

Health Council of the Netherlands

Guidelines for a healthy diet: the ecological perspective





To the State Secretary of Economic Affairs, Agriculture and Innovation

Subject : presentation of advisory report *Guidelines for a healthy diet: the ecological perspective*
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Dear Secretary of State,

On 29 April 2010 the then Minister of Agriculture, Nature and Food Quality asked the Health Council of the Netherlands to formulate qualitative guidelines for a diet that was both healthy and sustainable in terms of environment and biodiversity. I am delighted to present you with the present advisory report, *Guidelines for a healthy diet: the ecological perspective*. I shall also be sending this report today to the Minister for Health, Welfare and Sport.

In response to your request, a group of experts examined the extent to which a healthy diet is also an ecologically responsible one during a working conference. The Health Council's Standing Committee on Nutrition, its Standing Committee on Health and the environment, and its Standing Committee on Public health reviewed their findings.

As the findings of much of the research into ecological effects are subject to considerable uncertainties, the report emphasises those guidelines which have an unambiguously significant ecological effect. Its main conclusions are that a healthy diet has much in common with an ecologically responsible diet. Within the guidelines, by far the greatest ecological benefits are obtained by moving to a less animal-based, more plant-based diet. It is only the recommendation to eat two portions of fish per week which has a negative ecological impact.

Within the Dutch context, this report is eminently suited to the provision of consumer information on healthier and more eco-friendly food choices. The working conference found that priority should be given to analyses and measures at the European and global

P.O.Box 16052
NL-2500 BB The Hague
Telephone +31 (70) 340 70 18
Telefax +31 (70) 340 75 23
E-mail: rianne.weggemans@gr.nl

Visiting Address
Parnassusplein 5
NL-2511 VX The Hague
The Netherlands
www.healthcouncil.nl

Gezondheidsraad

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Page : 2

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level, because Dutch food production is strongly internationally oriented and it is measures at this level which can achieve the greatest effect. The Council therefore recommends that broad European support be sought in the development of guidelines for a healthy and eco-friendly diet. This also means that Dutch efforts are needed not just at the national, but also and particularly at the European level, if the supply of ecologically responsible foods is to be expanded.

Yours sincerely,

(signed)

Professor D. Kromhout

Vice-President

P.O.Box 16052

NL-2500 BB The Hague

Telephone +31 (70) 340 70 18

Telefax +31 (70) 340 75 23

E-mail: rienne.weggemans@gr.nl

Visiting Address

Parnassusplein 5

NL-2511 VX The Hague

The Netherlands

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Guidelines for a healthy diet: the ecological perspective

to:

the State Secretary of Economic Affairs, Agriculture and Innovation

the Minister of Health, Welfare and Sport

No. 2011/08E, The Hague, June 21, 2011

The Health Council of the Netherlands, established in 1902, is an independent scientific advisory body. Its remit is “to advise the government and Parliament on the current level of knowledge with respect to public health issues and health (services) research...” (Section 22, Health Act).

The Health Council receives most requests for advice from the Ministers of Health, Welfare & Sport, Infrastructure & the Environment, Social Affairs & Employment, Economic Affairs, Agriculture & Innovation, and Education, Culture & Science. The Council can publish advisory reports on its own initiative. It usually does this in order to ask attention for developments or trends that are thought to be relevant to government policy.

Most Health Council reports are prepared by multidisciplinary committees of Dutch or, sometimes, foreign experts, appointed in a personal capacity. The reports are available to the public.



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Contents

Executive summary *11*

1 Introduction *17*

1.1 Background *17*

1.2 Request for advice and working methods *17*

1.3 Report structure *19*

2 Guidelines for a healthy diet and on food choice *21*

2.1 The 2006 Guidelines for a healthy diet *21*

2.2 Translating the Guidelines for a healthy diet into Food Based Dietary Guidelines *23*

2.3 Dietary factors in the risk of illness and death *25*

2.4 New scientific insights in connection with the Guidelines for a healthy diet *25*

3 Ecological aspects of diet *31*

3.1 Ecosystem functions *31*

3.2 Ecological indicators in relation to diet *33*

3.3 Methods for calculating ecological effects *34*

3.4 Research into the ecological effects of food production *36*

3.5 Research into the ecological effects of food chain activities *39*

3.6 The findings in a wider perspective *43*

3.7 Conclusion *44*

4	The Guidelines for a healthy diet and their ecological effect	45
4.1	Guidelines abroad	45
4.2	Win-win	46
4.3	At odds with ecological effects	48
4.4	Ecological benefits, no clear effect on human health	50
4.5	Conclusions	53

5	Conclusions and recommendations	55
5.1	Conclusions	55
5.2	Policy recommendations	56
5.3	Recommendations for food producers	58
5.4	Recommendations for further research	59

Literature 61

	Annexes	71
A	Request for advice	73
B	Conference participants	77
C	Summary of the international working conference on healthy and sustainable food	81

Executive summary

For many years the Health Council's Guidelines for a healthy diet have provided dietary advice for healthy nutrition. But to what extent is a healthy diet also a sustainable one? That is the subject of this advisory report. Emphasis will be placed on the ecological aspects of the rather wide-ranging concept of sustainability. The aim of the report is to support government in developing policy for a healthy and eco-friendly diet.

The indicators of ecological effects are strongly interrelated

Ecological effects are linked to essential ecosystem services such as the provision of food and fuel and climate regulation. Numerous indicators exist by which these effects can be measured. With regard to the effects of human diet, the choice of ecological indicators has generally little influence on the conclusions. This is because such ecological indicators as biodiversity, land use, greenhouse gas emissions, disturbances in the nitrogen and phosphate cycles, water use and soil quality are strongly interrelated. The principal cause of this interrelatedness is that in food provision the production of animal protein, in particular, has a heavy ecological impact.

The present advisory report describes the ecological effects of human diet in terms of land use, greenhouse gas emissions, and biodiversity, particularly with regard to marine biodiversity. While other aspects of sustainability such as animal welfare and fair trade are also important for sustainable development,

they are included in this report only to qualify certain conclusions and to illustrate the complexity of sustainability issues. The report is concerned with the ecological effects at European and global levels, because these effects determine the most important action points for measures designed to reduce the ecological impact of food production.

Uncertainties in the assessment of ecological effects permit only qualitative guidelines

There are many research methods for assessing the ecological effects of food production, dietary patterns, and food chains. The outcomes, however, are often associated with considerable statistical uncertainty. For instance, an estimation of the effects of milk production on greenhouse gas emissions showed a 26 % variation around the mean*. Meat production figures are probably associated with comparable levels of variation. The problem is that reports are seldom published on these uncertainties, which makes the actual outcomes difficult to interpret and compare. The analyses give an impression of the effects, rather than delivering hard evidence for them. These uncertainties mean that the current state of knowledge permits only qualitative rather than quantitative guidelines.

Methodological issues also mean that the international comparison of guidelines for eco-friendly food is problematic. To begin with, there are hardly any guidelines that combine health and ecological perspectives. Those that do exist employ different reporting methods, indicators, ecological effect scale levels, and research scope (attention being given to food alone, or widened to include related issues such as food cultivation methods and transport).

Win-win guidelines

Two 'win-win' guidelines, however, deliver both health benefits and ecological benefits in terms of land use and greenhouse gas emissions:

- a less animal-based and more plant-based diet, containing fewer meat and dairy products and more whole grain products, legumes, vegetables, fruit, and plant-derived meat substitutes. This dietary pattern is associated with a lowered risk of cardiovascular disease and also has a smaller ecological impact. From a health perspective it is not necessary to avoid meat and dairy products; nor does this appear to be necessary from an ecological perspective. There are also contra-indications for a diet containing no animal

* 'Variation around the mean' is defined as the standard deviation/mean * 1,96 * 100%.

products; in children, such a diet has been linked with a raised risk of growth retardation. From an ecological viewpoint, it is also important to note that a certain amount of grassland is suited only for grazing, and that waste material from the food production industry is used as food for pigs and chickens. A diet entirely devoid of animal products would mean that this capacity was unused. At the European level, an estimated 40-50 % of existing livestock can be fed using only natural grasslands and food industry waste products

- the reduction of energy intake for those with an excessive body weight, in particular by eating fewer non-basic foods, such as sugary drinks, sweets, cakes and snacks. A healthy body weight is associated with a reduced risk of diabetes, cardiovascular disease, and certain forms of cancer. Lower energy intakes also reduce the demand for foods, which lowers production and consequently reduces the ecological impact.

A health guideline with a detrimental ecological impact

A guideline which may yield health benefits but which may be ecologically detrimental, particularly to marine biodiversity:

- eat two fish portions a week, at least one portion of which is oily fish. Even though the indications are that a single portion of oily fish per week is enough to lower the risk of cardiovascular disease, this recommendation is ecologically detrimental because this level of fish consumption is higher than current levels in the Netherlands. From an ecological perspective it is advisable to emphasise the use of those fish species that are not currently being overfished or those which are being farmed in an environmentally-friendly way.

A guideline with ecological benefits and neutral health effects

A guideline which yields ecological benefits while having neutral health effects:

- reduce food waste. In the Netherlands, consumers throw away 8-16 % of the edible food they purchase.

Subjects still under discussion

A number of factors influencing the ecological impact of human food production and consumption habits remain the subject of debate:

- cultivation methods, transport, storage and preparation location are all factors contributing towards a food product's ecological impact. Many suppositions
-

are held about this impact, but the scientific evidence is somewhat equivocal. For instance, locally-produced food is not necessarily more eco-friendly than food produced at a distance, and products made in an environmentally-friendly way do not necessarily score higher in terms of land use and greenhouse gas emissions than do products made by conventional means, because of the lower yields per hectare of land. They do, however, generally score better on other sustainability dimensions such as animal welfare and landscape value. Finally, while the transport of fruit and vegetables by air is associated with large greenhouse gas emissions, only a small proportion of fruit and vegetables is transported in this way, so the contribution that this makes to the overall food-related emission of greenhouse gases is relatively small

- shifts in animal protein sources. Replacing beef with pork or chicken can yield ecological benefits in terms of land use and greenhouse gas emissions, but the consequences for human health are uncertain. This is because different meat products from one and the same animal can have very different nutritional values and therefore health effects. Moreover, the ecological benefits of a shift away from beef and towards pork or chicken do not necessarily run parallel with the effects on animal welfare, for instance.

A healthier, more eco-friendly diet requires a food policy

Qualitative guidelines serve to help consumers choose healthy and eco-friendly food. The government possesses a number of instruments to this end, from regulatory powers and nutritional information provision, to the promotion of a healthy, eco-friendly lifestyle through schools and agreements with the business community. Businesses also make their own contribution; ideally, a more eco-friendly production should become the standard.

It remains important to seek broad support for the development of European guidelines, given that earlier national initiatives from other countries for a healthy and eco-friendly diet have met opposition from commercial interests.

More research is needed into the further development of guidelines for a healthy and eco-friendly diet

The present report has found that the current state of knowledge about healthy and eco-friendly diet is marked by numerous lacunae. Without attempting an exhaustive list, the report outlines a number of possible research avenues. It is particularly important that we obtain a deeper understanding of eco-friendly diet

on which to base measures by which the environmental impact of food production and consumption can be reduced. The degree of uncertainty attached to these analyses deserves special attention; it must be made clear what consequences these uncertainties have for any conclusions on the ecological effects.

Other important avenues of research include alternatives for, and other sources of, animal proteins and fish oil fatty acids. Finally, the report advises that further research is carried out into the effectiveness and feasibility of sustainability logos and other strategies for encouraging consumers to choose healthy and sustainable foods.

