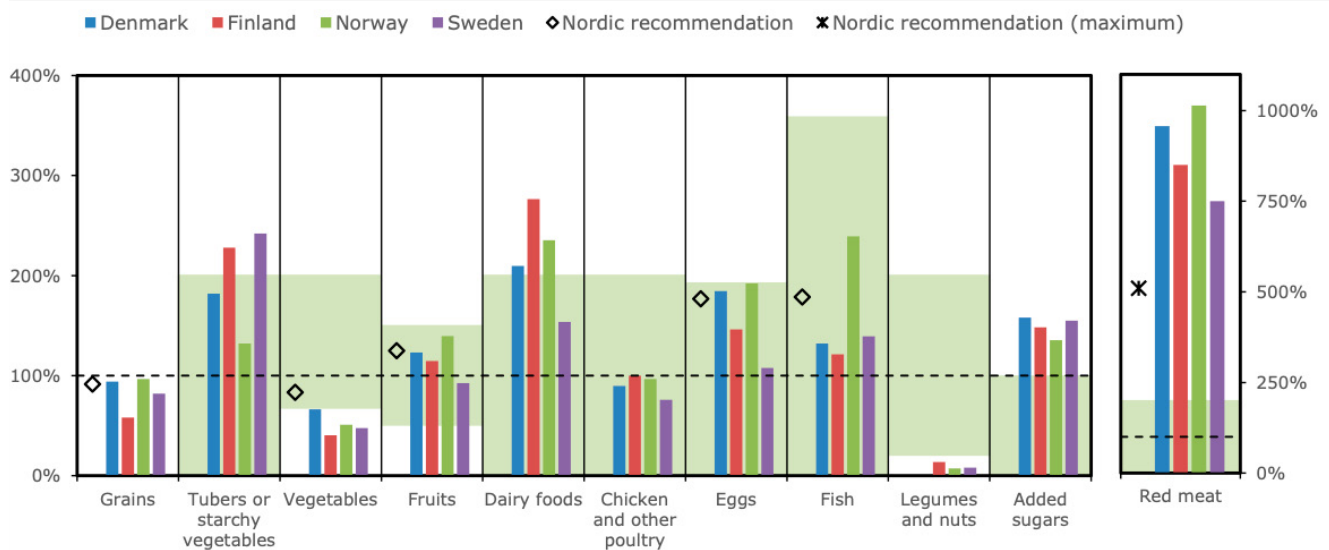


Figure 16. Comparison of the EAT-Lancet targets to current per-capita food consumption in each Nordic country and to Nordic dietary recommendations. Per-capita consumption is determined from dietary survey data. The dotted line at 100% indicates the EAT-Lancet dietary targets, and the green shaded areas represent the EAT-Lancet ranges. The Nordic dietary guidelines are indicated by a diamond, except for the red meat recommendation, which is a maximum (rather than average) recommendation.

considered unhealthy) and of total energy intake due to underreporting. For example, in the Danish, Norwegian and Swedish diet surveys, total energy intake was underreported by 20, 16 and 19 percent of participants.^{59,61,62} Therefore, in Appendix 2 we also present consumption estimates based on supply data from the FAO Food Balance Sheets. We applied standard conversion factors to these supply data,¹⁶² therefore accounting for household food waste and providing a second food consumption estimate.

Figure 16 illustrates how current Nordic diets (using dietary survey data) compare with the EAT-Lancet dietary

targets. This comparison illustrates that Nordic diets are meeting many dietary goals. However, there are several food groups where Nordic diets are above or below the dietary targets proposed by the EAT-Lancet Commission. Nordic populations should, on average, include at least one extra serving of vegetables (about 100 g) to their diets each day to reach the EAT-Lancet target of 300 g/day. Legumes and nuts could also feature much more in the typical Nordic diet – a ten-fold increase at population level would be needed to reach the EAT-Lancet target of 125 g/day. While Nordic populations’ intake of grains is within the recommended

Box 6. Nutrition and mortality analysis of shifts to Nordic dietary guidelines or to the EAT-Lancet healthy diet

Springmann and colleagues used a comparative risk assessment framework to model the reductions in premature mortality resulting from shifts to different dietary patterns in 2030.⁴⁶ The framework includes six dietary risk factors (reduced consumption of red meat, increased consumption of fish, legumes, nuts and seeds, fruits, vegetables), three weight-related risk factors (obesity, overweight, underweight) and five disease endpoints (coronary heart disease, stroke, type 2 diabetes mellitus, cancer, and an aggregate of other causes associated with changes in body weight).⁴² Springmann modelled shifts to Nordic dietary guidelines and to the EAT-Lancet dietary targets.¹⁶³ As shown in Figure 17 below, reductions in premature mortality in 2030 will result from dietary shifts to either the Nordic dietary guidelines or the EAT-Lancet targets. However, greater reductions in premature mortality will result from shifts to the EAT-Lancet healthy diet. In this scenario, the greatest reductions in premature mortality in 2030 would be attributed to reductions in obesity, increased nut and seed consumption, and increased vegetable intake.

Springmann also undertook a nutrient analysis to determine nutritional adequacy of dietary shifts.¹⁶³ The analysis showed that shifts to the EAT-Lancet healthy diet in the Nordic countries

would satisfy all nutrient requirements, except for iron in Finland and Norway, which were slightly below recommended levels (1% and 2% below recommended iron intake in Finland and Norway, respectively). However, this is a very small deviation from recommended intakes, and is significantly smaller than the deviation of business-as-usual diets to recommended iron intake (business-as-usual diets would be 36%, 43%, 37% and 46% below recommended intake in Denmark, Finland, Norway and Sweden, respectively). Additionally, protein intake in the Nordic countries (shifting to the EAT-Lancet healthy diet) is still well-above adequate intake levels (47–49% deviation), signalling that the reductions in meat needed to satisfy the EAT-Lancet healthy diet will not compromise adequate protein intake. Finally, saturated fat would be below recommended intake (9-22% below recommended intake) through shifts to the EAT-Lancet healthy diet, while saturated fat intake would be significantly above recommended levels (62% to 87% above recommended intake) if business-as-usual diets continue to 2030. Differences exist across the countries since current consumption patterns, which vary across countries, were used to model dietary shifts fulfilling the EAT-Lancet targets with the least deviation from current consumption patterns.

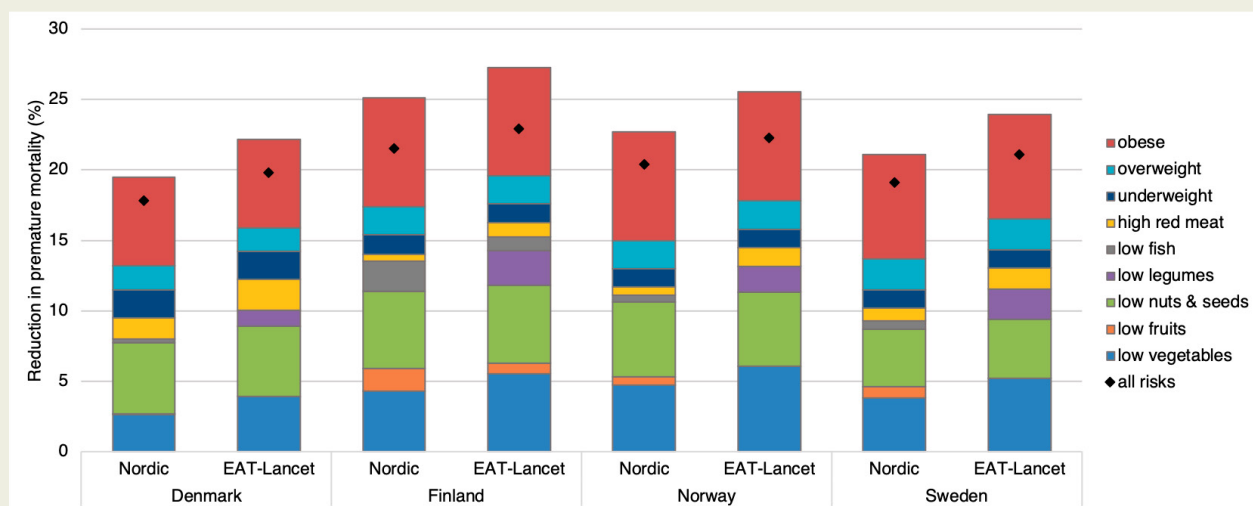


Figure 17. Reductions in premature mortality in 2030 from shifts to Nordic dietary recommendations (Nordic) or the EAT-Lancet dietary targets (EAT-Lancet).¹⁶³

EAT-*Lancet* range (0-60% of total daily energy), the EAT-*Lancet* emphasizes whole grains, whereas only a small portion of grains consumed in the Nordics are whole grain. Nordic populations are also consuming about nine times the amount of red meat (beef, lamb, pork) recommended for a healthy diet (EAT-*Lancet* target: 14 g/day), and four and a half times the upper EAT-*Lancet* recommendation of red meat for a healthy diet (28 g/day). Together, these findings suggest that Nordic populations as a whole need to increase the diversity of plant-based foods consumed, swap refined grains for whole grains and include more plant-based proteins while reducing red meat consumption.

