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# Global environmental impact on health

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Horizon scanning report







To the Minister of Housing, Spatial Planning and the Environment

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Subject : Presentation of horizon scanning report *Global environmental impact on health*  
Your reference : -  
Our reference : U-5541/EvV/PM/789-G  
Appendices :  
Date : November 24, 2009

Dear Minister,

I hereby present the advisory report 'Global environmental impact on health'. It is an advisory report from the Health and Environment Surveillance Committee, which has the task of advising government and Parliament on important issues concerning health and the environment, and of highlighting threats and opportunities.

The advisory report shows that the effects are plausible, serious and relevant for public health. This has also been pointed out recently in international reports. The Committee's findings are a further exhortation to give threats to public health a prominent place at the forthcoming Climate Change Conference in Copenhagen.

I support the Committee's call for more attention to be paid to this problem in policy and research. Policy decisions concern far-reaching measures but they have an impact on more than one front simultaneously. A good example is economical use of energy – especially for transport – which limits CO<sub>2</sub> emissions while also improving air quality, thereby quickly benefiting public health.

The research that the Committee recommends demands a coherent international approach but must also focus on the Netherlands. It could be linked to research initiatives being developed in the Netherlands to give shape to research programmes concerned with global environmental changes.

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Page : 2  
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I have sent a copy of the Committee's advisory report to your ministerial colleagues at the Ministry of Health, Welfare and Sport, the Ministry of Agriculture, Nature and Food Quality, the Ministry of Transport, Public Works and Water Management, and the Ministry of Education, Culture and Science.

Kind regards,  
(signed)  
Professor J.A. Knottnerus

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Horizon scanning report

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to:

the Minister of Housing, Spatial Planning and the Environment

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No. 2009/15E, The Hague, November 24, 2009

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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, Housing, Spatial Planning & the Environment, Social Affairs & Employment, Agriculture, Nature & Food Quality, 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.



The Health Council of the Netherlands is a member of the European Science Advisory Network for Health (EuSANH), a network of science advisory bodies in Europe.



**INAHTA**

The Health Council of the Netherlands is a member of the International Network of Agencies for Health Technology Assessment (INAHTA), an international collaboration of organisations engaged with *health technology assessment*.

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This horizon scanning report can be downloaded from [www.healthcouncil.nl](http://www.healthcouncil.nl).

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# Contents

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Executive summary *11*

---

1 Introduction *17*

1.1 Focus of this advisory report *17*

1.2 Question *18*

1.3 Structure of the document *18*

1.4 Committee and method of working *19*

---

2 A range of global environmental changes *21*

---

3 Health effects of global environmental changes *25*

3.1 Importance of the report on current knowledge  
of global environmental changes and public health *25*

3.2 Health effects *26*

3.3 Research agenda *31*

3.4 Conclusion *32*

---

4 Systems thinking approach for public health *35*

4.1 Determinants of health *35*

4.2 Importance of the systems thinking approach *37*

4.3 Systems thinking approach *38*

4.4 Conclusion *44*

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---

5 Conclusions and recommendations 47

---

References 53

---

Annex 59

A The committee 61

---

10 Global environmental impact on health

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## Executive summary

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Major environmental changes which are occurring worldwide include global warming and a decline in the diversity of species. These are complicated processes with particular characteristics: they cover a wide area, are insidious, expand in time and space, have numerous causes and impacts and are interdependent. This advisory report from the Health Council of the Netherlands discusses the consequences of global environmental changes for public health in the Netherlands.

More than twenty years ago, the Health Council determined that there were no indications that climate change would have an adverse impact on public health in the Netherlands. The Council's opinion on this subject has changed. This conclusion comes from the advisory report of the Health and Environment Surveillance Committee, which has particular responsibility for identifying important links between environmental impacts and public health.

International reports contain convincing indications that climate change and other global environmental changes pose a health threat. The fact that the Netherlands will not escape the effects is clear from the report published last year on current knowledge of global environmental changes and public health: '*Mondiale milieuveranderingen en volksgezondheid: stand van de kennis*'. The report specifically examines the impact of global environmental changes on the health of the population of the Netherlands and covers the following processes: atmospheric changes (climate change and damage to the ozone layer), changes in land use, depletion of freshwater stocks and a decline in biodiversity. The report

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closes with a proposal for a research agenda. The report's publication was a major reason for the Committee deciding to reassess the situation.