Introduction

1.1 Background

The Ministry of Economic Affairs, Agriculture and Innovation and the Ministry of Health, Welfare and Sport are jointly responsible for Dutch policy on food safety, food quality, and food and health issues. The ultimate aim of this policy is to bring about healthier and more sustainable dietary patterns. In a memorandum on *Sustainable food* the then Minister of Agriculture, Nature and Food Quality said that she wished to entice consumers to make sustainable food choices by means of intensive information provision. The memorandum employs the term ‘sustainable’ to cover such aspects as land use, raw materials use, greenhouse gas emissions, and the use of water and energy, but also with regard to the reduction of food wastage and the improvement of human and animal welfare,¹ an approach referred to as ‘integral food quality’.²

1.2 Request for advice and working methods

On 29 April 2010 the Health Council received a request from the then Minister of Agriculture, Nature and Food Quality for advice on the relationship between healthy diet, environment, and biodiversity (Annex A). What is held to comprise a healthy diet is described in the Health Council’s *Guidelines for a healthy diet* published in 2006.³ The Minister’s request was to use these guidelines as a basis to derive qualitative guidelines for dietary choices that are both healthy and

sustainable in terms of environment and biodiversity (Annex A). She also asks in which direction scientific knowledge in this area should be developed in the coming years.

This advisory report is therefore directed towards the ecological aspects of sustainability in relation to diet. Other aspects of sustainability, such as fair trade, good working conditions and animal welfare are also important to sustainable development, but are mentioned in this report only in order to qualify certain conclusions and to illustrate the complexity of sustainability issues.

Definitions of sustainability

The most widely employed definition of sustainability is taken from the Brundtland report *Our Common Future*:

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.⁴

Sustainability is concerned with effects over several generations. These effects play out at different scale levels, from global to local, and that which is sustainable at the national level is not necessarily sustainable at the global level. It is also a multiple interpretation, because it concerns estimates of future needs and circumstances and covers questions of social, ecological and economic capital (in other words *people, planet, profit*).⁵⁻⁸ Ecological capital covers the entirety of natural resources: non-renewable (fossil fuels) and renewable raw material resources, environmental resources (clean water, clean air, space), and biodiversity.⁹

The present advisory report focuses on the two Ministerial questions:

Question 1: Taking the Guidelines for a healthy diet as a starting point, provide qualitative guidelines for healthy and sustainable dietary choices. If possible, include a number of examples of operationalisation in the area of proteins.

Question 2: Along which lines should scientific knowledge in this area preferably be developed in the coming years at the national, European and international level?

To answer these questions, the Health Council secretariat first carried out a review of the literature*. The Council also organised an international working conference on 'Healthy and sustainable diets', which took place on 25 November 2010. Annex B contains a list of the conference participants, and Annex C contains a summary of the conference itself.

The arguments put forward during the conference confirmed the findings of the literature review. The present report has adopted, in particular, their emphasis on the relevance of scale in performing analyses and adopting measures: the European and global scales should be prevalent. The local scale is important, certainly, but remains subordinate.

The draft advisory report was reviewed by three of the Health Council's standing committees: Nutrition, Health and environment, and Public health. Dr H. Westhoek and T. Rood of the Netherlands Environmental Assessment Agency were also consulted as external experts.

1.3 Report structure

Chapter 2 discusses the *Guidelines for a healthy diet 2006* and how these informed the Food Based Dietary Guidelines and the Wheel of Five. Chapter 3 looks at ecological food indicators within a broad framework: the interaction between ecosystem functions, human health, and the factors influencing them. How do (groups of) foods and food chain processes score on these indicators? Chapter 4 compares the Guidelines for a healthy diet with those for a diet having a low environmental impact. Finally, Chapter 5 provides conclusions and recommendations, particularly on subjects deserving further research.

* The selection of grey literature, such as reports and information from websites, was continuous between June 2010 and April 2011. The newsletter of the British *Food Climate Research Network* formed an important source of this information. The systematic literature research into systematic reviews and large-scale studies comprised all the literature in the databases held by PubMed/Medline, Dialog Web, and ISI Web of Knowledge/Web of Science up to and including 27 April 2011. The search algorithm used for the central question addressed by the report was: (nutrition policy OR nutrition ecology) AND (climate change OR sustainable development OR environmental impact OR organic farming). The filter of the database concerned was employed to identify systematic review articles.

Guidelines for a healthy diet and on food choice

This chapter reviews existing guidelines for healthy dietary and food choices, and describes the health benefits that may be expected to result from these choices. The chapter closes with a description of new scientific insights that are relevant to an ecological perspective on the Guidelines for a healthy diet.

2.1 The 2006 Guidelines for a healthy diet

In 2006 the Health Council of the Netherlands published its Guidelines for a healthy diet.³ These guidelines answer the question of what constitutes a good diet from a health perspective, with regard to an ostensibly healthy Dutch population from 12 months of age upwards. The guidelines are based on systematic research into the health effects of diet. For each of the guidelines, it is explicitly indicated whether the evidence for it is either convincing or plausible.

For people of normal weight, eight qualitative guidelines apply:

- ensure a varied diet
- take adequate daily physical activity
- eat plenty of fruit, vegetables and whole-grain cereal products every day
- regularly eat (oily) fish

- generally avoid products with a high level of saturated fatty acids and mono trans unsaturated fatty acids*
- avoid frequent consumption of foods or beverages that contain easily fermentable sugars and drinks that are high in alimentary acids
- limit intake of salt
- if alcohol is used, do so in moderation.

The qualitative guidelines have been translated into the following quantitative targets for adults whose body weight is desirable and stable:

- take at least 30 minutes moderate intensity physical activity – brisk walking, cycling, gardening, etc – at least five days a week, but preferably every day
- eat 150 to 200 grams of vegetables and 200 grams of fruit a day
- eat 30 to 40 grams a day of dietary fibre, especially from sources such as fruit, vegetables and whole-grain cereal products
- eat two portions of fish a week, at least one of which should be oily fish
- limit saturated fatty acid consumption to less than 10 per cent of energy intake and mono trans-fatty acid consumption to less than 1 per cent of energy intake
- limit consumption of foods and beverages that contain easily fermentable sugars and drinks that are high in food acids, to seven occasions a day (including main meals)
- limit consumption of table salt to 6 grams a day
- if alcohol is consumed at all, male intake should be limited to two Dutch units a day and female intake to one.

Alcohol consumption is inadvisable for the under-eighteens, and for pregnant women, women who are seeking to become pregnant and women who are breastfeeding.

The following additional guidelines apply to people with undesirable weight gain or overweight:

- take at least an hour's moderate intensity physical activity a day
- reduce energy intake, in particular by limiting:
 - consumption of high energy-dense foods, *i.e.* products that are high in saturated and mono trans unsaturated fatty acids and added sugars (empty calories)

* These fatty acids are associated with a raised risk of coronary heart disease, compared to cis-unsaturated fatty acids

- consumption of sugar-rich beverages
- portion sizes.

2.2 Translating the Guidelines for a healthy diet into Food Based Dietary Guidelines

The Guidelines for a healthy diet are principally concerned with the intake of nutrients and contain only a few recommendations on actual foods. Turning the Guidelines for a healthy diet into food guidelines therefore involves a translation. In the Netherlands this task is performed by the Nutrition Centre Foundation, which sets Food Based Dietary Guidelines and directs the associated public information campaigns.¹⁰ The Food Based Dietary Guidelines contain recommendations on overall dietary patterns and foods, and distinguish between basic and non-basic food products:

- in Dutch dietary patterns, basic food products are important for the provision of essential nutrients (vitamins, minerals, essential fatty acids and essential amino acids), dietary fibre, and water. It concerns the following groups: vegetables and fruit; bread, (breakfast) cereals, potatoes, rice, pasta and legumes; dairy products, meat and meat products, fish, egg and meat substitutes; fats and oils; drinks.
- non-basic food products make little or no contribution to nutrient supply; these include snacks, biscuits, sweets, and sauces and soups eaten as a starter or between meals.

The Food Based Dietary Guidelines describe different population groups' average needs for basic food products in order to obtain adequate amounts of almost all essential nutrients. For public information purposes, the Food Based Dietary Guidelines were then translated into the Wheel of Five (see text box).¹¹ This contains recommended intake levels for each of the five basic food product categories. Non-basic products are not included, because these are all regarded as 'extras'; readers are simply advised not to eat too much of them, in order to maintain a healthy weight.

The Food Based Dietary Guidelines apply to people eating an average Dutch diet. People with other dietary habits will sometimes have to make other choices in translating advice on a healthy diet into a healthier selection of food products. This applies, for instance, to vegetarians, vegans, immigrants choosing to eat the diet of their country of origin, and people with food allergies.¹⁰

The Wheel of Five rules on a balanced diet

The five rules indicate what a healthy diet needs by highlighting its most important aspects.

1 Eat a varied diet

No single food contains adequate amounts of all nutrients, so eating a varied diet ensures that you get all the nutrients you need. It also spreads the risk of ingesting any harmful substances.

2 Avoid overeating and be physically active

To stay a healthy weight, it is important to eat a varied and healthy diet with no excess calories and to get plenty of physical activity. A healthy body weight reduces the likelihood of chronic disease; overweight is linked to cardiovascular disease, diabetes and certain forms of cancer. Not overeating also means limiting salt and alcohol intake.

3 Less saturated fat

Limiting the intake of saturated fat reduces the likelihood of cardiovascular disease, but the body needs fat as a source of unsaturated fatty acids, vitamins A, D and E, and energy. So choose mostly unsaturated fats such as low-fat margarine, vegetable oils, and liquid frying and cooking fats. Eating fish twice a week (and oily fish at least once a week) is important, because of the healthy fish fatty acids.

4 Lots of vegetables, fruit and bread

A healthy diet contains plenty of vegetables, fruit and bread, because these are fibrous foods which, for their weight and volume, contain many nutrients and few calories. It is therefore hard to eat too much of them. This is important for people keeping an eye on their weight. Moreover, eating lots of fruit and vegetables reduces the risk of chronic disease.

5 Safe

Food can also harbour unhealthy substances and bacteria. While today's food has never been safer, there is no such thing as 100 % safety. At home, consumers are responsible for their own food safety. Taking a few simple measures can reduce or remove the risk of food infection and consequent illness, such as food poisoning.