Using the information presented in Appendix 2, we can also compare Nordic dietary guidelines with the EAT-*Lancet* Commission dietary targets. For ease of comparison, the Nordic guidelines used here were determined by using the dietary guidelines from Denmark, Finland, Norway and Sweden. On the whole, the national guidelines are consistent across countries. However, some country guidelines are more or less detailed than others (e.g. Finland is the only country with advice for egg consumption). Where at least one country provided advice for a particular food group, that value is used. Where advice on food groups differs across countries (e.g. fish intake), an average value is used. Where advice on food groups indicates a serving size but not a specific amount (in grams, mL, etc.), common serving sizes of those food items are used to determine an amount in grams. Development of 'Nordic dietary guidelines' enables comparison to the EAT-*Lancet* dietary targets, although it loses some country-specific detail.

There is overall alignment of national dietary guidelines across the Nordic countries with the EAT-*Lancet* dietary targets, but with several notable divergences. In all Nordic countries, the dietary guidelines recommend no more than 500 g of red meat each week*, or about 70 g per day – two and a half times the upper EAT-*Lancet* recommendation (28 g/day). Additionally, Finland and Norway suggest that up to 10% of total daily energy can come from added sugars, while the EAT-*Lancet* Commission recommends that no more than 5% of total daily energy comes from added sugar, or a maximum of 31 g of sugar each day. Note that Danish and Swedish dietary guidelines advise to reduce sugar intake, but do not specify a daily energy intake from added sugar. As previously mentioned, the EAT-*Lancet* targets provide more detailed guidance on specific food groups, such as legumes, tubers, eggs (NB Finland does provide advice for egg intake) or specific kinds of nuts or added fats. Box 6 presents the modelled health gains (in terms of reduction in premature mortality) resulting from shifts to either the Nordic dietary guidelines or the EAT-*Lancet* Commission dietary targets.

Comparison of Nordic food consumption impacts to environmental boundaries

Next, we compare the environmental impacts of Nordic food consumption to environmental boundaries that have been downscaled from the EAT-*Lancet* targets. We derive these downscaled boundaries using an “equal per capita” approach. This means the global target is divided by the global population, giving a per capita value for environmental impact of consumption. In other words, these per capita boundaries equally share the global allowance of impacts with every person of the global population. As noted in the previous section, this approach is one of several approaches that can be used to downscale the global targets to regional values. For example, this approach is based on the idea of sharing allowances of environmental impacts equally, but other approaches could for example account for regional variation in production conditions, traditions and habits.

The downscaled boundaries at per-capita and Nordic level are then compared to estimated environmental impacts of Nordic food consumption (at per-capita and Nordic level). As outlined in Box 4, a consumption-based approach to quantifying environmental impacts looks at everything eaten here in the Nordics – considering both domestically-produced and imported foods – and calculates the environmental impacts of these foods. Using consumption-based approaches, water and land used, emissions, and other environmental impacts resulting from e.g. potatoes grown in Sweden, fruits and vegetables produced in Spain or cattle farming in Latin America figure into this calculation. In other words, this approach looks at the global impact of Nordic consumption.

Table 3 presents the global EAT-*Lancet* targets in Row 3, which propose the global sum of environmental impact that can result from food systems. These values provide the basis for the downscaled per capita boundaries in Row 5 that were derived using the equal per capita approach. Numbers in Row 5 represent the average share of environmental impact that can be ‘consumed’ through a person’s diet each year. Row 6 presents the current environmental impacts per capita of food consumption in the Nordics. Therefore, the current environmental impacts in Row 6 can be compared to the boundaries in Row 5. Row 8 presents the boundaries scaled to the Nordic level. This means that the per capita boundary was multiplied by the Nordic population. Finally, Row 9 presents the current environmental impact of Nordic food consumption. Therefore, the impacts in Row 9 can be compared to the boundaries in Row 8.

Because the EAT-*Lancet* targets represent environmental impacts in the year 2050, two downscaled boundaries are given – one for 2015 and one for 2050 (Rows 5 and 8). This

* Note that 500g is the cooked weight. Nordic dietary guidelines note that this equates to about 600-750 g raw weight. However, the 500g maximum intake recommendation across the Nordics also includes processed meat or meat products, in addition to red meat. The EAT-*Lancet* recommendation is raw weight and for red meat only. Therefore, we have kept the Nordic recommended intake value at 500g for this comparison.

Environmental indicator	GHG emissions	Cropland use	Bluewater use	Nitrogen application	Phosphorus application	Biodiversity
EAT-Lancet global targets	(GtCO₂-eq per year)	(million km²)	(km³ per year)	(Tg N per year)	(Tg P per year)	(extinctions per million species-years)
Target (uncertainty range)	5 (4.7–5.4)	13 (11–15) (1.3 billion hectares)	2500 (1000–4000)	90 (65–90; 90–130)	8 (6–12; 8–16)	10 (1–80)
Per capita boundaries	(tCO₂-eq/yr)	(hectares)	(m³/yr)	(kg N/yr)	(kg P/yr)	
Boundary	0.69 (2015) 0.54 (2050)	0.18 (2015) 0.14 (2050)	340 (2015) 270 (2050)	12 (2015) 10 (2050)	1.1 (2015) 0.9 (2050)	More work needed
Current environmental impact	1.8 (1.7 – 1.9)	0.3–0.4*	97–118 ¹⁴⁶	Not known	Not known	Not known
Nordic boundaries	(MtCO₂-eq per year)	(million hectares)	(km³ per year)	(Tg N per year)	(Tg P per year)	
Boundary	18.0 (2015) 17.6 (2050)	4.7 (2015) 4.6 (2050)	9.0 (2015) 8.8 (2050)	0.32 (2015) 0.32 (2050)	0.03 (2015) 0.03 (2050)	More work needed
Current environmental impact	47 (44-50)	7.8 – 10.4*	2.5 – 3.1	Not known	Not known	Not known

Table 3. Row 3 presents the EAT-Lancet environmental targets for food systems. Row 5 presents the downscaled boundary derived using the equal per capita approach. In Rows 5 and 8, the top number provides a boundary based on the 2015 population, and the bottom number provides a boundary based on the 2050 population. Row 6 provides an estimate of current per-capita environmental impacts of Nordic diets. In Rows 6 and 9, values in parentheses indicate an uncertainty range. Row 8 presents the boundaries scaled to the Nordic population. Row 9 presents the environmental impacts of total Nordic food consumption. *Current cropland use estimate based on Rööös et al., 2015¹³⁸ for Sweden.

accounts for changes in population size (based on SSP2 projections).¹⁶⁴ The 2015 boundary gives a better estimation of how current food consumption compares to the environmental boundary. Yet given a projected growing global population, the per-capita boundary in 2050 will be smaller.

Table 3 illustrates that the Nordic countries consume nearly three times the GHG emissions as the downscaled climate boundary. In addition, cropland use needed to fuel the average Nordic diet is roughly double that of the downscaled land use boundary. It should be noted that the current per capita land use associated with Nordic food consumption was estimated from data in Sweden. As additional country-specific data is analysed, this estimate is subject to change. Finally, using coarse estimates, the comparison shows that bluewater associated with Nordic diets is below the downscaled boundary. More work is needed to compare nitrogen and phosphorous application and biodiversity loss associated with Nordic food consumption to downscaled boundaries. Again, the EAT-Lancet Commission did not set targets for chemical use in agriculture, but Box 7 presents a baseline estimate of chemical use attributed to Swedish food consumption.