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The consequences for health of global environmental changes should be paid more attention in policy and research

The Committee notes that in recent decades there has been an increase in knowledge of what the adverse effects of global environmental changes will be on health, both worldwide and in the Netherlands. Climate change in the Netherlands could lead to early death owing to extremely high temperatures and an increase in respiratory complaints and infectious diseases. Additional cases of skin cancer are one of the consequences of damage to the ozone layer. Public health in the Netherlands is also likely to suffer from other environmental changes, such as changes in the use of land, depletion of freshwater stocks and a decline in biodiversity. For example, changes in the use of land and a decline in biodiversity could lead to more infectious diseases. However, indications of the way in which these impacts arise are less direct than in the case of climate change and damage to the ozone layer. The various processes do not usually occur independently but affect each other.

The health effects can be separated into phenomena that probably already occur in the Netherlands and phenomena that may well exist in the future. Examples of the former are the aforementioned increased mortality rate during heatwaves and additional cases of skin cancer attributable to higher levels of UV radiation. An example of the second group of phenomena is an increase in infectious diseases. Also global environmental changes can damage local environments which can lead to conflicts whereby people are forced to flee their homes, and this can have consequences for their health. All these effects are plausible, serious and relevant for the Netherlands. However, they will partially be attributable to other factors, such as an increase in infectious diseases as a result of the growth in international passenger travel and trade.

Health effects still receive little consideration in Dutch policy on global environmental changes. They also receive little attention in the scientific world. As these are plausible, serious and relevant effects and there is still a great deal of uncertainty about how extensive they will be and where and when they will occur, the Committee believes extra policy and research efforts are required.

Policy includes measures for tackling the causes of environmental changes and measures for limiting the adverse effects. Measures in the first category are mainly taken at the international level, as in the case of reducing CO<sub>2</sub> emissions;

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measures in the second category generally have a national character; in the Netherlands they are primarily intended to protect the population against flooding.

From the health point of view, the Council believes that it would be advisable to intensify and increase both types of measures.

### Research into health threats and protective measures

In the light of this, further research into the health effects of global environmental changes is required. So much is already known about climate change that it would be advisable for part of the research to focus on possibilities for us to adapt, for example by paying more attention to identifying risk groups and how the health threats they face can be reduced. This is less important in the case of damage to the ozone layer because effective global measures have been taken which are expected to result in the ozone layer being restored in due course. Concerning other environmental changes, a lot more research is required into the nature of the health threats, how extensive they will be and where and when they will occur.

### Adopt systems thinking

Factors other than global environmental changes also affect public health. Many of them are beyond the scope of the environment. Examples include the quality of education, lifestyle and the level of affluence. Taking the factors as a whole – including global environmental changes – we know or can reasonably assume that some of them are influenced by each other's effects. However, there are still many gaps in our knowledge of how they are interrelated. More detailed information on the connections is required to enable a better assessment of the health effects of global environmental changes and more accurate delineation of the effectiveness of possible measures. It will only be possible to make significant headway by taking these relationships into account. This approach is known as systems thinking.

It involves using knowledge obtained from different fields. Focusing systems thinking on the health effects of global environmental changes requires the integration of disciplines such as epidemiological, biomedical and ecological research into health effects with research in the fields of economics and social science. The strength of systems thinking is that it can help to give structure to available knowledge and to understand the operation of (parts of) the system. The initial aim is a qualitative description of possible processes, links, interactions and feedback. Insofar as components lend themselves to computation, they

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are mainly used in aid of the qualitative assessment. Two tools that are commonly used are computer simulation models and scenarios in which possible global developments are described (a free market or a more regulated market, for example). These instruments can be used to make futures studies.

Systems thinking demands the compilation of adequate data. Such data will need to be to some extent specific to the situation in the Netherlands.

#### Actively encourage research into the health effects of global environmental changes

Systems thinking is becoming established in the field of global environmental changes and their causes and effects. However, there is a blind spot in the area concerned with the effects on public health. System modellers and scientists from various disciplines in the natural and social sciences are involved in the research. Few, if any, doctors and other medical scientists, who familiar with empirical health research, are represented. However, input from this group is essential for public health to have a place in systems thinking about global environmental changes. Dutch scientists have extensive knowledge of systems thinking and it would be advisable to put it to good use. The Committee therefore recommends encouraging systems thinking in the required direction by making grants available to support research that promotes this.