2.3 Dietary factors in the risk of illness and death

The observance of individual dietary recommendations yields considerable health benefits. The National Institute for Public Health and the Environment has calculated the effect of a number of interventions it considered realistic, such as eating less saturated and mono trans unsaturated fatty acids, eating more fish, fruit and vegetables, and preventing overweight and obesity. In combination, the five dietary interventions will lead to over 20,000 fewer annual cases of cardiovascular disease. According to these calculations, the greatest benefits are obtained from the increased consumption of fish and fruit. A healthier body weight also means almost 5,000 fewer annual cases of diabetes and 4,000 fewer annual cases of cardiovascular disease.¹² The total health benefits of a healthier body weight may be even greater, because overweight and obesity are also linked to higher rates of several forms of cancer.¹³ It has also been calculated that if the entire population of the Netherlands followed the recommendations for a healthy diet, there would be 7,000 fewer deaths per year.¹⁴ These calculations have also been performed in other countries, with comparable results.^{15,16}

2.4 New scientific insights in connection with the Guidelines for a healthy diet

In the years ahead the Health Council will continue to screen the Guidelines for a healthy diet in the light of the latest scientific developments. Some of these developments would appear to be relevant from an ecological perspective, and have been considered in the present report, taking into account the conclusions of a scientific background report into the latest American guidelines for a healthy diet, published in 2010.¹⁷

2.4.1 *Shifting towards a less animal-based, more plant-based diet*

One of the recommendations in the scientific background report to the American guidelines for a healthy diet is a shift towards a less animal-based and more plant-based diet, which is characterised by a high fibre intake and a low intake of saturated fatty acids.¹⁷ An example of a more plant-based diet is the traditional Mediterranean diet. Prospective cohort studies have shown that this diet is associated with a lowered risk of premature death and with a lowered risk of cardiovascular disease, cancer, and neurodegenerative diseases such as Parkinson's disease and Alzheimer's.^{18,19} Incidentally, these recommendations

from the scientific background report are not explicitly mentioned in the public version of the American guidelines for a healthy diet.^{17,20} The public version does, however, state that a healthy diet contains less red meat and processed meat, and more fish and low-fat or no-fat milk products, than does the current American diet.²⁰

The public version also contains examples of healthy vegetarian and vegan diets.²⁰ It cannot, however, be stated with certainty whether a vegetarian diet leads to a greater fall in the risk of disease than simply increasing the intake of plant-based foods within an omnivorous diet.²¹ It is known, however, that in young children a vegan (macrobiotic) diet is linked to a raised risk of growth retardation.^{22,23}

The quality of animal protein is higher than that of vegetable protein; it contains more of the essential amino acid lysine* than does vegetable protein.²⁴ Replacing meat and dairy products with vegetable protein sources raises the body's need for protein**. However, because the current average intake of protein is considerably higher than the recommended amount, there is no cause for concern that people who choose to eat fewer meat and dairy products will ingest inadequate amounts of protein.²⁴⁻²⁶ It is also possible to compensate for a lower protein quality by regularly eating legumes which contain relatively large amounts of lysine.²⁷

Meat and dairy products are not only important sources of protein, but also of vitamins and minerals; for instance, red meat contains iron and zinc, and dairy produce contains calcium, vitamin B₁₂ and riboflavin. Whether a lower intake of meat and dairy products leads to a lower intake of these micronutrients depends on which products take their place. Legumes, for instance, are naturally rich in a variety of micronutrients, and meat substitutes and soya milk are often enriched with the most important micronutrients found in meat and dairy products, respectively. It is, incidentally, unclear what the health effects of a lower intake of these micronutrients would be, as this would depend both on the total intake and on the requirement.²⁸⁻³⁰

* 'Essential amino acids' are amino acids that the human body cannot synthesise for itself.
** The recommended protein intake is about 50 g per day for adult women and about 60 g per day for adult men. Vegetarians need 1.2 times as much protein and vegans 1.3 times as much as people with omnivorous eating habits.²⁴

2.4.2 *Dietary habits versus foods and nutrients*

The *2006 Guidelines for a healthy diet* had already drawn the conclusion that in the prevention of food-related chronic illness, it was more important to focus on the overall dietary pattern than on individual foods or their constituents:

If a diet is rich in vegetables, fruit, wholegrain cereal products and vegetable oils, regularly includes fish and low-fat dairy products, contains meat products, and includes few foods having a high energy density and low nutrient density, then this – in combination with adequate physical activity, limited alcohol intake and not smoking – will contribute most towards reducing the risk of chronic illness.³

Mozaffarian & Ludwig³¹ draw this conclusion wider still, and argue that Guidelines for a healthy diet and Food Based Dietary Guidelines should give more emphasis to foods and eating habits and less to nutrients. In their view, the current focus on nutrients has led to confusion and has stimulated the supply and consumption of strongly processed foods, such as refined cereal products and sweet drinks to which micronutrients have been added in order to make them appear nutritious.³¹

2.4.3 *Fish and n-3 fatty acids*

The *2006 Guidelines for a healthy diet* recommend eating two portions of fish a week, at least one of which should be oily fish, to reduce the risk of cardiovascular disease.³ Given the high protein intake and relatively low consumption of fish in the Netherlands, fish plays almost no meaningful role as a source of protein in this country. For example, on average, 2 % of protein consumption in young adults is derived from fish.²⁶

The relationship between fish consumption and the risk of cardiovascular disease does not appear to be linear. The greatest protective effect appears to be achieved when someone who normally eats no fish, eats at least one portion of fish per week.³ The effects of fish consumption on the risk of coronary heart disease is consistent between prospective studies.³²⁻³⁴ According to the *2006 Guidelines for a healthy diet*, the protective effect of fish consumption should probably be ascribed to the long-chain, n-3 fatty acids found in fish.³ Whether this is actually the case cannot be stated with certainty.³⁵⁻³⁹

On the basis of the findings of both prospective cohort studies and intervention studies, researchers have estimated that eating one to two portions of fish per week (yielding about 250mg of fish oil fatty acids) reduces the risk of

coronary heart death by 36 %.⁴⁰ The evaluation of the fish recommendation would therefore appear to turn on the question of whether a single portion of oily fish per week (yielding 250mg of fish oil fatty acids per week) is enough to reduce the risk of cardiovascular disease.⁴⁰

The relationship between n-3 fatty acids derived from plants, alpha-linolenic acid, and the risk of cardiovascular disease is less clear than for n-3 fatty acids derived from fish.^{3,41} Observational research has found only indications for a protective effect against non-fatal myocardial infarct (heart attacks), but not against other cardiovascular disorders. Short-term intervention studies have found inconsistent effects on outcomes linked to the risk of cardiovascular disease.⁴¹ A recently published randomised controlled longer-term intervention study into the risk of cardiovascular disease showed that no significant reduction of this risk was associated with a daily intake of 2g alpha-linolenic acid.³⁷

2.4.4 *Limiting consumption of red and processed meat*

Since 2006 a number of bodies have published recommendations to limit the consumption of red and processed meat* in connection with the risk of colorectal cancer.¹³ However, this relationship is based on observational research, which means that it is uncertain whether the link is causal.²⁸ The same applies to more recent cohort studies, which found a link between the consumption of red and processed meat and the risk of death in general and cancer and cardiovascular disease in particular.^{42,43} The World Cancer Research Fund nevertheless recommends those accustomed to eating red meat to limit their consumption of red meat to 500 g per week and to eat as little processed meat as possible. At the population level, the aim is to achieve an average consumption of 300 g of red meat per week.¹³ In Great Britain the Scientific Advisory Committee on Nutrition recommends that as a precautionary measure, although the evidence is not convincing, the consumption of red and processed meat be limited to the current average intake of 70 g per day. Those who ordinarily eat 90 g per day or more are advised to cut this down.²⁸

At the time of writing of the present report, Dutch food consumption surveys had details of meat consumption in general, but none on the proportion of red and processed meat in particular. In 2003 young adult men in the Netherlands consumed 142 g of meat per day and women ate 98 g per day.²⁶ The total amount of meat eaten by Dutch participants in the European Prospective Investigation

* The term 'processed' meat refers to meat products which have been smoked, salted, or otherwise conserved, for example using preservatives.

into Cancer and Nutrition is of the same order of magnitude; this study did distinguish between different types of meat. Men ate 64 g of red meat and 72 g of processed meat per day, while women ate 41 g of red meat and 38 g of processed meat per day.⁴⁴ Both the average consumption of red meat at the population level and the combined intake of red and processed meat exceeded the norms set by the World Cancer Research Fund and the British Scientific Advisory Committee on Nutrition.^{13,28} The significance of this fact for questions of health is uncertain.⁴⁵

2.4.5 Conclusion

In the years ahead the Health Council will be evaluating the 2006 *Guidelines for a healthy diet*. A number of the themes under review also have ecological relevance; this applies, for instance, to the finding that a less animal-based and more plant-based diet is linked to a reduced risk of cardiovascular disease and other health disorders. There are also indications that eating fish once a week may be enough to reduce the risk of cardiovascular disease. Finally, there may be a relationship between the consumption of red and processed meat and the risk of colorectal cancer, although the evidence for this is weak.

Ecological aspects of diet

This chapter examines the extent to which the ecological effects of human diet can be measured. Which indicators and methods are available? It then looks at research into the ecological impact of food production and discusses the ecological impact of cultivation methods, transport, storage and waste. Finally, these findings are placed in a broader context.

3.1 Ecosystem functions

We are entirely dependent on the Earth's ecosystems and the functions that these ecosystems possess. Figure 1 gives an impression of the many complex linkages and interactions involved. In the last sixty years we have altered these ecosystems more quickly and on a larger scale than ever before. This is largely the result of our growing need for space, food, fresh water, wood, fibre and fuel, caused both by human population growth and by rising needs per head of the population. Although these ecosystem changes have led to a net profit in terms of human welfare and economic development, this has been at the expense of other ecosystem functions.⁴⁶ The world population is expected to grow from today's 7 billion to 9 billion by 2050, and animal protein consumption and fuel use, particularly in expanding economies, will continue to grow. If no measures are taken, the loss of biodiversity is set to grow; land use, the disruption of phosphate, nitrogen and carbon cycles, greenhouse gas emissions, and water requirements will all rise; and soil and water quality will be put under growing

pressure. These may well lead to the further disruption of ecosystem functions.⁴⁶⁻⁵² The scale of this disruption is uncertain, because it will also depend on the countermeasures taken and on unpredictable economic developments. There are also large statistical uncertainties with regard to the consequences of a wide range of environmental measures to tackle global biodiversity loss.⁴⁹

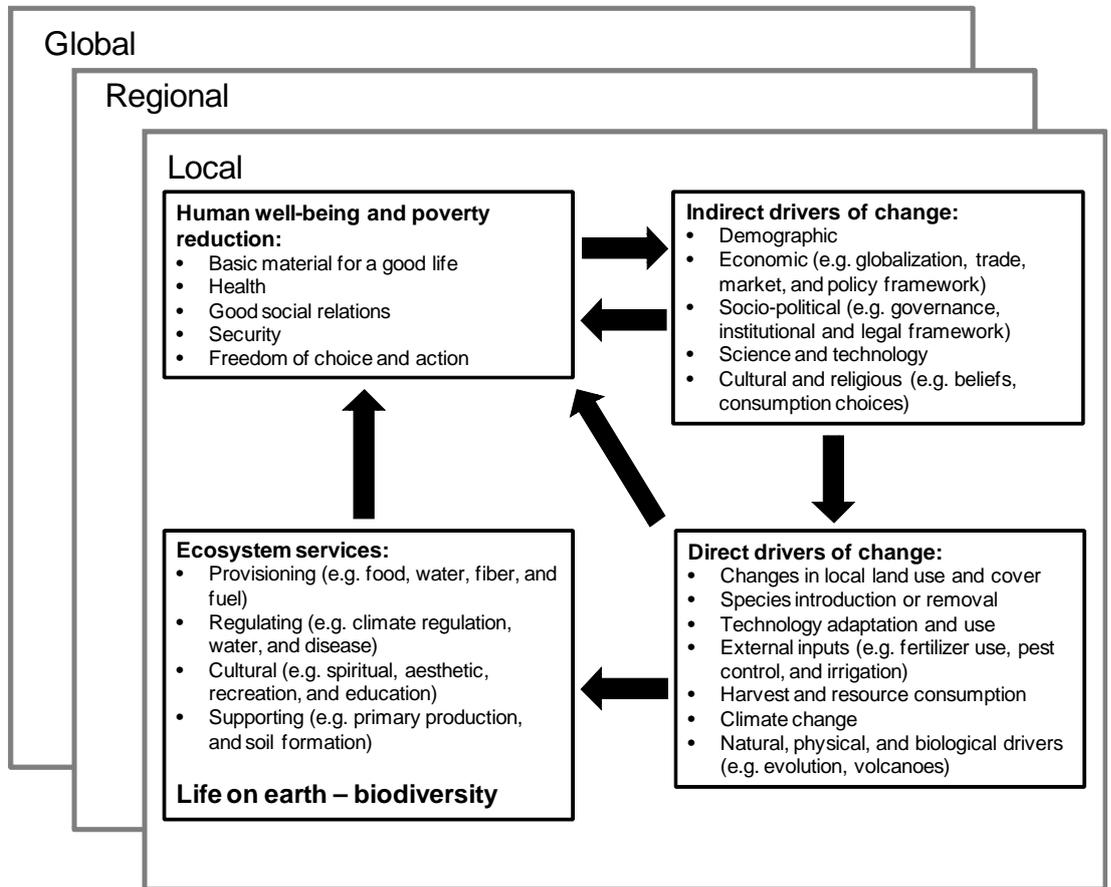


Figure 1 Conceptual framework for interactions between biodiversity, ecosystem functions, human welfare and factors directly or indirectly influencing ecosystem functions. With permission from the World Resources Institute, reproduced from the Millennium Ecosystem Assessment 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, D.C.⁴⁶