The per-capita boundaries can be useful in communication to individual consumers, as they provide a

clear target to aim for and benchmark ones purchases against.* However, boundaries presented on a per-capita level may not be the most useful for policy makers, and they may put disproportionately large emphasis on ‘personal responsibility’ to reduce environmental impacts of consumption rather than signaling the need for systemic shifts to food supplies and food environments. An additional approach is to use a Nordic boundary (Row 8 of Table 3), calculated by multiplying the per capita boundary by the Nordic population. Similarly, national boundaries could be presented by multiplying the equal per capita boundary by the country population – these boundaries are presented in Appendix 3. These national boundaries could be easier for policy makers to compare national consumption impacts to.

There is a risk that the downscaled boundaries we present in Table 3 could be used to make comparisons that do not take into account a country’s distinct food system characteristics – particularly a country’s export or import orientation. Consumption and production-based approaches give different yet complementary measures of environmental impact, and to capture a complete ‘whole food system picture’ both are needed. For example, Denmark exports large quantities of its agricultural products. Therefore, production-based impacts are most likely higher than consumption-based impacts. Different boundaries to

* ICA supermarket provides a free service to calculate the climate impact of shoppers’ purchases (<https://www.ica.se/buffe/artikel/mitt-klimatmal-info/>). This tool could be used to roughly estimate annual climate impact (although foods purchased from other retailers, restaurants, etc. will not be included) and compare to the per-capita climate boundary.

Box 7. Chemical use associated with Nordic food consumption

Chemical use associated with food consumption includes the use of veterinary medicines (e.g. animal antibiotics) and pesticides (e.g. herbicides, fungicides and insecticides). In the Nordic countries, the use of antibiotics in livestock production is low in an international perspective. However, large amounts of meat are imported so that Nordic food consumption is associated with unsustainable use of antibiotics and concerns of widespread antimicrobial resistance.^{12,165} Similarly, the use of pesticides in agriculture raises concerns about water pollution, soil contamination and human toxicity.^{166,167} A recent study proposed the first 'planetary boundaries' for antibiotic and pesticide use and suggested that some of these boundaries might already be surpassed.¹⁶⁸ This indicates a possible health and agricultural crisis in the longer term.

It is beyond the scope of this report to investigate in detail the chemical use associated with Nordic food consumption

since we mirror the scope of the *EAT-Lancet* Commission report, which did not set global targets for chemical use in food systems. However, given the importance of these issues to food system health and sustainability goals, we present results from the PRINCE project,¹⁶⁹ which aims to monitor the impact of Swedish consumption on a number of environmental indicators, including chemical pollutants. Figure 18 below shows the per capita footprints from Swedish consumption of pesticide and veterinary medicine use. This figure illustrates that the majority of the pesticide and veterinary medicine footprint results from food grown outside of Sweden (i.e. imported foods). Compared to other EU-28 countries, the veterinary medicine footprint of Swedish consumption is among the lowest, while the pesticide footprint is higher, but still on the lower side of the EU average.¹⁷⁰

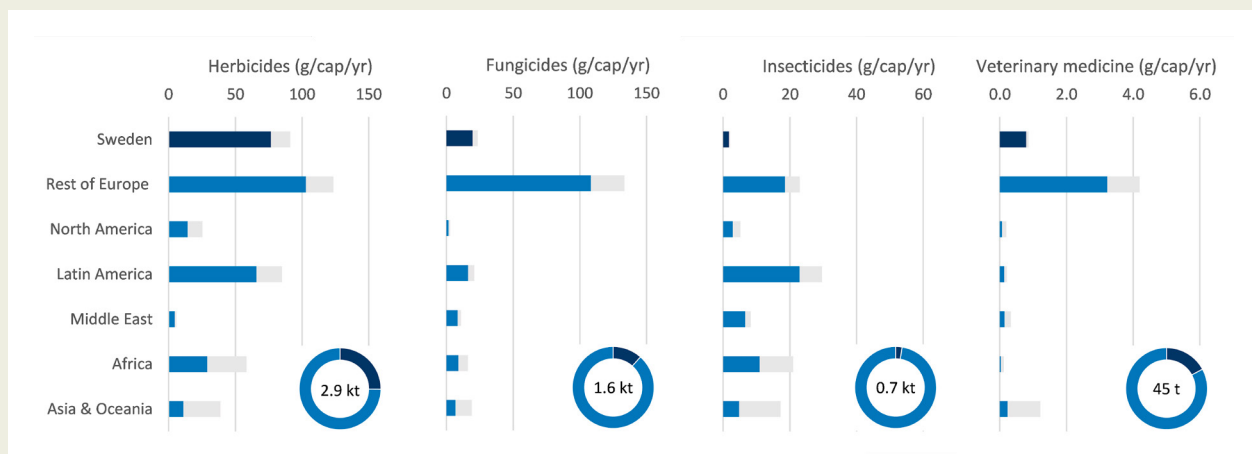


Figure 18. Per capita footprints for Swedish consumption of herbicides, fungicides, insecticides, veterinary medicine year 2013, divided by where the footprint occurs. Blue bars represent footprints for final consumption of food, while grey bars represent the full consumption footprint, covering all final consumption. Circle insets show the share of impacts originating from Swedish production (dark blue) versus imports (light blue). Reprinted from Cederberg et al., 2019¹⁷⁰ with permission from the authors.

compare against production- and consumption-based impacts could take into account the distinct characteristics of a country's food system. Therefore, while current Nordic food production impacts have been calculated in Table 2, we do not present a comparison of the equal per-capita boundaries to production-based impacts here, since other types of boundaries might enable a more appropriate comparison.

Boundaries could be developed against which Nordic food production impacts are compared. However, such boundaries require normative decisions to be made. Returning to the example of Denmark – given that Denmark exports large quantities of food, should that country be able to produce a larger 'share' of the global total environmental impact? Or, because Denmark, like other high-income countries, has historically produced more environmental impact than lower-income countries, should they be given a smaller 'share' of the global total environmental impact?

Science alone cannot determine the most appropriate way to downscale global targets for comparison to national or regional food system performance. Sustained, multi-sector dialogue is needed to tackle the normative decisions inherent in food systems change.

Given that there are several ways to develop boundaries for comparison to national level environmental impacts, our aim is not to set final Nordic boundaries for environmental damage of food consumption, but rather to indicate the scale of change needed based on one possible translation of global targets to the Nordic region scale. By doing so, we show that the overall direction of change is known – the environmental impact of Nordic food consumption needs to be greatly reduced. In the subsequent section we highlight immediate change opportunities supported by scientific analysis and also bring to light a number of barriers and challenges to closing the 'gap' between current and desired food systems.

Task 4: Act to transform Nordic food systems

A central message of this report is that there is enough evidence and assessment of Nordic food systems to begin transformation towards more desirable, healthy and environmentally sustainable systems. Our starting point is a leverage-point approach to action. As shown in Figure 19, intervention points closer to the fulcrum will in isolation have little potential to transform food systems from their current state, while the intervention points furthest from the fulcrum will have the most leverage to transform food systems (yet are the hardest changes to implement). Given the focus in Nordic countries on evidence-informed action, we expand the leverage point concept to include some indication of the scientific certainty of the different actions proposed.

The lower leverage intervention points can be activated with what we refer to as ‘no regrets’ actions. While the risk of negative unintended consequences is probably small, ‘no regrets’ actions are also not likely to be transformative in nature. These are the tested actions supported by scientific evaluation as creating a desirable change. These actions can

also have an indirect effect of changing consumer or political attitudes, which can be important for increasing the acceptance of intervening at other, deeper leverage points.¹⁷¹ However, by themselves, they do little to address systemic blockages or challenges within food systems.

The middle leverage actions are comprised of innovative actions. These actions might begin to change feedback loops and might begin to change the structures or incentives within a system.¹⁵ These are largely untested solutions to more complex challenges. There is perhaps no straightforward solution, or there is little scientific evidence to estimate the impact of an action. However, the existing body of research shows potential that this innovative action will work to move food systems towards the desired goals. The risk of unintended consequences is unclear.