#### Precautionary action

Paying attention to the health effects in the manner outlined above would be in keeping with a precautionary strategy. Here, the Committee defines 'precautionary' as dealing with uncertainties in a careful, transparent and situation-specific manner. Decision-making concerned with precautionary action should include regular policy evaluation and proper communication. This is all the more important because it concerns an international issue with insidious, far-reaching and irreversible effects which can only be partially described, let alone reliably quantified. The numerous uncertainties and the divergent opinions in society on the urgency of the problem call for participative dialogue with those concerned: authorities, citizens and parties in the community, and experts. The parties include the business community, trade unions and consumer and environmental protection organisations. The Committee sees communication as a two-way exchange of information and discussions between the parties concerned, whereby the importance of information on scientific findings and explanations of policy options should not be underestimated.

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The transnational nature of the problem makes international coordination essential for measures and agreements intended to tackle the causes. It will also be possible to take specific measures domestically. A particular aspect of any such measures is that they often have an impact on more than one front simultaneously, which means that they are helpful in tackling more than one environmental issue. For example, energy saving not only reduces the use of natural resources but also emissions, and reducing dependence on fossil fuels for vehicles and transport improves air quality while also reducing greenhouse gas emissions. This is all beneficial to public health.

Finally, the Committee recommends monitoring the effectiveness of policy renewals and examining whether they have any adverse side-effects. The complexity of the problem and the many uncertainties make it difficult to predict the effect of policy. Precautionary action involves assessing policy at set times and more often than in other cases. The findings can be used in combination with new research data to adjust or revise policy.





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# Introduction

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## 1.1 Focus of this advisory report

The Health Council first assessed the effects of global climate change on public health in the Netherlands more than twenty years ago.<sup>1</sup> It saw no clear indications to confirm the existence of effects but noted that there were large knowledge gaps. Its main recommendation was therefore ‘ongoing monitoring’.

The publication of an overview report on global environmental changes led the Council to reassess the situation.<sup>2</sup> The report in question not only summarised current knowledge of the impact of climate change but also discussed the effects of other global environmental changes on public health in the Netherlands. Examples of such changes included damage to the ozone layer, deforestation and a decline in species diversity.

This advisory report therefore has a broad scope. It focuses primarily on the consequences of global environmental changes for public health in the Netherlands. It first discusses the knowledge we have of the effects concerned and where there are still gaps in the information. It then indicates the type of research that would help improve the situation and how it would enable us to be better prepared for the effects. How this fits in with a strategy that focuses on precautionary action is also discussed. The Council has previously defined ‘precautionary’ as dealing with uncertainties in a careful, transparent and situation-specific manner.<sup>3</sup>

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## 1.2 Question

Recent international reports focused on all the aspects of global changes that will affect the living environment and extrapolations for the future were made on the basis of recent environmental trends (see for example <sup>4,5</sup>). The emphasis is on the environment in relation to the physics and chemistry (climate change, increase in sea level, melting ice and chemical changes in the soil, water and atmosphere) and the biology (decreasing biodiversity for example). However, the reports in question also confirm that global environmental changes will affect public health. The health effects are discussed but in less detail than physical, chemical and biological processes and the forces that drive them. It also becomes clear that changes and their consequences differ markedly worldwide. For example, the average temperature will increase but more in the northern than the southern hemisphere. A report was recently published on current knowledge of global environmental changes and public health in the Netherlands: *Mondiale milieu-veranderingen en volksgezondheid: stand van de kennis*.<sup>2</sup> The report shows that our knowledge in this field has grown considerably since 1986 but that there are still major gaps. Besides a summary of gaps, the report includes an agenda for further research.

Some comments to the aforementioned report on current knowledge of global environmental changes and public health in the Netherlands that may be useful for drawing up a research programme have been included in this advisory report at the request of the President of the Health Council. As a sequel to this the Committee answers the following questions:

- What effects might global environmental changes have on public health in the Netherlands and what will be the consequences of the answer to this question for the research agenda?
- Which research methods are most suitable for obtaining more data on the effects of global environmental changes on public health in general, and, in the Netherlands in particular? Furthermore, how can those options be improved, if necessary, and what will the significance of the methods concerned be for assessing the effectiveness of the measures?

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## 1.3 Structure of the document

Chapter 2 provides an overview of existing knowledge of global environmental changes. Chapter 3 answers the question regarding what the effects of global

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environmental changes will be on public health in the Netherlands and where the main knowledge gaps are; an indication is provided of how best to fill the gaps. Chapter 4 answers the question as to which research methods would be most meaningful for analysing global environmental changes and their effects on public health; the answer also covers options for influencing specific developments. The main conclusions and recommendations are set out in chapter 5.