3.2 Ecological indicators in relation to diet

There exist a great many ecological indicators. An ‘indicator’ is generally a quantitative measure which can be used to illustrate or communicate about complex phenomena, for instance trends over time. For instance, the European Environment Agency employs indicators for air and the ozone layer, biodiversity, climate, soil, water and energy. Other indicators apply specifically to waste, agriculture, fisheries and transport.⁵³

3.2.1 Ecological indicators in relation to diet

Ecological indicators such as land use, greenhouse gas emissions, disturbances in nitrogen and phosphate cycles, biodiversity, water use and soil quality are closely interrelated.⁵⁴⁻⁵⁶ This is chiefly because within food production, the production of animal protein, in particular, has a large ecological impact.^{56,57} Because of this interrelatedness, the selection of indicators makes little difference to the conclusions at supranational level; this was also confirmed during the working conference (Annex C).

The influence of our diet on ecosystems has been examined by reference to only a small number of indicators. Most research has been carried out into the global effects on land use, greenhouse gas emissions, and energy use. The effects on biodiversity have been studied mostly indirectly, via the effects on land use. Less research is available into the direct effects of biodiversity, as is also the case for water use. Local indicators such as eutrophication, acidification, and ecotoxicity have been studied principally in relation to the use of fertilisers, manure surpluses, and crop protection chemicals, rather than in relation to food. Even less is known about the relationship between food and such indicators as water management, water storage, landscape value and nature value.^{51,58-64}

The present report employs land use and greenhouse gas emissions as ecological indicators. As the emission of greenhouse gases is also an indicator for energy use, energy use is not separately included in this report.^{65,66} In order to cover the ecological effects of fish consumption, marine biodiversity is taken as a third indicator in the analyses.

3.2.2 *Land use and the emission of greenhouse gases*

By land use* is meant principally the land needed for the production of food crops. Land use changes can influence the characteristics of the Earth's surface, with a potential impact on biodiversity and climate at local or global level.⁹

The emission of greenhouse gases concerns the emission of carbon dioxide (CO₂) produced through the use of fossil fuels, methane (CH₄) released through livestock breeding and the cultivation of certain crops such as rice, and nitrous oxides (NO_x) released from fertiliser and ploughed grassland**. Emissions are often expressed in CO₂ equivalents or in terms of the percentage of the total emission of greenhouse gases.^{65,66}

3.2.3 *Marine biodiversity*

With regard to the third indicator, marine biodiversity, a variety of measures are available. The studies to which this report refers have used the degree of fishing (moderately exploited, fully exploited, or overfished); the marine depletion index, an indicator of the average population size of fish and other species in seas and oceans compared to that in 1950; and the marine trophic index, a measure of the shift in fish catches away from carnivorous fish and towards fishes lower in the food chain.^{54,67-69}

3.3 **Methods for calculating ecological effects**

There are a variety of methods for calculating the ecological effects of foods, dietary patterns and food chains, while the outcomes are associated with the usual uncertainties.

3.3.1 *Methods*

The most frequently applied method for calculating ecological effects is the life cycle assessment. In this, an estimate is made of the effects on one or more ecological indicators over the whole, or a certain phase, of the life cycle of a

* Often expressed as m²/kg of product.

** Greenhouse gases differ in terms of their radiative forcing of the atmosphere (their potential to warm the Earth) compared to carbon dioxide. This is expressed in CO₂ equivalents. One kilo of methane is 25 kilo CO₂ equivalents and one kilo of nitrous oxide is 298 kilo CO₂ equivalents over a period of 100 years.⁶⁵

specific product.^{66,70,71} Another method is input-output analysis, which estimates the ecological influence of goods and services. The outcome is an estimate of the average ecological impact of a given product group.^{63,72} Many hybrid methods are in current use, in which the outcomes of an 'input-output' model are included in a life cycle analysis. A third method is the use of global equilibrium models, also called integrated assessments, in which the ecological effects are calculated of long-term developments in supply and demand, such as trade flows, demographic developments, crop yields and livestock feed.^{59,60}

3.3.2 *Uncertainties*

All these methods yield ecological effect estimates which are associated with a given uncertainty. For instance, an estimate of the effect of milk production on the emission of greenhouse gases was linked with a variation around the mean of 26 %*.⁷³ Meat production figures are probably associated with comparable levels of variation**.⁷⁴

These uncertainties are inherent to the complexity of agricultural systems: besides their main products, such as meat and dairy products, these systems also have by-products such as leather and gelatine; the product yield and ecological impact are strongly dependent on location, and can vary considerably between different production systems.^{57,66} Uncertainties in estimates are also caused by the lack of high-quality data with which to quantify the emission of greenhouse gases as a consequence of land use and land use changes. The large uncertainty surrounding the emission factors of different production systems also plays an important role.⁷⁵ The problem is that these uncertainties are only occasionally reported, and their consequences for the conclusions often under-illuminated.^{71,76}

Another source of uncertainty is that analyses often comprise a broad range of outcome types, such as acidification, eutrophication, and greenhouse gas emission, measures which are then sometimes integrated into a single outcome measure. This integration is debated, because it means that weighting factors are (implicitly or explicitly) attributed to the various effects. And even though many outcome measures are strongly correlated, when comparing two alternatives the effects do not always point in the same direction.⁷¹

Individual analyses therefore seldom form hard evidence, but give an impression of the possible ecological effects. The explanatory power of these

* 'Variation around the mean' is defined as the standard deviation/mean * 1.96 * 100.⁷³

** The report published by Blonk *et al.* describes how a methodological range of greenhouse effect scores for meat products is difficult to calculate and varies per meat type, but that a range of plus or minus 25% seems very probable. A definition of this range is absent.⁷⁴

findings rises as the number of different life cycle analyses and methods come to the same conclusion.⁶⁶ To obtain greater certainty about an estimate, in practice the outcomes of different life cycle analyses are compared rather than examining the variation of individual estimates.^{69,75-77}

3.4 Research into the ecological effects of food production

Agriculture has a profound ecological effect; it has been estimated that, worldwide, a third of all non-frozen land and three-quarters of all available fresh water is used for food production.⁷⁸ Examples of the ecological effects of food production include the loss of biodiversity, land use changes, soil resource exhaustion, the disruption of phosphate, nitrogen and carbon cycles, the emission of greenhouse gases, and the deterioration of soil and water quality.^{8,57,79} The production of meat and dairy produce has the largest food-related ecological impact, because of the inefficient nature of this production: on average, the production of a single kilo of meat protein requires six kilos of vegetable protein.^{56,80,81}

The effects of livestock farming on greenhouse gas emissions

Estimates exist at global, European and national level of the ecological effects of livestock farming. The current global contribution to these effects made by livestock farming is held to be 30 % for biodiversity loss, 10-18 % for climate change as a consequence of greenhouse gas emissions, and from 30 % to over 50 % for nitrogen fixation, which is linked to disturbances in the nitrogen cycle and eutrophication. A number of assumptions underlie these estimates.^{47,54,57,59,60} For instance, the estimate of the contribution made by livestock farming to greenhouse gas emissions depends on the supposed scale of the emission of nitrous oxide, which has in fact been adjusted at international level in recent years.⁵⁴

The contribution made by the European livestock industry to the total European emission of greenhouse gases has been estimated at 8-9 %.^{54,75} When greenhouse gas emissions as a result of (changes in) land use are considered, this rises to about 13 %.⁷⁵

In the Netherlands, the livestock industry accounts for 11 % of the country's total emission of greenhouse gases. These emissions in the Netherlands are higher than elsewhere in Europe, because the country has a relatively high number of livestock animals per hectare of land. These estimates take no account of land outside Europe that is used for the production of fodder intended for the European livestock industry.⁵⁴

3.4.1 Variation in ecological impact between different food groups

The ecological effects of different food product groups such as bread, potatoes, cereals, rice, pasta, legumes, vegetables, fruit and snacks are less pronounced and less unequivocal than are the effects of meat and dairy products. The fact that the effects are less pronounced is principally the result of their more efficient production. The fact that the effects are less unequivocal is partly because different studies show differences in underlying assumptions, the allocation of foods into product groups, the number of products taken into consideration, and the delineation of the production chain (see Tables 1 and 2).^{30,55,61-64,66,82-84} Tables 1 and 2 show a trend in which meat and dairy production together have a heavy ecological impact. With regard to the contribution to greenhouse gas emissions made by other food groups, the figures show more of a spread. Any statements on these differences are further hampered by the realisation that the estimates – as with milk and meat products – are themselves subject to considerable variation (as indicated by the 26 % variation mentioned in section 3.2).⁷³

Table 1 The contribution to total greenhouse gas emissions made by different food product groups (expressed as a percentage of all food groups combined).^{30,62,82,85}

Food product group	The Netherlands	Sweden	Great Britain
Meat, meat products and fish	28 %	35 %	38 %
Dairy	23 %	15 %	15 %
Bread, biscuits, cakes, and flour	13 %	10 %	5 %
Potatoes, fruit and vegetables	15 %	19 %	6 %
Fats and oils	3 %	4 %	10 %
Drinks and sweetened products	15 %	^a	20 %
Other foods	3 %	17 %	3 %

^a Falls into the category of ‘other foods’

Table 2 The contribution made by different food product groups to the emission of greenhouse gases in the Netherlands (in percentages), including the effects of packing, preparation, storage and washing.⁸⁴

Segment of the Wheel of Five	Greenhouse gas emissions (%)
Meat, fish, chicken, egg, meat substitute	34
Dairy	21
Bread, potatoes, cereals, rice, pasta, legumes	11
Fruit and vegetables	6
Fats, oils, savoury sauces	2
Drinks	9
Other: sweets, cakes, snacks	16

3.4.2 Variation in ecological impact within food groups

The effects of individual foods on land use and the emission of greenhouse gases vary within product groups, and in part they also vary per indicator employed (see frame). For instance, in the fruit and vegetables group a distinction can be drawn between products linked with low greenhouse gas emissions (seasonal, easily storable vegetables grown in the open air) and products linked with high greenhouse gas emissions (easily damaged products that are warmed and lit during growth, and then need to be cooled and quickly transported). However, the ecological benefits that can be obtained by choosing low-emission fruit and vegetables are considerably smaller than the benefits of reducing meat and dairy product use.^{66,86}

Double pyramid

The Italian report Double Pyramid ranks food products on the basis of their ecological impact, calculated with the help of life cycle analyses per product.⁸⁷ The resulting pyramid depicting the ecological impact of various products is placed alongside the food pyramid (a type of Wheel of Five), but no lateral links are drawn between the two. The report examines three indicators:

- the ecological footprint, a measure of the use of natural resources by a community
- the carbon footprint, a measure of the emission of greenhouse gases
- the water footprint, a measure of the amount of water used and how.