The actions with the greatest potential leverage will be paradigm shifts. These actions represent issues where fundamental ideological differences have resulted in contentious problems. Triggering these leverage points will mean changing the underpinning values, goals and world

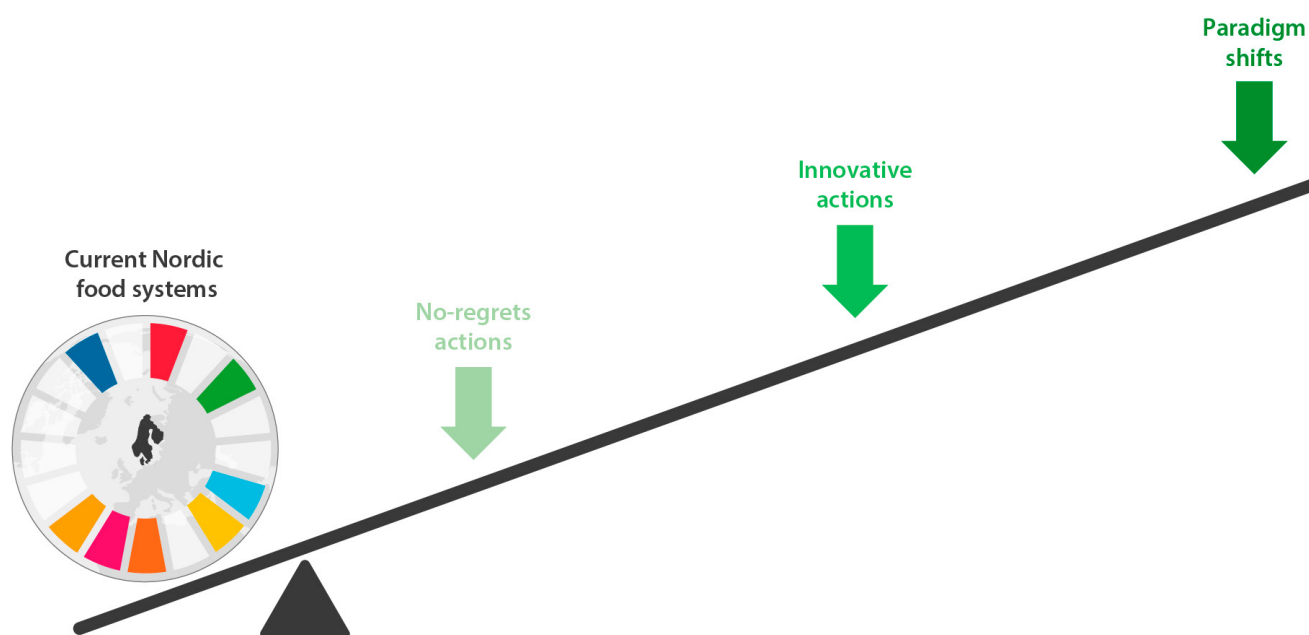


Figure 19. Three leverage points for food systems change. Adapted from Meadows 1999 and Leuphana University.^{15,16}

view of individuals¹⁵ – no easy feat. However, because these actions trigger fundamental rather than marginal changes, they have the greatest potential for transformative change.¹⁷¹

The aim of this section is not to provide a comprehensive list of leverage points. These can be identified through an iterative process between scientific assessment and stakeholder dialogue. While science can provide an indication of what has been more or less effective in driving food systems change to date, and can provide assessments of effectiveness of innovative solutions, stakeholders can provide insights into the opportunities afforded by context, e.g. leaders who can motivate change, innovations born out of the specific resources of the region, or connections across networks that can create a critical mass of change. Examples of each of the three tiers of leverage points are discussed below and in Box 8.

No-regrets action

The Nordic countries have already implemented many no-regrets actions,¹⁷² yet a wealth of additional no-regrets actions could be implemented.

The establishment of infrastructure to enable efficient data collection and information sharing is a no-regrets action. This could include public private partnerships to make *scanner data* available from retailers to more efficiently monitor changes in purchasing/sales patterns. This would require some level of aggregation to comply with data protection regulations, but could better facilitate assessment of interventions to shift dietary patterns. More *centralized, harmonized collection and reporting of dietary survey data and environmental impact data* could enable comparison

across Nordic countries. As this assessment illustrated, such harmonized data does not always exist. A *repository or database of interventions* – both successes and failures – would facilitate knowledge transfer between stakeholders, minimizing wasted resources through multiple implementations of a ‘failing’ intervention and accelerating change by building upon previous trials.

To encourage both production and consumption of healthy and sustainable diets, policies could *support Nordic businesses to develop new healthy and sustainable products* (e.g. a wider range of plant-based products). Similarly, *support could be given to primary producers* to encourage the shift or diversification of their production towards the inputs of healthy diets, and additional incentives could be given to adopt sustainable practices (i.e. production systems that help preserve semi-natural pasture and deliver other ecosystem services). Collaboration between producers and the agricultural boards in the respective Nordic countries could help identify the most appropriate measures. Additionally, a focus on development of new technologies and products could make primary food production a more attractive livelihood. Some of these measures already exist within the Nordic countries,²⁴ and so a ‘no regrets’ action would be expanding support structures for production and business development of healthy and sustainable foods.

Governments could set *national or even Nordic goals for healthy and sustainable food systems*. For example, the work of this assessment report to develop environmental boundaries could be expanded (e.g. the biodiversity boundary or chemical use boundary, which could not be developed in this report), and complementary boundaries to

Box 8. Healthy and sustainable dietary guidelines: one action – multiple leverage potentials

The Nordics are pioneers in the development of dietary guidance that incorporates environmental considerations – yet sustainability is only used to guide the types of foods selected (e.g. certified sustainable seafood) rather than the amount of food consumed. **Strengthening these guidelines so that the recommended intake values reflect both health and sustainability would be a no-regrets action.** This action would be based on a growing scientific literature on eating patterns that support health and environmental sustainability.¹ This action does not ‘disturb’ prevailing structures and values – the use of guidelines appeals to the narrative of personal responsibility by focusing on education rather than stronger interventions and aligns with the current drive to limit government intervention in choice.

Yet, guidelines can have little impact on actual consumption patterns unless they are supported by regulatory mechanisms. **An innovative action would be embedding healthy and sustainable eating guidelines into public food procurement, public meals programs, and food marketing through the use of**

regulatory measures. While still working within current regulatory structures, this would signal a move towards a narrative of collective effort – of individuals, governments, businesses and more – to support healthy and sustainable diets. This action would start to shift the design of the food system to favor those producers satisfying the healthy and sustainable criteria.

For the greatest leverage to change current food systems, the Nordics could also consider **a paradigm shift where healthy and sustainable diets are considered to be a public good.** This builds upon SDG2, emphasizing the universal right to food and the global challenge to eliminate hunger. However, as emphasized in the *EAT-Lancet* and many other reports, a healthy diet goes far beyond optimal caloric intake, and a ‘win-win’ diet must also support the wellbeing of the planet. The Nordics could use their strong social support system and focus on social equality to fulfil the right of every person in the Nordics to a healthy and sustainable diet.

compare to environmental impacts of domestic food production could be established. These boundaries would give all stakeholders a common goal to work towards. Without regulatory backing, these targets have limited potential to change the underlying structure or goals of food systems, but nonetheless may create positive feedback loops.

In terms of changing food environments, while the Nordic countries have existing restrictions on marketing to kids and monitoring systems for junk food marketing to kids,¹⁷³ the *existing marketing restrictions could be broadened* by, for example, including new media types like social media platforms. Further, some Nordic countries serve healthy meals in schools and limit the sale of junk food and sugary drinks,¹⁷⁴ yet all countries could ensure that the sale of these unhealthy products are eliminated in and around schools, publicly funded sports arenas, etc.

The *multi-sectoral partnerships for healthier, more nutritious diets* in Norway and Finland could be used as templates for similar collaborations in Denmark and Sweden, and broadened to address sustainable diets. While these voluntary public-private partnerships may not bring about transformational change,¹⁷⁵ publicly naming and ‘faming’¹⁷⁶ food business commitments can encourage reformulation or development of healthier foods on offer, and voluntary industry initiatives have been effective in for example reducing salt in food products.¹⁷⁷ Researchers have offered frameworks to strengthen voluntary industry commitments for salt reduction,¹⁷⁸ and Garnett and colleagues recommend that voluntary targets should be ambitious and clearly defined, with a robust monitoring system in place to measure effectiveness.¹⁷⁹

In the same vein of collaboration, Nordic cities and municipalities could be supported to join the growing ranks of *local food policy councils*. Bringing together the diverse representatives of their local area, these councils can develop holistic food strategies, such as those already developed in Malmö.¹⁸⁰ These councils could also support the development of co-designed future visions¹⁸¹ of their local food systems. Cities can share their ideas and be inspired by food policy councils around the world through membership to networks such as C40 Food System Network¹⁸² or the Milan Urban Food Policy Pact¹⁸³ (some Nordic cities are already members). The Nordic cities participating in the World Health Organization’s Healthy Cities Network¹⁸⁴ could also be involved, aligning health and sustainability goals to yield co-benefits.