Red meat has the largest ecological footprint, followed by cheese. The footprint is smallest for vegetables, potatoes, bread and fruit. The same ranking also applies, in general terms, to the other two indicators. However, the ranking of other products in the food pyramid vary with the indicator employed.⁸⁷

In drawing up the final Italian guidelines, only the data on the ecological footprint was used. This data was the most comprehensive and it is also the indicator most amenable to communication. The European Commission has also recently advised that the use of this indicator should be encouraged.⁸⁷ The Double pyramid should be regarded as a first small step towards the provision of public information on sustainable food, partly because the guidelines are strongly oriented towards the Italian situation, and particularly towards foods that are prepared in a traditional manner.⁸⁷

3.4.3 *Uncertainties in and limitations to the available research data*

As we have already indicated, estimates of these ecological effects are associated with large uncertainties^{73,74} which frequently go unreported.^{30,55,61-64,82,83} So the question arises what the estimated differences between and within food product groups actually signify in practice.⁶⁶

Moreover, the analyses cited here contain no detailed information on exactly which activities within a product's life cycle are responsible for the greatest ecological impact. A British review comes to the conclusion that complete life cycle analyses, which include consumer behaviour and waste processing, exist only for a few processed and unprocessed foods. Most of the research is directed towards primary production, and only occasionally includes the processing phase.⁵⁸ Only one study calculated the effects of the entire life cycle ('cradle to grave')⁶³, while one other study analysed the entire production chain including the packaging phase and the effects of preparing, storing and washing food at home (see Table 2).⁸⁴

The British review also concludes that most of this research has been carried out in Scandinavian countries. The outcomes of this research would seem to be reasonably applicable to Great Britain and the Netherlands, although some caution should be exercised in connection with national differences in production and distribution techniques.⁵⁸

3.5 **Research into the ecological effects of food chain activities**

Besides the animal or vegetable origins of a product, factors such as cultivation method, transport, storage and preparation location are relevant to questions of ecological impact.^{88,89} According to a report for the British Department for Environment, Food and Rural Affairs, the influence of these factors is often ambiguous and varies according to the indicator employed and / or per product group.⁵⁸ One exception would appear to be the potential benefits of reducing food waste.^{69,90} Otherwise the influence of these factors is subject to numerous assumptions; the scientific argumentation is less convincing.

3.5.1 *Organically cultivated foods*

It is widely held that organically grown foods are more ecologically friendly than foods grown using more conventional methods. But is this true? The question is not easy to answer. One factor is that organic crops require more land than

conventional farming in order to yield the same amount of product; the yield per hectare is therefore lower. In the Netherlands, organic arable farming and open-field vegetable farming has a lower per-hectare emission of greenhouse gases than does conventional farming, but when expressed per ton of product, the greenhouse gas emission levels of organic farming are the same as in conventional farming, or even higher.⁹¹⁻⁹³ Organically grown foods are, however, generally associated with better scores in animal welfare and landscape value.^{58,93,94}

3.5.2 *Ready-made meals*

What is the ecological impact of ready-made meals, compared to that of meals prepared at home? Little research has been done into this.⁵⁸ A Swedish study found no clear difference in ecological impact between these options.⁹⁵ It is also open to question how any differences between the ecological impact of ready-made meals and home-prepared meals might be related to the ecological impact of the ingredients involved; it is likely that the presence of animal protein in a meal has a considerably greater ecological effect than does the location of its preparation.

3.5.3 *Local food*

There is only weak evidence for the claim that locally produced and consumed food is generally ecologically friendlier. First of all, it is not clear exactly what is meant by 'locally produced food'.⁷⁰ It is true that buying certain foods from a nearby farm can reduce the transport-related emission of greenhouse gases. But at the level of the entire food-buying population, the impact of bulk transport is not of overriding importance.^{58,70,96,97} For instance, in Great Britain it has been estimated that consumer car transport to and from shops is responsible for half of all the kilometres travelled by food.⁹⁶ In certain cases, importing food from other countries can even be a better option because of the large differences in ecological effects between agricultural systems worldwide.^{58,70,96,97}

To be able to quantify the ecological effects of local and non-local food, complete life cycle analyses are needed which include the effects of production, processing, transport and trade. For instance, a British study has shown that the ecological effect of the location at which apples are cultivated depends on the time period being studied. If the apples are eaten straight after production, British apples have a lower ecological impact than do New Zealand apples transported to Great Britain; but if British apples are first kept for close to a year in cold

storage, then the inverse is true.^{70,98} This type of research is rare, which means that it is hard to state with certainty that locally produced food has a lower ecological impact than food grown non-locally.^{70,98}

3.5.4 *Fresh as opposed to cooled or conserved*

There is no unambiguous data on the ecological impact of fresh food as opposed to cold (refrigerated or deep-frozen) and conserved (e.g. tinned, bottled, dried) food. The energy needed for freezing can make cold products ecologically less friendly than fresh produce, but freezing also has an ecologically friendly aspect: it can reduce food waste by making products less perishable.⁵⁸

3.5.5 *Transport*

Regarding the role of transport in the life cycle, the ecological impact of transport by air comes first to mind. Otherwise, the research findings have not been particularly unanimous. The limited amount of research available is directed towards the effects of food transport, and from this perspective it would seem that consumer use of a car to go shopping often forms a greater ecological impact than the transport of the product itself.⁵⁸ For meat products, the effect of feed production and livestock breeding on greenhouse gas emissions is much greater than the effect of transport; the latter often represents less than 20 % of the whole.⁵⁴ An exception is formed by air transport, which has a large ecological impact. However, only a small number of products, mostly vegetables, are currently transported by air. According to data from a large British supermarket chain, these vegetables do not belong to the top 150 sold foods.⁵⁸ The contribution of this form of transport to the food-related emission of greenhouse gases is estimated at 0.5 %.⁶⁶ However, there is a trend that food is increasingly being transported by air.

3.5.6 *Packaging*

For certain foods, for example bottled water, the ecological effect of packaging is extremely high. The quantification of this effect is problematic, however, because it depends strongly on how a country deals with its waste. Other factors include consumer disposal behaviour and the degree of recycling.⁵⁸

3.5.7 Waste

The reduction of food waste would appear to offer considerable ecological benefits.^{69,90} It is estimated that at least 30 % of cultivated food is lost or wasted during its life cycle (from cultivation through to consumer). The greatest losses seem to take place at the consumer end and at intermediary food service companies.⁹⁹ In recent years food losses in the retail trade, in intermediary companies, and within households has risen sharply. Food is relatively cheap, so resistance to throwing it away is relatively low (see frame). Consumers have also become accustomed to buying food that looks good, so suppliers have taken to

Waste statistics

In the Netherlands and Great Britain, the way households deal with food waste has been comprehensively charted.^{100,101} Three types of waste are distinguished:

- avoidable waste = discarded food and drink that had been edible or drinkable at some point. The reasons given are: more was cooked, prepared or served than was needed; it was not used quickly enough; other
- potentially avoidable waste = discarded food that some people would eat and others would not (e.g. breadcrumbs), or which is only edible if prepared in a certain way (e.g. potato skins)
- unavoidable waste = discarded food that is not normally (ever) edible (e.g. eggshells).

In the Netherlands, consumers throw away 10-20 % of all the food they buy.¹⁰¹⁻¹⁰⁴ According to one study, 11 % of the 528 kg of solid food which households buy per person per year is not eaten: 7 % is avoidable waste and 4 % unavoidable waste.¹⁰¹ Other Dutch and British studies found even higher percentages of food waste, around 20 %, one fifth of which was unavoidable waste.^{100,104} The main reason for the higher percentages in the later studies is the higher estimate of food thrown away through the waste water system and – in the British study – the much larger amounts being thrown away in the domestic refuse system.

The avoidable food waste comprises chiefly bread, dairy produce, vegetables, rice and pasta, potatoes and fruit, each having a share of 10-17 %. 60 % of the unavoidable food waste is formed by stalks and peelings, and 28 % is formed by coffee grounds.¹⁰¹

throwing away food products that are edible but damaged. Commercial interests can also lead to more waste, as when customers are tempted to buy 'two for the price of one'.⁸

3.6 The findings in a wider perspective

3.6.1 *Other aspects of sustainability*

Not everything which is ecologically favourable is good for other aspects of sustainability, such as animal welfare or the economic position of the populations of developing countries.^{84,105} For instance, advising people not to eat food that has been transported by air may violate international development aims.⁶⁶

3.6.2 *Shared responsibilities*

Dutch food production and provision forms part of global food production and trade. Decisions at national or European level can exert a strong influence on the production and sales of foods produced in other parts of the world, and this can have profound consequences for the populations of these countries. The European Group on Ethics in Science and New Technologies has advised the European Commission to make food security, food safety and sustainability the guiding principles for new agricultural technologies. The Group is hereby acknowledging that new technologies alone cannot provide answers to sustainability problems; these answers will also require responsible policy measures, as well as socially responsible behaviour from both producers and consumers.¹⁰⁶ In other words: government, producers and consumers share the responsibility for more sustainable, socially just food consumption patterns.

This question does raise some problematic considerations. Measures to improve the production efficiency of animal protein may lead to reduced global land use, less greenhouse gas emissions, and therefore less biodiversity loss; however, at the local level, especially in regions where a great deal of animal protein is produced, these measures can lead, on the contrary, to biodiversity loss and overfertilisation.⁶⁹

3.6.3 *The ecological perspective as a starting point*

In accordance with the Ministerial request for advice, this report takes the Guidelines for a healthy diet as its starting point. Adopting a different perspective, namely the sustainability of the Earth, leads to a more radical

position. This is well illustrated by the calculation of how much animal protein will be available per person in 2050 if meat and dairy production stay at 2000 levels while the global population rises to 9 billion. The answer is half a kilo of meat and a litre of milk per person per week: the same as the current average in developing countries.⁶⁶

3.7 Conclusion

Within the domain of food provision, it is the production of animal protein which has the largest ecological impact. One explanation for this is that producing a kilo of animal protein requires, on average, six kilos of vegetable protein. The effects of other food groups have been found to be less pronounced. These results are also less unequivocal, because of differences between studies and considerable uncertainties in the outcomes, which means that it is not always possible to attach a clear value to the conclusions.

Few clear conclusions can be drawn on the ecological effects of the cultivation, transport, storage, and preparation of food. For instance, locally-produced food is not necessarily ecologically friendlier than food imported from abroad, and food produced in an environmentally friendly manner does not necessarily score better, in terms of land use and greenhouse gas emissions, than food produced by more conventional methods. It does, however, perform better in other aspects of sustainability, such as animal welfare and landscape value. It is clear that transporting fruit and vegetables by air is associated with very large greenhouse gases emissions. However, because only a small percentage of all fruit and vegetables is transported in this way, the contribution that this makes towards total food-related greenhouse gases emission is relatively small. It can, however, be stated with certainty that the reduction of food waste promises considerable ecological benefits.

The Guidelines for a healthy diet and their ecological effect

This chapter compares the Guidelines for a healthy diet with the current state of knowledge on the ecological effects of dietary patterns and food groups. The aim of this comparison is to gain insight into those guidelines and measures which:

- have both health benefits and a low ecological impact
- have possible health benefits, but a high ecological impact
- have a low ecological impact, but whose health effects are neutral or uncertain.