Innovative actions

No country in the world has succeeded in developing food systems that are financially acceptable while good for both people and the planet. As such, the transformation needed to reach such desired systems will require innovative and untested action. These actions focus on changing the ‘rules’ and structures of the food system, or the design of a

system.¹⁷¹ The Nordic region has a heritage of innovative action – or thinking outside the box when it comes to tackling complex challenges. The Nordic policies on gender equality or parental support are testament to this. Because of the safety nets embedded into these societies, ‘failures’ can better be absorbed and turned into learning opportunities. We highlight several actions where the Nordics are well-placed to lead the innovation and monitoring of untested action.

The *food environment* in which an individual lives determines the availability of certain foods. Currently, based on food supply data (Appendix 2), there is an oversupply of some unhealthy foods. To tackle food consumption, food policies need to look beyond consumer-oriented interventions and nudges. The food system – in terms of alignment of food supply and food environments with healthy and sustainable diets – needs to be re-evaluated. Interventions to be explored include *taxes* (on sugar and climate impacting foods), *subsidies* on healthy and sustainable foods, *legislation on how unhealthy food can be exposed in stores or regulation on placement of fast food restaurants or on portion sizes*. While taxes and subsidies are typically referred to as shallow leverage points,¹⁵ here we view them as tools to significantly re-design the food environment. At the time of press, Statskontoret (the Swedish Agency for Public Management) was reviewing the evidence about the use of economic instruments and marketing restrictions to children relating to food, with the report due in mid-2019.

Concerted initiatives to decrease meat consumption could also be an innovative leverage point. We focus on meat (as opposed to all animal products), given that red meat consumption in particular is by far the furthest from EAT-Lancet recommendations. A Nordic meat consumption reduction goal, such as the one recently proposed in the Netherlands,¹⁸⁵ could provide a starting point. These goals could be strengthened through multi-sectoral collaboration on and investments in a ‘Less but Better Meat Initiative’ Action Plan, similar to the Organic Action Plans adopted in several Nordic countries. The action plan could outline what ‘better’ meat production is in terms of environmental sustainability and landscape management (i.e. production systems that help preserve semi-natural pasture and deliver other ecosystems services). To ensure a balanced diet, dietary guidance would need to be reviewed to ensure adequate nutrient intake. For example, a more explicit recommendation and nuts and legumes could be included in dietary guidance.

To increase policy coherence across governmental portfolios and advance an integrated food systems approach, the Nordics could *adopt a ‘food in all policies’ approach*, similar to the ‘health in all policies’ (HiAP) initiatives of Finland, Norway and Sweden.¹⁸⁶⁻¹⁸⁸ Similar to the HiAP approach,¹⁸⁹ the goal of a Food in All Policies approach would be to recognize that food systems are influenced by

most, if not all, sectors; to strengthen synergies across departmental mandates; and to systematically ensure that the food system implications of decisions are taken into account.

Paradigm shifts

Through the heritage of multi-stakeholder dialogue and tradition of cross-sectoral collaboration, the Nordic region is also well placed to set an example of how to cultivate paradigm shifts.

For sustainable, healthy, just and resilient food systems, the Nordics could *adopt a new narrative for Nordic food production*. The dominant narrative for development of the agricultural sector in the Nordics is an increase in production, yet as the previous section discussed, this can come at the expense of social and ecological wellbeing. A new narrative for the agricultural sector could emphasize quality and value over increased production. This narrative could emphasize the overall contribution of primary food production to social and ecological well-being, including the contributions that the food system make to public health and ecosystem services.

Redistributive policies that help smallholders in transitions are particularly important. Risk sharing with farmers investing in new developments would be crucial when transitioning to different production systems. Public procurement policies that work in favor of smallholders could also redistribute wealth and make the food system more resilient and sustainable.

Major changes to agricultural subsidies and policies, if achieved, could change the core structure and function of the food system. Particularly if subsidies for unsustainable practices should be ceased, and that money could be redirected, for example, to supporting transition of domestic agricultural systems to more sustainable systems. In the Nordics, this could include supporting the diversification of

products (mixed systems). We list this as a paradigm shift for two reasons. First, this requires a fundamental change in perception of what types of agriculture should be supported. Second, a systemic change to subsidy policy in the Nordic region will also require rewiring subsidy support at the EU level through the Common Agricultural Policy (CAP). The constraints and opportunities of the CAP to support the sustainable production of healthy foods should be further explored.¹⁹⁰⁻¹⁹²

As highlighted throughout this report, Nordic food systems are intimately connected with global food systems (and local food systems around the world). Nordic food systems rely on the inputs from food systems around the world, and the analysis in this report and of the PRINCE project¹⁷⁰ indicate that the countries of origin are incurring environmental impacts of this production. Greater transparency of global supply chains can be improved through continued assessments of products' full lifecycles. *Increasing the transparency of global food chains* and shifting to healthier and more sustainable supply chains would require collaboration of actors across the food system. At the same time, shifts in demand for healthy products from sustainable production methods points to the need to support smallholders in this transition. In particular, *aligning international development strategies to support healthy and food systems globally*, especially in low- and middle-income (LMIC) countries, is crucial for the long-term viability of global food systems and supports LMICs in achieving their sustainable development goals.¹⁹³

Barriers and challenges

In current food systems – and broader regulatory, health and business systems – there are barriers and challenges that stand in the way of the changes explored above. In this section, we bring to light an initial, uncomprehensive list of

Box 9. Strengthening existing strategies to adopt an integrated, whole food systems approach.

The Finnish National Food Strategy, “Huomisen ruoka”¹⁹⁵ released in 2010, and the updated government report on food policy, “Food 2030”⁸⁷ exemplify a food systems approach to food policy. From primary production to food culture, business competitiveness to public health, these approaches integrate the concerns and priorities of actors across the food system, working to ensure that the overarching goals address tensions among competing priorities. This provides a framework for thinking about how these food system ‘parts’ can work toward a common vision of Finnish food systems.

The Swedish National Food Strategy⁸⁶ adopted an integrated agenda focused on increased production to yield economic gains, employment activities and increased market opportunities. Environmental goals were raised, yet tensions

between increased production and decreased environmental impact were not highlighted. Health was not a prioritized goal of the strategy. Without this health focus, there is little consideration of what is produced, and if the foods produced will enhance the health of domestic and international populations.

These countries should be commended for taking this first step towards integrated food strategies. However, the key divergence in these strategies is taking a production-oriented perspective versus a whole food systems perspective. While there is room for improvement, the Nordics have shown that national food systems strategies that promote the range of social and environmental and health and economic goals can be developed.

the factors acting as barriers to Nordic food system transformation.

I. An integrated, ‘whole food systems’ approach is lacking

Analysis of policy strategies and action plans illustrates that the Nordics embrace critical assumptions necessary to implement boundaries for a safe operating space – namely, that food production should be environmentally sustainable and that diets should provide for health. No doubt the Nordics are exemplars of designing approaches that integrate these goals – e.g. integrated dietary guidelines or the Finnish Climate Programme for Finnish Agriculture.¹⁹⁴ Yet in many strategies – particularly production-focused strategies – the link between production and consumption is weak.

As discussed in Box 1, an integrated, whole food systems approach acknowledges that decisions made about agriculture, trade, processing, retail, waste management and more need to align toward common goals of ensuring public health, food security, natural resource management and more. A food systems perspective allows for linkages to be made all the way from the soils or seas where food is produced to the mouths of consumers, thereby integrating health, environmental, social and economic priorities.

Our analysis emphasizes that it is not merely the existence of integrated goals that is important, it matters that health *and* environmental *and* social *and* economic goals are part of this mix. In other words, *what* is integrated matters. Box 9 discusses two different examples of integrated strategies.

Only one takes a holistic food systems approach, while the other integrates a limited set of goals, undermining the ability of the strategy to guide development towards healthy and sustainable food systems.

II. Analysis of trade-offs among food system goals warrants attention

Many food system challenges span the entire food chain, and overcoming these challenges will require many different actors from across the food system to work together toward common solutions. However, these actors often hold a diverse range of interests, whether in the public or non-governmental sectors, and progressing solutions can often be stalled when prioritization of certain goals creates unacceptable trade-offs to certain actor groups.

Understanding the trade-offs that occur when certain goals are prioritized over others is needed to make informed decisions about the trajectory of food system transformations.

Analysis of Nordic policy strategies (dietary guidelines, food strategies and policies, meal strategies, sustainable production and consumption strategies, sustainable development plans, bio-economy strategies, waste and circular economy strategies) highlights some of these competing priorities with respect to food systems. Several dominant priorities include increased production (including increased production for export, and increased production of organic foods), economic growth, job creation, reduction of environmental impact and improvement of public health.

Box 10. Competing priorities relating to production and consumption of meat

Dietary guidance, production priorities, and trade: The Swedish National Food Agency has recommended a reduction in meat consumption to improve health and sustainability. However, the Swedish National Food Strategy states that ‘increased levels of livestock production nationally can lead to increased consumption of Swedish meat.’ The current amount of red meat available per capita in the Nordics is already above what is recommended to consume.¹⁹⁷ Revisiting trade priorities (e.g. limiting imported meat) could be one option to reconcile these priorities. Further, if it is recommended to dramatically reduce meat consumption (and therefore, production) at a global scale, then countries cannot continue to produce more meat for export. One argument is in support of continued Nordic meat production (e.g. the Nordics produce ‘better’ meat), yet the strengths and weaknesses of such an argument need to be critically explored.

Production structures, farmer livelihoods and environmental goals: On the production side, greening of agricultural production is prioritized in many Nordic strategies. This would require changes to production practices, yet many argue that farm-level changes in production (e.g. shifting what is produced

on farm, how it is produced, etc.) would negatively impact farmers and employment. However, OECD statistics¹⁹⁸⁻²⁰⁰ reveal that smallholders could be negatively impacted in the current system, given that the number of smallholder farms is decreasing most rapidly of all farm sizes across the Nordics. Changes in production (supported through appropriate mechanisms such as subsidies to support production transitions) might bring about benefits for smallholders rather than be their demise.

Self-sufficiency, trade, resilience, and more: Several government strategies⁸⁶ and scientific analysis¹⁹⁶ have underscored the imperative to increase self-sufficiency of the food supply (and agricultural inputs) in Nordic countries. Yield statistics indicate that it is in fact possible for Nordic countries to be mostly or completely self-sufficient in their food supply. Yet this would require major shifts in the types of foods produced – in particular, a reduction in meat production and feed crops and increased production of legumes, fruits and vegetables.⁷⁴ The self-sufficiency issue also brings into question goals in terms of integration or isolation from international markets, trade policy, resilience of food systems, and farmer livelihoods.

Self-sufficiency of food supply is highlighted in a number of strategies, as was encouraging local consumption of food. Engagement in international markets and shaping of international policy (particularly EU) is also emphasized.

Trade-offs will occur when some of these goals are prioritized over others. While certain trade-offs can be managed, there are other unavoidable trade-offs. For example, trade-offs could occur when deciding how to balance the desire for food self-sufficiency with the drive to produce specific products (e.g. livestock) for export. Increased self-sufficiency of the food supply and agricultural inputs could be desired to protect food security in times of unexpected crisis (e.g. global food shortages) or conflict,¹⁹⁶ while increased exports could be desired from an economic perspective. One reconciliation of these priorities is to increase production for both domestic and export markets. However, production increases without limit have unavoidable trade-offs with environmental impacts. Another example is the trade-off of efficiency versus resilience in the food system. A resilient food system requires some redundancy to be able to weather shocks and disturbances (such as the droughts across Sweden in over the summer of 2018), yet this can be seen as inefficient with a short-term perspective. A certain level of redundancy could be accepted by factoring in the long-term profitability of a resilient food system.

Box 10 highlights some of the competing priorities relating to meat production and consumption, highlighting areas where analysis of trade-offs is needed.

III. Prevailing forces and current lock-ins will need to be confronted

As illustrated in Figure 3, Nordic food systems are locked in to the current stable state where food systems fail to support healthy people and a healthy planet. Here we examine just two ‘attractors’ - or prevailing forces and lock-ins – to the current state that need to be confronted to move towards healthy and sustainable food systems.

Influence of food industry and retail: The food industries of Nordic countries are key sectors, representing the largest industrial sector in Norway, and the fourth largest industries in Sweden and Finland.²⁰¹⁻²⁰³ They provide many with livelihoods – over 180,000 individuals across the Nordics are supported through direct food industry employment.^{201,202,204,205} They are also important economic actors, with annual turnovers of 177 billion SEK, 187 billion DKK, 238 billion NKK and 10.8 billion EUR in Sweden, Denmark, Norway and Finland, respectively.^{201,202,204,205} As mentioned previously, these industries also have significant export values, varying by country.

Some Nordic and multi-national food companies are developing business strategies in line with health and sustainability goals.²⁰⁶ Yet many are working against these goals, with multi-national food companies representing a

major driver behind the global increase in some unhealthy foods such as sugar sweetened beverages and foods high in salt, sugar and fat.²⁰⁷ Their influence on politics is documented²⁰⁸ – sometimes leading to policy decisions contradicting the best available scientific evidence.²⁰⁹ Food advertising expenditures have been increasing, and it has been shown that such advertising influences eating patterns – particularly of children.²¹⁰

There have been recent calls by leading academics to work with food companies to improve nutrition and public health outcomes.¹⁷⁶ One approach has been the creation of ‘keystone actor’ dialogues.^{211,212} The logic underpinning this approach is that there is a small number of dominant actors – keystone actors – with disproportionate impact on way in which their sector is structured and functions. In the Nordic region, food retailers in particular serve as keystone actors. Retailers are a key interface between both consumers and suppliers/producers, driving consumer demand through pricing, marketing, product placement and offers, and driving supply in response to consumer preferences and trends. The top three retailers in each Nordic country control 82-96% of market share,²¹³ meaning this handful of companies has disproportionate influence on both food supply and demand. There is an opportunity to encourage Nordic retailers to take a leadership role in shaping food supply in line with health and environmental sustainability goals, which could have a cascading effect across the sector.

Changing consumer demand: Individuals, communities and cultures have developed deeply entrenched traditions around food. From coming together over fika in Sweden to preparing flaeskesteg (pork roast) for the Danish Christmas dinner, changing food habits faces a number of barriers. These include, but are not limited to, our innate biological preference for sweet and high-fat foods, cultural norms, price of foods, or even childhood exposure to certain foods.²¹⁴⁻²¹⁷

In many places, the narrative of ‘individual responsibility’ has taken hold in industry and political responses to the need for dietary change.^{218,219} In this narrative, onus falls on each individual to rationally make decisions in his or her own best interest, while largely ignored are the systemic drivers of choice (e.g. availability, accessibility, affordability). This narrative promotes the use of educational and informational campaigns as a tool to drive behavioral change, while critiquing government intervention (e.g. restrictions of junk food sales, taxes on unhealthy food items) as being nanny state and limiting choice of those individuals choosing to consume unhealthy foods in moderation.^{220,221} The rising prevalence of overweight and obesity suggests that governments must go beyond the personal responsibility narrative and build communities and cities where individuals are helped in their quest to choose healthy and sustainable diets.

It is clear that educational campaigns – in isolation from interventions subject to regulatory control – fail to produce

sustained, widespread changes to consumer demand.¹⁷⁹

Reviews of effective behavior change approaches illustrate that multi-faceted approaches incorporating regulatory, fiscal and voluntary interventions along with informational campaigns are needed to support shifts toward healthier eating habits.¹⁷⁹ Rather than viewing this composite approach as an attack on personal responsibility, this can be seen as a collective call for responsibility.²²² In other words, highlighting the role of all actors – governments, businesses, individuals – in enabling and making healthy and sustainable dietary choice.