4.1 Guidelines abroad

At international level, the number of guidelines containing recommendations for both a healthy and an ecologically responsible diet is limited. In 1986 a start was made to relate the American guidelines for a healthy diet to the ecological effects. The aim was to initiate a discussion of the feasibility of incorporating ecological effects into dietary guidelines.¹⁰⁷ According to these 25-year-old guidelines, a healthy diet went very much hand-in-hand with ecological benefits. The guidelines made no recommendations on fish consumption.

The World Wide Fund for Nature has published a report which describes what a healthy diet, with a low greenhouse gas emission profile, would look like in 2020. The Fund concludes that this diet would not differ greatly from current

recommendations for a healthy diet. The emphasis lies on eating smaller amounts of meat and dairy produce, and more vegetable products. The report does not consider issues such as distinguishing between fruit and vegetables on the basis of season and production methods.⁸³

Finally, several countries have drawn up guidelines for a sustainable diet. Examples include the British report *Setting the table*^{90*} and the Swedish report *Environmentally effective food choices*.¹⁰⁸ The guidelines in these reports are (partly) based on effects on health and ecological sustainability, though neither report employs guidelines on a healthy diet as the starting point. While report advice on a healthy diet shows strong similarities worldwide,¹³ guidelines for a sustainable diet show large differences as well as similarities. These differences are linked to the indicators employed, the scale level at which the ecological effects are determined, and the reach of the research (whether concerned with food alone, or also with related issues such as cultivation methods and transport). Other countries' recommendations therefore seem to provide guidelines for more sustainable food choices, rather than any definitive and universally applicable prescription for them. An interesting lesson may be learned from experiences in Sweden; their recommendation to choose locally-produced food wherever possible turned out to be in violation of European free trade regulations.¹⁰⁹ This, too, argues for a pan-European perspective in drawing up future guidelines for a healthy and ecologically responsible diet.

4.2 Win-win

A number of guidelines may be given which yield both health benefits and ecological benefits.

4.2.1 *Move to a less animal-based, more plant-based diet*

The scientific background document to the 2010 American guidelines for a healthy diet argue explicitly for the adoption of a more plant-based diet, characterised by the consumption of more fibre and few saturated fatty acids, and which is linked to a lower risk of cardiovascular disease.¹⁷ Whole-grain cereal products, legumes, vegetables, fruit and vegetable meat substitutes replace part of the meat and dairy products normally found in the diet.

* The report *Cooking up a storm* forms an important source of information.⁶⁶

A less animal-based, more plant-based diet is an ecologically responsible one because it requires less land use and generates fewer greenhouse gas emissions.^{59,60,63,64,69,74,83,84,90,108,110}

The American report Dietary Guidelines for Americans contains no specific recommendations to switch to a vegetarian or vegan diet,¹⁷ because it is impossible to state with certainty whether a vegetarian diet leads to a greater fall in health risks than does increasing the consumption of vegetable foods within an omnivorous diet.²¹

The recommendation to eat less meat and dairy produce is given from an ecological perspective, but the question is whether, from this perspective, these products ought to be omitted from the diet altogether. It is a fact that part of the world's grassland is suited only for livestock grazing, and that the waste products of the food production industry can serve as feed for pigs and chickens.^{8,66,111} At the European level, an estimated 40-50 % of current livestock can be fed by this method.⁶⁹

Finally, it should be emphasised that replacing meat with dairy products does not necessarily lead to reduced land use or greenhouse gas emissions.^{59,60,74,84} For instance, the production of cheese is linked to similar land use and greenhouse gas emission levels as the production of pigs and chickens.⁶⁹

4.2.2 *Lower energy intake, fewer snacks*

Those contending with unwanted weight gain or with overweight are advised to reduce their energy intake.³ If everyone in the Netherlands was of a healthy weight, this would prevent an estimated 5,000 cases of diabetes and 4,000 cases of cardiovascular disease every year.¹⁴

A reduced energy intake leads to a reduced demand for food and ultimately to lower production levels. This would therefore also reduce greenhouse gas emissions,^{66,112-114} provided that people did not spend the money they thereby saved on other products linked to high greenhouse gas emissions.

Methods of reducing energy intake include reducing the consumption of products with a high energy density and sweet drinks, and limiting portion size.³ Snacks – that is to say, non-basic foods – are estimated to be responsible for over 15 % of food-related greenhouse gas emissions, while estimates of their effect on land use vary (see Tables 1 and 2).^{30,62,82,84,85} Limiting the number of snacks eaten can therefore yield ecological benefits, especially if they are not replaced by other products.

It cannot be stated with certainty whether smaller food portions lead to ecological benefits or to ecological impacts. On the one hand, smaller portions

may lead to less food being thrown away or to lower consumption of a product with a high ecological impact; but on the other hand, smaller portions may also mean more packaging. The net ecological effect will also depend in part on how a country deals with its food waste.⁵⁸

4.2.3 *Dietary patterns according to the Guidelines for a healthy diet*

In general terms, too, a shift from the usual diet towards that described in the Guidelines for a healthy diet is good not only for health, but would also seem to be beneficial in terms of land use and greenhouse gas emissions. If everyone in the Netherlands ate in accordance with the Guidelines for a healthy diet, there would be an estimated 20,000 fewer cases of cardiovascular disease every year. Most research studies conclude that a diet in accordance with (international) healthy diet guidelines in the Netherlands, Italy, Great Britain, Europe and the rest of the world would be linked with less land use and lower greenhouse gas emissions compared with today's habitual diets.^{59,60,74,84,115-117} The effects on marine biodiversity have not been taken into consideration in these studies.

The question is: which aspects of the guidelines for a healthy diet are chiefly responsible for the ecological benefits? The studies use different definitions of a 'healthy diet': some only change the consumption of protein-rich products,^{59,60,74} while others include drinks or non-basic foods^{116,117} or the diet as a whole.^{84,115} One study which did include the diet as a whole, states that most of the ecological benefits can be attributed to eating less meat and fewer snacks.⁸⁴

4.3 **At odds with ecological effects**

4.3.1 *Fish, health, and ecological effects*

Fish has been included in the Guidelines for a healthy diet because its consumption is linked with a reduced risk of cardiovascular disease.³ New scientific insights indicate that a single portion of oily fish may also be enough to reduce the risk of cardiovascular disease.⁴⁰

Fish stocks are under serious threat.^{54,67,69} Fish is still taken principally from nature*, in contrast to most other foods, which are derived from agriculture – a sort of artificial ecosystem. Fish therefore represent a specific problem, with marine biodiversity loss and falling catches over the last twenty years in combination with a shift in catch from carnivorous fish towards herbivorous fish

* In 2009, 60% of all fish consumed came from the wild and 40% from fish farms.⁶⁹

located lower in the food chain.^{48,67,68} In the last 60 years the sea areas in which fishing takes place have been greatly expanded.¹¹⁸ It is estimated that, worldwide, about 50 % of fish stocks are being fully exploited and 30 % are being over-fished or exhausted.⁶⁸ Between 1950 and 2005 the populations of fish and other marine species fell by a quarter.⁵⁴

The precise ecological impact of fish consumption depends on the fish type (herbivorous or carnivorous, position in food chain), origins (location, wild or farm-raised), and fishing method. By-catch also varies strongly between different fishing methods.^{69,119,120}

Farmed or wild?

Farmed fish is not necessarily ecologically more sustainable than wild fish. Farmed carnivorous fish are fed with fishmeal and fish oil, much of which is extracted from wild fish. Farming carnivorous fish therefore has an impact on wild fish stocks and marine biodiversity. In herbivorous fish farming, the ecological impact lies principally in the land use requirements, which are comparable with those of poultry. Fish farms also use antibiotics and biocides, which can lead to water pollution. Fish farms can also be involved in the problem of eutrophication.^{69,119,120}

Because the current usual consumption of fish in the Netherlands* is lower than the guidelines recommend (two portions of fish a week**), higher fish consumption will necessarily lead to a higher ecological impact. Even the recommendation to eat a single portion of oily fish per week will raise the ecological impact, as this is still higher than current Dutch average consumption levels.^{26,72,120-123}

4.3.2 *Other sources of, and alternatives to, fish oil fatty acids*

With a view to declining fish stocks, alternative sources of the fish oil fatty acids (n-3 fatty acids derived from fish) and alternatives to these fatty acids could theoretically be of great importance. However, both alternatives have their limitations.

Fish oil fatty acids occur not only in fish but also in certain types of meat, shrimp, and krill. Only small amounts of n-3 fatty acids are found in meat,¹²⁴

* In 2003 the average (+/- standard deviation) consumption of fish, crustaceans and shellfish by young adults was 8 (+/- 25) grams per day.²⁶

** A portion of fish weighs 100-150 grams.¹²¹

although this amount depends in part on the type of feed: the meat of grass-fed cattle contains a little more n-3 fatty acid than that of grain-fed cattle.¹²⁵ On the basis of the amount of n-3 fatty acids found in shrimp and krill, they may be expected to have effects comparable to the n-3 fatty acids found in fish.¹²⁶ However, the drawback to this alternative is that large-scale fishing of shrimp and krill would have an unfavourable effect on marine biodiversity.^{124,127}

Finally, certain plants contain a short-chain form of n-3 fatty acids known as alpha-linolenic acid.¹²⁰ However, the effects of alpha-linolenic acid on cardiovascular disease have been less convincing in epidemiological and intervention research than the effects of fish-oil fatty acids.^{3,41}

4.4 Ecological benefits, no clear effect on human health

4.4.1 *Shifting between protein-rich foods*

The usual sources of animal protein are meat, meat products, dairy products and eggs.* Examples of vegetable protein sources include whole-grain cereal products, legumes and nuts. Of all food product groups, the consumption of animal protein sources has the greatest ecological impact.^{55,61-64,66,69,84,128} A less animal-based and more plant-based dietary pattern is associated with a reduced risk of death from cardiovascular disease and other disorders.^{3,17,24} This has principally to do with differences in the ingested amounts of food fibre and unsaturated fatty acids. The question addressed here is whether a distinction can also be drawn between different protein-rich foods with regard to dietary quality and ecological impact.

4.4.2 *The health effects of shifting between protein-rich foods*

The nutritional value of animal protein-rich food products varies both between and within meat types. On the basis of their nutrient composition, the Food Based Dietary Guidelines distinguish between food products whose consumption is 'preferable', 'in moderation', and 'occasionally'.¹⁰ Since large variation exists between the nutritional values of different beef products, for instance, it is impossible to make generalised statements on the consequences to health of a shift within the category of meat-based foods (see Table 3).

* Fish is treated separately in this report, because the Guidelines for a healthy diet considered fish as a source of n-3 fatty acids and not as a source of protein.

Table 3 Categorisation^a of product meat types whose consumption is preferable, in moderation, or occasionally.¹⁰

	Preferable	In moderation	Occasionally
Meat	Lean beef, lean pork, chicken breasts, beefsteak, rib chop	Chicken with skin	Mince, rolled beef, sausage
Meat products	Chicken fillet, roast beef, ham on the bone, gammon, lean Frankfurter	^b	Raw ham, smoked meat, Frankfurter, shoulder of ham, sausage, bacon, pâté, pork fricandeau

^a The categorisation is made on the basis of saturated fatty acids, mono trans unsaturated fatty acids, sodium and added sugar content.

^b There are no examples of meat products falling into this category.

4.4.3 The ecological effects of shifting between protein-rich foods

In interpreting data on the ecological effects of shifts between protein-rich foods, it is important to note that the estimates of these effects are associated with a variation of 26 % around the mean.^{73,74} In order to improve the certainty of these conclusions, Table 4 gives an overview of the estimated average effects as found in a number of different studies.

Beef, pork and chicken

There are considerable differences in ecological impact between different meat types (see Table 4).^{30,55,61-64,66,69,82,110} A variety of studies have concluded that per kilogram of meat, beef has the largest ecological impact at European and global level, followed by pork and chicken. The differences in ecological impacts between these meat types are less marked when they are expressed per kilogram of protein instead of per kilogram of product. The three main causes of the differences in ecological effects between beef, pork and chicken are:

- differences in the efficiency with which fodder is converted to edible meat
- differences in methane emissions between monogastric animals and ruminants
- differences in the speed of procreation.^{69,77,129}

Incidentally, the comparisons between these meat types become less clear when other sustainability indicators, such as animal welfare, are included.⁸⁴ There is also a large variation in ecological impact within any given meat type (see Table 4).

Table 4 Global land use and greenhouse gas emission of protein-rich products, per kilogram of product. Figures indicate the spread of average effects found in several life cycle analyses ('cradle' to shop).⁶⁹

Product	Land use (m ² /kg)	Greenhouse gas emissions (CO ₂ equivalents/kg)
Beef and veal	7-420	9-129
• Feedlot systems	15-20	14-40
• Mixed systems/dairy calves	15-29	9-42
• Meadow systems/suckler herds	33-158	23-52
• Extensive pastoral systems ^a	286-420	12-129
• Culled dairy cows	7	9
Pork	8-15	4-11
Poultry	5-8	2-6
Cheese	6-17	6-22
Eggs	4-7	2-6
Mutton and lamb	20-33	10-150
Milk	1-2	1-2
Soya milk	1	1
Meat substitutes	1-3	1-6
Tempeh / tofu	2-3	1-2
Walnuts	4	2
Legumes	3-8	1-2

^a Beef and veal from extensive pastoral systems score better on other ecological indicators such as biodiversity loss or nitrogen surplus than meat from feedlot systems.

Dairy products, eggs, and meat substitutes containing dairy or egg products

The production of milk appears to be linked to lower land use and lower greenhouse gas emissions than does the production of chicken per kilogram of product; eggs and meat substitutes containing dairy or egg products have a broadly comparable ecological impact, while cheese and yoghurt have a greater impact.^{54,58,58,74,77,84} Because milk has a low protein content, its ecological impact is relatively favourable compared to that of meat. However, if milk is being considered as an alternative source of protein, then its ecological impact should be expressed per kilo of protein rather than per kilo of product. Expressed per kilo of protein, the ecological impact of milk is broadly comparable with that of pork.^{69,74}

Vegetable meat substitutes, whole-grain cereal products, legumes, nuts

Entirely plant-based meat substitutes are associated with lower land use and similar or slightly lower greenhouse gas emissions than the production of chicken. For the legumes such as soya used to produce these meat substitutes, cultivation methods, cultivation location, and preparation methods have a significant ecological effect.^{74,110} From an ecological perspective, replacing animal products with whole-grain cereal products is a better alternative than replacing them with plant-based meat substitutes, because the latter is associated with a larger ecological impact.¹¹⁰

Legumes are associated with lower greenhouse gas emissions than animal sources of protein. The land use requirements of legumes varies: it is sometimes lower than, and sometimes equal to, the production of pork and chicken.^{74,130,131} In absolute terms, greenhouse gas emission levels do not differ greatly between nuts and legumes. The variation in land use is larger, because certain nuts are extensively cultivated.⁷⁴

4.5 Conclusions

One guideline which yields both health benefits and ecological benefits is to eat a more plant-based and less animal-based diet; in other words, to eat more whole-grain cereal products, legumes, vegetables, fruit, and vegetable-based meat substitutes, and to eat less meat and dairy products. Health benefits and ecological benefits are also delivered by the Guidelines for a healthy diet's recommendation to deal with excess weight by reducing energy intake, particularly from non-basic foods such as sugary drinks, sweets, cakes and snacks.

A guideline which may well yield health benefits, but which is ecologically detrimental, is the recommendation to eat two portions of fish a week, of which at least one should be oily fish. This damages marine biodiversity. Although there are indications that a single weekly portion of oily fish is enough to reduce the risk of cardiovascular disease, this recommendation, too, has an ecological impact, because current fish consumption in the Netherlands is below this level.

Replacing dietary beef with pork or chicken, on the other hand, may yield ecological benefits in terms of land use and greenhouse gas emissions, but its health consequences are unclear because different meat products from a single animal can have very different nutrient values. Moreover, the ecological benefits of a shift away from beef and towards pork and chicken do not always go hand in hand with, for instance, the effects on animal welfare.

Conclusions and recommendations

This chapter summarises the qualitative guidelines for a healthy and ecologically friendly diet. Starting from the Guidelines for a healthy diet, this advisory report has charted the ecological aspects of sustainability in terms of land use, greenhouse gas emissions, and biodiversity, with special attention for marine biodiversity, at the European and the global level. Other aspects of sustainability, such as animal welfare and fair trade, have been included only to qualify the conclusions and to illustrate the complexity of sustainability issues. All these aspects are important in assuring the ability of future generations to meet their needs.

The qualitative guidelines serve to help consumers make healthier and more eco-friendly choices. This chapter will briefly describe some of the instruments that government and food and drink industry can employ to contribute towards these aims. Finally, the chapter outlines the directions in which scientific knowledge could usefully develop in the area of a healthy and ecologically sustainable diet.

5.1 Conclusions

Two guidelines which deliver both health benefits and ecological benefits in terms of land use and greenhouse gas emissions are:

- adopt a less animal-based and more plant-based diet: less meat and dairy products, and more whole-grain cereal products, legumes, vegetables, fruit, and vegetable-based meat substitutes
- to counter excess body weight, reduce energy intake, particularly by eating less non-basic foods such as sugary drinks, sweets, cakes and snacks.

A guideline which may yield health benefits, but which may have detrimental ecological effects, particularly for marine biodiversity, is:

- eat two portions of fish per week, at least one of which should be oily fish. Even if, based on the indications, it can be assumed that just one portion of oily fish per week is enough to lower the risk of cardiovascular disease, this recommendation is ecologically detrimental because this level of consumption is higher than the current level in the Netherlands. From the ecological perspective, it is advisable to concentrate on fish species that are not currently being overfished, or on species which are being farmed in an environmentally friendly way.

A guideline which yields ecological benefits, but whose effect on health is neutral, is:

- reduce food waste.

5.2 Policy recommendations

Seek European support for guidelines on a healthy and sustainable diet

Earlier healthy and sustainable diet initiatives from other countries have fallen foul of national trade interests. Considerations from a pan-European perspective offer the prospect of broad-based European support and collective guideline implementation.

Evaluate recommendations on diet and fish consumption, both from the health perspective and the ecological perspective

In this report, those new scientific developments affecting the *2006 Guidelines for a healthy diet* have been identified which are also relevant from an ecological viewpoint. New Guidelines for a healthy diet should focus on recommendations for less animal-based and more plant-based dietary patterns, because these would appear to yield both health benefits and ecological benefits. The recommendation to eat two portions of fish per week, at least one of which should be oily fish,

warrants reconsideration, as there are indications that a single portion of oily fish per week is enough to reduce the risk of cardiovascular disease. Ideally, this evaluation would weigh the health benefits of this recommendation against its ecological impact.

Include other aspects of sustainability in advice on sustainable diet

The conclusions of this report on ecological effects do not necessarily apply to other aspects of sustainability, such as animal welfare or fair trade. For instance, the dietary replacement of beef by pork or chicken yields ecological benefits in terms of land use and greenhouse emissions, but these ecological benefits are not necessarily accompanied by improvements in animal welfare. It is therefore advisable that these various aspects are examined before possibly recommending that people shift their meat consumption away from beef and towards pork or chicken. Another example is the transport of vegetables by air, which involves large greenhouse gas emissions; a recommendation to avoid these vegetables could have detrimental economic effects in the country of origin, particularly if this is a developing country.

Employ a variety of measures simultaneously to stimulate a healthy and ecologically friendly diet

As the *2006 Guidelines for a healthy diet* have indicated, government can call on a broad range of instruments with which to contribute to healthier and eco-friendlier lifestyles in the population. It is best to employ these instruments simultaneously and in concert. Specific instruments and concerns include the following:

- regulations and public information, the classic policy instruments. As the Health Council has advised in the past, it is essential that public information provision is founded on a solid theoretical and empirical approach. * This applies as much to information on healthy and eco-friendly food as information on getting enough exercise
- it is also important that there is no substantive conflict between government information provision and commercial product promotion. Mutual agreements can effectively prevent this

* Health Council. Plan of campaign. Promotion of healthy behaviour by mass media education. The Hague: Health Council of the Netherlands 2006; publication number 2006/16.

- ideally, a healthier and more ecologically friendly lifestyle would begin as early in life as possible. Information could therefore be provided even before pregnancy, and at the infant welfare centre. A healthy and eco-friendly lifestyle can also be encouraged through the education system; this might take the form of scheduled lessons on nutrition and diet, in up-to-date and creative forms, under the supervision of qualified teaching staff
- government should carefully monitor the availability and affordability, for all population groups, of foods important to a healthy and eco-friendly diet.

5.3 Recommendations for food producers

The measures described in this advisory report are concerned principally with overall food consumption patterns rather than with individual products. This does not alter the fact that, alongside government and consumers, producers can also play a vital role in improving the ecological effects of their products. As the Minister's letter indicated, producers have initiated numerous activities in the area of sustainability, varying from the reduction of greenhouse gas emissions in the production of their entire product portfolio to the purchase of sustainable raw materials and the improvement of animal welfare (see Annex A).

The *2006 Guidelines for a healthy diet* describe measures by which producers can contribute towards a healthier diet. From an ecological perspective, the measures could be extended:

- a good label gives the consumer adequate information on the product's energy value and nutrient composition. An 'eco-friendly food' logo could also play a role in this consumer information provision, whether this concerns changes in the entire food chain or simply makes it clear that the product is part of a programme to produce food in a more eco-friendly way (see also the recommendations for research). It does not seem feasible to make the entire food product market a healthy one, but as far as eco-friendly production is concerned, ideally all production should ultimately be eco-friendly as a matter of course
 - in questions of product development and adaptation, the food industry would do well to address not only the recommendations contained in the *2006 Guidelines for a healthy diet* on such matters as portion size and nutrient composition, but also the recommendations given in the present report on moving towards a more eco-friendly diet, including the reduction of food waste. Catering organisations, too, such as catering companies and school, company and sport canteens, can contribute towards the achievement of this goal
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- finally, consumer food choices are influenced by the environment; food industries and supermarkets can do much to promote the purchase of healthy and eco-friendly products.

5.4 Recommendations for further research

The Minister requested recommendations for further research at national, European and global level. The following recommendations, which are not exhaustive, outline a number of possible research directions.

Survey eco-friendly foods

The ecological impact of different food groups needs to be better surveyed, so that the information can be used to make foods more eco-friendly. This also means looking more closely at how uncertainties influence conclusions on ecological effects.

Research into alternatives for, and other sources of, animal protein and fish

From a nutritional standpoint, it is desirable that more research is done into alternatives for, and other sources of, animal protein-rich products and fish. Animal protein products can be replaced by vegetable sources, but meat substitutes are not to everyone's taste. There are as yet no suitable alternatives for, or other sources of, the n-3 fatty acids we currently derive from fish.