In the Nordic region, there are many examples of educational campaigns to influence eating habits towards healthier (and more sustainable) diets. Discussed previously, each Nordic country has well-established dietary guidelines; schools in several Nordic countries take a pedagogical approach to mealtimes, teaching healthy habits from a young age;^{26,27} and initiatives such as the New Nordic Food movement are promoting healthier, more sustainable meal choices that reflect traditional foods from the region.²²³ Some regulatory measures to influence food choices have been introduced or trialed, such as taxes targeting foods high in sugar or saturated fat,^{224,225} yet the range of policy instruments²²⁶ is yet to be fully utilized in the Nordics to support behavior change. Coordination of such regulatory measures would be needed to minimize unintended consequences such as increased border sales of unhealthy foods.²²⁵

Conclusions and next steps

This report has presented an assessment of current Nordic food consumption, primary production and waste and has shed light on the processes and practices that shape these activities as well as the impacts of these activities on people and the planet. While there is work to be done to extend this assessment to include all parts of food systems (e.g. transport, processing, retail or food preparation), this report is, to our knowledge, the most comprehensive assessment of the health and sustainability of Nordic food systems to date. We present a first example of downscaling global food system targets to the Nordic scale in order to guide progress towards sustainable development goals.

As stressed by the Food and Agricultural Organization and the EAT-*Lancet* Commission, improvements to food systems are crucial to achieve the integrated goals of Agenda 2030. For example, Nordic food systems that provide and market safe, nutritious and environmentally sustainable diets progresses work on zero hunger (SDG2), good health and wellbeing (SDG3), quality education (SDG4), climate action (SDG13), and support life on land and below water (SDGs 14 and 15). When Nordic food systems support the livelihoods of its farmers, fishers and foresters, then employment (SDG8) and sustainable cities and communities (SDG11) are encouraged. If support is given to Nordic businesses to develop healthy and sustainable products, then industry, innovation and infrastructure (SDG9) will benefit.⁵⁰ And when the Nordic countries use their global influence to ensure that men and women around the world have equitable access to resources to grow and obtain food, the global community will be closer to delivering on its goals to reduce poverty (SDG1), promote gender equality (SDG5) and reduce inequalities (SDG 10). To achieve these co-benefits, strong and extensive partnerships are needed (SDG17).

Major effort will be needed by actors from all sectors and all levels of society in order to turn current food systems into desired future food systems that deliver on global commitments. There are no silver-bullet solutions, and a combination of different actions, jointly implemented across sectors, will be needed. Food system change will also require tough decisions, including acknowledging that there will be ‘winners’ and ‘losers’ of food system change. The solid economic and institutional foundations of Nordic countries, along with the underpinning societal values of equality, innovation and sustainable development for all position the Nordic region well to tackle the challenges of food systems change. Below we outline several opportunities for ‘next steps’ to progress the transformation towards healthy and sustainable Nordic food systems.

I. Initiate action to transform Nordic food systems

Our analysis demonstrates that there are sufficient data on Nordic food systems to understand the crucial action areas and to begin taking immediate steps towards food systems transformations. As highlighted throughout the report, action is already underway on many fronts to enhance food systems’ potential to support healthy, prosperous people and a sustainable, resilient planet. However, these actions must be joined up and ratcheted up, and new, bold action will be needed to reach desired food systems that help deliver on the Nordic’s commitment to global goals.

II. Build upon the heritage of stakeholder collaboration to initiate a multi-stakeholder scenario development process to define a common food vision for the Nordics

While a common vision for Nordic food systems may be difficult to achieve, the lack of such a vision would increase the risk of incoherent policies implemented across various sectors and government portfolios. Given the need for a shared, integrated vision of Nordic food systems,^{22,227,228} collaboration of food system actors will be crucial. The Nordic advantage is their strong preference for collaboration among relevant stakeholders, used widely from implementation of Nordic Council Initiatives to national level policy development. Buy-in for a common vision can be increased when stakeholders contribute to the creation of this vision and feel ownership of the decisions taken.²²⁹ It is particularly important to include stakeholders who are often marginalized in these types of collaborative decision-making processes.

In addition, collaboration, particularly between researchers and food system actors, can enhance the legitimacy, ownership and political palatability of science-based future visions of healthy and sustainable food systems.^{153,192,230} For example, scenario modelling is often used to ‘test’ the impact of future food systems on a range of health, social or environmental indicators.^{41,42,46} However, normative decisions are inherent in such modelling approaches. Collaboration between researchers and other food system actors could provide a democratic, inclusive and transparent process to inform the normative decisions inherent in scenario modelling.¹⁵³ Such participatory modelling collaborations have already been tested in the Nordic region,¹⁵³ and this method is being refined and promoted through global initiatives.²³¹

There are many existing political forums in the Nordics that could be used to cultivate such participatory food system dialogues. For example, the Nordic Working Group for Sustainable Consumption and Production could host dialogues about food systems. The Nordic Council Food Policy Lab has already taken an important step in highlighting consumer-oriented approaches to shift towards healthier and more sustainable diets.¹⁷² These approaches could now be connected to other food system policies (e.g. production, trade, processing) to ensure all political goals are pulling in the same direction. National forums – such as Sweden’s Livsmedelsforum or Denmark’s Madens Folkemøde – could also be used to drive and sustain stakeholder development of the safe operating space. The use of public sector conveners is in line with the prevailing Nordic ideology that governments have a role in steering society towards sustainable development. Yet, we emphasize the need to engage all food system actors in these dialogues, since a range of actors will be needed to work toward food systems that fall within the safe operating space.

III. Develop strategies to handle the trade-offs of change

As highlighted in Box 1, food systems are comprised of many interconnected parts. The linkages between and feedbacks among these various food system pieces are needed in order to design coherent food policies. Without a food systems approach, policies addressing different parts of the food system could undermine each other.²²

It is also important to consider these linkages because changes to one part of the food systems can create trade-offs among food policy priorities. For example, establishing targets (or boundaries) for meat production would create ‘winners’ (e.g. the Nordic community in progressing towards environmental goals) and ‘losers’ (e.g. farmers relying on livestock production). By better understanding these trade-offs, proper support for those who lose out can be established, such as financial support and training for farmers to shift toward more mixed production systems, support for farmers to produce added-value meat, or reorienting trade policy to limit imported meat and in turn, support consumption of meat produced in the Nordics. These supports would help minimize any net income loss.

IV. Evaluate Nordic food systems in a global context

Nordic food systems are reliant on the functioning of food systems around the world, and Nordic food systems need to be understood in the global context. As illustrated in this report, environmental impacts are borne around the world from Nordic consumption, and the health of individuals in the global community can be impacted by the foods exported from the Nordics. Care should be taken to ensure that spillover effects of Nordic food systems do not work against other countries’ ability to achieve the SDGs.

Additionally, as emphasized in the *EAT-Lancet* Commission report, all national food system transformations should work towards the same broad food system targets. Yet, there are many ways to determine ‘fair’ contributions of each country to improved health and environmental sustainability. In order to better assess Nordic food systems in the global context, Nordic researchers, policy makers, businesses and other food system actors can engage with international consortiums such as the Food, Agriculture, Biodiversity Land and Energy (FABLE) Consortium.²³¹ FABLE was created to establish a global overview of countries’ proposed pathways for healthy and sustainable food and land use systems. In particular, through state-of-the-art modelling tools, FABLE is able to aggregate and assess country contributions to meeting global goals and highlight the role of international trade in resolving or exacerbating unsustainable food and land use practices. In this way, Nordic countries can test and refine their ambitions towards global goals as responsible global citizens.

As food systems around the world become increasingly connected, the need to assess spillover effects is needed. For example, the ‘Task 1: Assessment’ section of this report demonstrated that greenhouse gas emissions, land use and blue water use associated with Nordic consumption often occur outside of the Nordic region. Other research initiatives, such as the Swedish PRINCE project, highlighted in Box 7, are further exploring the ‘outsourced’ impact of domestic food consumption. More work is needed to fully understand the impact of Nordic food systems on other countries’ ability to reach their health and environmental goals.

Acknowledgements

The authors would like to thank the reviewers who provided comments on the full draft – Pia Lindeskog, Gun Rudquist and Eeva Furman. We would also like to thank the many contributors who helped make this report possible – thanks to Ashkan Afshin, Fabrice DeClerck, Mattias Eriksson, Jennifer Hinton, Malin Jonell, Magnus Nyström, Kajsa Resare Sahlin, My Sellberg, Marco Springmann and Max Troell for their contributions to the content of the report. Thanks to the Livsmedelsverket team for their comments which improved the clarity of the terminology used in this report. Thanks to Victor Maus for helping with the data visualization of Figure 15. Thanks to Jerker Lokrantz of Azote for producing several figures in this report. Finally, we are grateful to Livsmedelsverket for requesting this report.

Funding statement

This research was produced through in-kind contributions from the authors. AW was funded at the start of this project by a Wellcome Trust grant administered by EAT and is now funded by the Marianne and Marcus Wallenberg Foundation grant, ‘Fundamental Research in Biosphere-based Sustainability Science – Strategic Research Collaboration and Postdoc Program between The Stockholm Resilience Centre, Stockholm University, and the Natural Capital Project, Stanford University’. LJG is funded through core support to Stockholm Resilience Centre. ER, JOK, and TR are funded by the Swedish University of Agricultural Sciences. TH is funded by the Formas project grant ‘Sustainable conditions for a circular and bio-based economy that operates within planetary boundaries.’ VB donated her departmental service to contribute to this research. LHS is funded by Albaeco. MB is funded by the ERC Consolidator Grant No 725525 (FINEPRINT). We appreciate the economic support from Livsmedelsverket to cover the publication and graphic design costs.

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Appendices

Appendix 1. Description of the method used to assess the outsourced environmental impact of Nordic food consumption

We use EXIOBASE v3.4 to calculate the domestic and foreign footprint of Nordic food consumption for the indicators of cropland use, blue water consumption and global warming potential (in CO₂ equivalents). A footprint includes direct and indirect resource input requirements or emission outputs along global supply chains. The carbon footprint (i.e. global warming potential) of Nordic food consumption thus includes all GHG emissions produced by actors (domestically and abroad) involved in the supply chains of food consumed in Nordic countries, i.e. emissions released at the farm, through transportation, in food

processing, trade and retail. Note that other environmental indicators, such as biodiversity or chemical use, are not included due to insufficient global data. Work is ongoing to expand the range of indicators included in IAMs.

Food is not only consumed at home, thus also the cropland and blue water footprint of food consumed in hotels and restaurants, as well as food provided by educational establishments and healthcare facilities are considered in the analysis. The carbon footprint of these distribution channels could not be included, because we could not isolate food related emission from other sectoral emissions in these cases.

Appendix 2. Detailed comparison of current Nordic food consumption with Nordic and EAT-Lancet healthy eating recommendations

Table 4. Comparison of global and Nordic dietary recommendations, Nordic consumption and Nordic food supply estimates.

Food group	EAT Lancet recommendation, g/day (healthy range)	Nordic recommendation*, g/day	Nordic consumption	
			Dietary survey data (g/day)**	Adjusted supply data (g/day)***
Grains/staple crops	232 (total grains 0-60% of energy)	Finland recommends 6-9 servings of cereals per day (approx. 170-252g/d), half of which should be whole grain. Other Nordic countries recommend 70-90g whole grains per day.	D: 218 F: 135 N: 224 S: 190	D: 275 F: 234 N: 249 S: 204
Tubers/starchy vegetables	50 (0-100)	Part of varied diet (no specific recommendation)	D: 91 ¹ F: 114 N: 66 ¹ S: 121	D: 139 F: 148 N: 123 S: 135
Vegetables	300 (200-600)	5-6 servings per day (500-600g)	D: 199 ² F: 121 N: 153 S: 143	D: 251 F: 193 N: 170 S: 215
Fruits and berries	200 (100-300)		D: 246 ³ F: 229 N: 279 S: 185	D: 255 F: 215 N: 310 S: 266
Dairy foods (whole milk or derivative equivalents) [†]	250 (0-500)	2-6 dL (approx. 200-600g) milk (low-fat) and about 25g of cheese per day	D: 524 ⁴ F: 691 N: 589 S: 385	D: 469 F: 714 N: 468 S: 558
Red meat (beef, lamb, pork)	14 (0-28)	No more than 500g red and processed meat per week	D: 134 [‡] F: 119 [‡] N: 142 [‡] S: 105 [‡]	D: 84 F: 88 N: 78 S: 100

Food group	EAT <i>Lancet</i> recommendation, g/day (healthy range)	Nordic recommendation*, g/day	Nordic consumption	
			Dietary survey data (g/day)**	Adjusted supply data (g/day)***
Chicken	29 (0-58)	No specific recommendation	D: 26‡ F: 29‡ N: 28‡ S: 22‡	D: 47 F: 36 N: 36 S: 30
Eggs	13 (0-25)	Most have no specific recommendation, Finland: 3-4 eggs/week	D: 24 F: 19 N: 25 S: 14	D: 37 F: 23 N: 28 S: 32
Fish	28 (0-100)	2-3 servings per week (200-450g), of which at least 200g is oily fish	D: 37‡ F: 34‡ N: 67‡ S: 39‡	D: 24 F: 35 N: 70 S: 40
Legumes	125 (25-225)	No specific recommendation	D: ND F: 17 N: 9 S: 10§	D: 22 F: 12 N: 29 S: 24
(of which 50g are tree nuts and peanuts)		Most have no specific recommendation, Finland: 30g per day	D: ND F: ND N: 72 S: 5	D: 19 F: 9 N: 16 S: 19
Added fats	51.8	Replace saturated fats with edible oils, liquid margarine and soft margarine	Insufficient data	Insufficient data
Added sugars	31 (0-31)	Less than 10% energy intake	D: 49 F: 46 N: 42 S: 48	D: 144 F: 83 N: 110 S: 107

D=Denmark, F=Finland, N=Norway, S=Sweden

* The Nordic recommendations were developed using the dietary guidelines from Denmark, Finland, Norway and Sweden. On the whole, the guidelines were consistent across countries. However, some national guidelines were more or less detailed than others (e.g. Finland was the only country with a recommendation for egg consumption). Where at least one country made a recommendation for a particular food group, that value was used. Where recommendations differed across countries (e.g. fish intake), an average value was used. Where recommendations indicated a serving size but not a specific amount (in grams, mL, etc.), common serving sizes of those food items were used to determine an amount in grams. This enabled comparison to the EAT-*Lancet* dietary targets.

** Data from dietary surveys in Denmark, Finland, Norway, and Sweden were re-aggregated to the extent possible into the EAT-*Lancet* food groups listed in column 1.

*** Food supply data for Denmark, Finland, Norway, and Sweden were taken from FAO's Food Balance Sheets. These estimates do not account for household food waste,²³² and standard conversion factors¹⁶² were applied so that the values presented for supply estimates could be more easily compared to the dietary survey data. There are some discrepancies between FAO data and national supply data.'

1) contains only potato and potato products, 2) includes legumes and nuts, 3) includes nuts, seeds and olives, 4) does not include butter

† To calculate milk equivalents for cheese, cream and butter, we used a 'total milk solids' method.

‡ Dietary survey data provide meat estimates in cooked (i.e. as consumed) values. To compare with the EAT-*Lancet* recommendation, given in raw weight, we used the following raw to cooked ratios to adjust the meat intake estimates – red meat: 0.74, poultry: 0.80, fish: 0.80. Distribution of beef, lamb and pork is based on consumption statistics in each country (StatBank Denmark, Statistisk sentralbyrå Norway, Luke Luonnonvarakeskus Finland and Jordbruksverket Sweden).

§ For legumes, dietary data in Sweden provided cooked intake estimates, while Norwegian dietary survey data provided dry intake estimates. To compare to the dry weight recommendation of the EAT-*Lancet* Commission, we used the dry to cooked ratio of 2.5 to adjust non-nut legume intake estimates.

ND – where current consumption was not available the corresponding cell is marked with "ND"

Appendix 3. EAT-Lancet environmental targets downscaled to country-level boundaries for Denmark, Finland, Norway and Sweden

	Climate Mt CO ₂ eq		Cropland million ha		Water km ³		Nitrogen Tg		Phosphorous Tg	
	2015	2050	2015	2050	2015	2050	2015	2050	2015	2050
Denmark	3.9	3.6	1.0	0.9	2.0	1.8	0.07	0.06	0.01	0.01
Finland	3.8	3.4	1.0	0.9	1.9	1.7	0.07	0.06	0.01	0.01
Norway	3.6	3.8	0.9	1.0	1.8	1.9	0.06	0.07	0.01	0.01
Sweden	6.7	6.8	1.8	1.8	3.4	3.4	0.12	0.12	0.01	0.01
Nordic	18.0	17.6	4.7	4.6	9.0	8.8	0.32	0.32	0.03	0.03

Table 5. EAT-Lancet environmental targets downscaled to country-level boundaries for Denmark, Finland, Norway and Sweden. Nordic boundary also listed. More work is needed to propose a biodiversity boundary. Discrepancy between sum of Nordic boundaries and Nordic boundary due to rounding.



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