Research into the effectiveness and feasibility of sustainability logos

There have been calls for various aspects of sustainability to be captured in a logo, but there are serious doubts about the feasibility of such a logo. In addition, the implementation costs for producers may be greater than the benefits. As is the case for healthy food logos, it is also uncertain whether such a logo has the desired effect. More research therefore needs to be done into what works in actual practice – both for logos and for other methods of promoting a healthy and sustainable diet.

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A Request for advice

B Conference participants

C Summary of the international working conference on healthy and sustainable food

Annexes

Request for advice

On 29 April 2010, the President of the Health Council of the Netherlands received the request from the Minister of Agriculture, Nature and Food Quality for an advisory report on Guidelines for a Healthy Diet 2010. The Minister wrote (letter no. VDC 2010-1238):

As the Minister of Agriculture, Nature and Food Quality, I hereby request the Health Council of the Netherlands produce an advisory report on the latest scientific findings on 'Guidelines for a Sustainable Diet' and suggestions for the selection of food products by consumers. The background to this request for an advisory report is explained below.

The importance different people attach to the values associated with food vary. The Government believes it has a duty to promote a situation in which consumers attach sufficient importance to food safety, food quality and health. These factors are largely guaranteed in existing policy programmes implemented through authorities such as the Ministry of Health, Welfare and Sport, the Ministry of Agriculture, Nature and Food Quality, the Food and Consumer Product Safety Authority and the Netherlands Nutrition Centre. In addition to this, the Policy Document on Sustainable Food places the emphasis on a new food quality value: making food production sustainable. Further emphasis was placed on the importance of this subject in the debate held in the Dutch House of Representatives on the Policy Document on Sustainable Food, in which the amount of animal protein consumed was frequently linked to environmental aspects. Making food production and consumption sustainable is also increasingly the focus of public attention by consumers, industry, government and science. The ultimate aim is to achieve a transition to a more sustainable and healthy food production pattern and to substantiate this

point of view with a sound knowledge base. Demand is increasing for perspectives on how to act to enable more sustainable consumption on the part of entrepreneurs and consumers. On the supply side, steps have already been taken in the policy of the Ministry of Agriculture, Nature and Food Quality through the Platform for Sustainable Food. The perspectives for action and the underlying knowledge base are less clear on the part of the consumer.

Various studies examined in an exploratory literature review by the Netherlands Nutrition Centre revealed that consumption which followed eating patterns in accordance with the criteria set out in 'Guidelines for a Healthy Diet' and the Wheel of Five based on the guidelines had a lower environmental impact than consumption which followed eating patterns that did not meet these criteria. There is a need for an unambiguous basis for consumer communication. This is sometimes difficult. For example, it may be that consuming a certain food product increases pressure on biodiversity but also promotes health. The consumption of fish is an example of this, whereby eating fish twice a week could have an adverse effect on marine biodiversity owing to overfishing. Another point for attention is the possible contradiction between, on the one hand, recommendations concerning a sustainable diet and, on the other, food health and safety requirements.

The development of a conceptual framework in the form of 'Guidelines for a Sustainable Diet' would be advisable for dealing with this complexity. A conceptual framework of this kind might also be helpful for estimating future developments concerned with food values and providing components for a periodic measurement of the effect of the efforts of the Ministry of Agriculture, Nature and Food Quality in this field.

This leads me to request the Health Council of the Netherlands produce an advisory report on the latest scientific findings on 'Guidelines for a Sustainable Diet' and suggestions for the selection of specific food products at the interface where health interacts with the environmental and biodiversity aspects of food. I also request the Health Council cover the following matters when conducting the study:

- Taking the 'Guidelines for a Healthy Diet' as the starting point, I request that you provide qualitative guidelines for sustainable and healthy dietary choices for the entire population as part of a more sustainable lifestyle. The Netherlands Nutrition Centre has taken an initial step in this. The initial step should be checked against the latest scientific findings and thereby clarified. I request the Health Council include examples of putting the field of sustainable proteins into practice in its advisory report.
 - Along which lines should scientific knowledge preferably be developed in the coming years at the national, European and international level? I request you list similar implementations of qualitative 'Guidelines for a Sustainable Diet' in other countries, such as those in Sweden and Great Britain and what their effect is.
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The advisory report may also be used in correspondence with the Dutch House of Representatives and must be presented for this purpose in the form of an extensive report to the Ministry of Agriculture, Nature and Food Quality no later than November 2010.

I look forward to receiving your advisory report and wish you every success in its compilation.

The Minister of Agriculture, Nature and Food Quality

(signed)

G. Verburg

Conference participants

A working conference on 'healthy and sustainable diets' was held on 25 November 2010 and was chaired by Professor D. Kromhout, Vice-President of the Health Council of the Netherlands, with secretarial support from Dr. H.F.G van Dijk, E.J. Schoten, Dr. C.J.K. Spaaij, N. Steenhuisen-Premchand, and Dr. R.M. Weggemans.

Participants:

- Professor D. Kromhout, *chair*
Vice-President of the Health Council of the Netherlands, The Hague
 - Dr H. Aiking
Associate Professor of Chemistry and Food, Toxicologist, VU University, Amsterdam
 - Dr R.A. Bausch-Goldbohm
Nutritionist, Epidemiologist, TNO Food, Zeist
 - M.K. Boshuizen
Ministry of Economic Affairs, Agriculture and Innovation, The Hague
 - W. Bosman
Former Secretary of the Standing Committee on Nutrition, Health Council of the Netherlands, The Hague
 - B.C. Breedveld
Head of Knowledge Department, Netherlands Nutrition Centre, The Hague
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- Dr E. Claupein,
Senior Scientist, Max Rubner Federal Research Institute for Nutrition and Food, Karlsruhe, Germany
 - Dr H. Crawley
Reader Nutrition Policy, City University, London, Great Britain
 - Dr A.D. Dangour
Senior Lecturer, London School of Hygiene & Tropical Medicine, Great Britain
 - C. van Dooren
Food Quality Knowledge Specialist, Netherlands Nutrition Centre, The Hague
 - Professor N.D. van Egmond
Professor of Environmental Sciences, University of Utrecht
 - Professor L.J. Gunning-Schepers
President of the Health Council of the Netherlands, The Hague
 - T. Garnett
Research Fellow, University of Surrey, Guildford, Great Britain
 - Dr J.E. Hermansen
Head of Research Unit, Research Centre Foulum, Tjele, Denmark
 - Professor M.B. Katan
Professor of Nutrition, VU University, Amsterdam
 - H.R.J. van Kernebeek
Ph.D. Student Animal Production Systems, Wageningen University
 - Dr C. Lagerberg Fogelberg
Senior Scientist, Swedish University of Agricultural Sciences, Uppsala, Sweden
 - Professor E.T. Lammerts-Van Bueren
Professor of Organic Plant Breeding, Wageningen University
 - J. Lok
Ministry of Health, Welfare and Sport, The Hague
 - T. Martens
Ministry of Economic Affairs, Agriculture and Innovation, The Hague
 - Dr S. Nonhebel
Associate Professor of Environmental Sciences, University of Groningen
 - T. Rood
Policy Researcher Sustainable Production and Consumption, Netherlands Environmental Assessment Agency, Bilthoven
 - Professor A. Tukker
Manager Sustainable Innovation Program / Professor of Sustainable
-

Innovation, TNO Delft / Norwegian University of Science and Technology,
Trondheim, Norway

- Dr H.M.G. van der Werf
Research Scientist Environmental Analysis of Agricultural Production
Systems, INRA, Rennes, France
- H.J. Westhoek
Senior Policy Support Assistant, Netherlands Environmental Assessment
Agency, Bilthoven

Summary of the international working conference on healthy and sustainable food

Introduction

On 25 November 2010, the Health Council of the Netherlands organised an international working conference on healthy and sustainable food. The objective was to draw on the insights and deliberations of experts from home and abroad in the preparation of the present advisory report.

In the course of the conference, a lively debate arose concerning the many facets of the 'sustainable food' theme. People repeatedly pointed out that this is not restricted to ecological sustainability alone, it also involves issues such as animal welfare and fair trade. However, because the advisory report confines itself to the impact of food production and consumption on the environment (in accordance with the terms of the Minister's request for advice), this report too focuses primarily on the views expressed by conference participants on this issue. The report also addresses the main points raised. In other words, it highlights the main conclusions and points of discussion. In this context, the numerous examples and sub-issues examined paved the way for the formulation of a core message. Such detailed issues are not discussed at any great length. This is because the current level of knowledge makes it difficult to see the wood for the trees.

Finally, for details of the introductions to each session, see the reports in question. This report focuses on the views exchanged in response to the introductory lectures.

Session I: Indicators of ecological sustainability in relation to food

Consensus was reached on the following issues:

- the most important indicators of ecological sustainability include: greenhouse gas emissions, biodiversity, energy use, water use, land use, and eutrophication
- these indicators are closely interlinked, even if the links themselves are not all equally well understood. This cohesion reflects the fact that these indicators are strongly influenced by the production of animal protein
- given the cohesion in question, it matters little which indicator is used to identify the sustainability effects associated with food, at least at supranational level
- supranational level is the main target for measures aimed at improving the ecological sustainability of food, and for monitoring of that process of improvement. Such endeavours should commence at regional (e.g. European) level, and converge at global level. It is essential to examine the environmental system as a whole, and to focus on the additional effects resulting from the extra consumption of a given type of food.

The following issue was discussed:

- when developing sustainable food guidelines, to what extent or under what conditions should allowance be made for national differences in areas such as land use and biodiversity? Inevitably, there is a risk that business interests will soon prevail.

Session II: Guidelines for a healthy diet

Consensus was reached on the following issues:

- given the broad consistency of guidelines for a healthy diet throughout the world, it should be a relatively straightforward matter to incorporate sustainable food guidelines over time, once they are agreed upon
 - achieving food sustainability is not simply a matter of changing consumption patterns. Food producers and organisations such as supermarket chains can do a great deal to help make food more sustainable.
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The following issues were discussed:

- it is time to review the recommendation that consumers should eat fish twice a week, consuming oily fish on least one of these occasions. This guideline's scientific basis appears to be weaker than was initially thought
- when updating the guidelines for a healthy diet, there are good health-based reasons for also focusing on the consumption of red meat
- the high dietary reference intakes for calcium, associated with the intake of dairy foods, should be closely examined.

Session III: Ecologically sustainable food

Consensus was reached on the following issues:

- the most significant step towards making food more sustainable would be to reduce the intake of animal protein (both meat and dairy products)
- by comparison, simply replacing one type of meat with another has a much smaller effect
- no effort should be spared in combating over-fishing
- farmed fish is not such an ecologically sound alternative to wild fish as it might seem
- while aviation is the most ecologically damaging form of transport, its effect is limited compared to that of total food production and consumption.

The following issue was discussed:

- any attempt to determine which type of food in a given product group is the most damaging in ecological terms will be influenced by the sustainability indicators used in the analysis.

Session IV: Guidelines on food choice in relation to ecological sustainability

Consensus was reached on the following issues:

- from the point of view of ecological sustainability, it is best to reduce the intake of meat and dairy foods and, where necessary, to replace them with wholemeal products, legumes, vegetables, and fruit, or plant-based meat substitutes
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- the maintenance of sustainable fish stocks is at odds with the recommendation that consumers should eat fish twice a week, consuming oily fish on least one of these occasions
- there is still considerable scope for ecological gains through the reduction of food wastage
- there are clear ecological benefits associated with a lower intake of saturated fatty acids
- in the case of fruit and vegetables, it is better to use seasonal or preserved products. Such measures have a limited ecological impact, however, as compared to the impact of reducing the intake of meat and dairy.

The following issue was discussed:

- meat substitutes are not everyone's cup of tea. Product innovation might help to resolve this issue.