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#### **1.4 Committee and method of working**

This advisory report was drawn up by the Health and Environment Surveillance Committee. Details of the Committee's task, composition and method of working are provided in annex A.

A draft of the advisory report was assessed by members of the Health Council's Standing Committee on Health and Environment, the members of the Advisory Council on Health Research, which is part of the Health Council, and a number of other experts including some in the Health Council. The names of the experts are also provided in annex A.



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## **A range of global environmental changes**

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Various international reports have appeared in recent years on environmental changes that are taking place. The reports are concerned with the physical environment. The same approach has been adopted for this advisory report.

### Climate change 2007

The fourth report of the ‘Intergovernmental Panel on Climate Change’ (IPCC), ‘Climate change 2007’, summarised current scientific information on the causes and consequences of climate change.<sup>5</sup> It explained present trends and evaluated various future scenarios. It also identified several options for adapting and countering climate change, such as energy saving, more efficient farming methods, more economical means of transport, a sustainable energy supply and storage of the greenhouse gas carbon dioxide. An indication was also provided of what these solutions would cost.

According to the IPCC it is ‘very likely’\* that the observed global warming – especially during recent decades – is largely a result of human activity. Increased use of fossil fuels and the changing use of land has caused greenhouse gas emissions to exceed the amount that nature removes from the atmosphere. This finally

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\* The IPCC uses standardised terminology. Varying levels of certainty are expressed on the basis of 11 levels from virtually certain to exceptionally unlikely. ‘Very likely’ is the third level and corresponds quantitatively to a certainty of 90-95%.

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results in the atmospheric concentration of greenhouse gases increasing and the atmosphere retaining more heat, which leads to climate change.

### Ecosystems and human well-being

Another series of significant reports in recent years contained results of the 'Millennium Ecosystem Assessment (MA)'. The 'Ecosystems and human well-being' report assessed changes in biodiversity (variation in and between living species), ecosystems and ecosystem services, and the consequences for human well-being.<sup>6</sup> Ecosystem services is the term used to refer to the benefits that ecosystems provide for human beings.<sup>6</sup> The benefits depend on the four functions of ecosystems: 1) suppliers of resources such as water, wood and fibres; 2) regulatory functions that affect climate, flooding, diseases, waste and water quality, for example; 3) cultural functions which enable activities such as recreation and which provide aesthetic and psychological benefits; 4) supporting functions, such as soil formation, photosynthesis and nutrient circulation.

The main conclusion of the MA project was that human beings have brought about unprecedented changes in natural systems over the past fifty years. This was necessary to meet increasing demands for food, water, fibres and energy. The changes have contributed to improving the standard of living of thousands of millions of people. However, the changes also led to a sharp decrease in the capacity of ecosystems to fulfil their functions in ecosystem 'Earth'.

The MA's compilers cite a wide range of direct and indirect causes of the global damage to ecosystems. The direct causes include the replacement of forest by agricultural crops, overfishing of the oceans and seas, and land, air and water pollution. Indirect causes include population increases, economic growth and technological developments. They extrapolated future scenarios from the trends and, amongst other things, warned that climate change will probably be the main cause of species extinctions over the next hundred years.

### Other international reports

Besides MA and IPCC documents, various other international reports refer to global environmental changes that are taking place: see for example 'Global Environmental Outlook 4' and 'The pan-European environment: glimpses into an uncertain future'.<sup>7,8</sup> These reports also show that the environment and therefore living conditions on earth are facing serious challenges and that a complex mix of social, economic and ecological measures are required to turn the tide and support living conditions.

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## Total picture

It follows from the aforementioned reports that, in addition to climate change, various other global environmental changes caused by human activity are taking place that affect each other, such as: air pollution, damage to the ozone layer, loss of biodiversity, pollution and acidification of seas and oceans, overfishing, soil erosion and deforestation, alteration of the nitrogen cycle and declining freshwater resources. This all results in such large-scale global changes to land, oceans and the atmosphere that the fundamental conditions necessary for sustained development of human society are jeopardised. As a whole, this involves complex, interrelated developments in a global context that result in a diversity of local, regional and global consequences.

## The Netherlands

The global environmental changes are also expected to occur or have an impact in the Netherlands; there is no reason to assume that the Netherlands will escape the changes. Indications already exist that the climate in the Netherlands is changing. For example, figures from the Royal Netherlands Meteorological Institute (KNMI) show that in the last fifty years the average temperature in the Netherlands has increased more than the world average.<sup>9</sup> The Dutch government's concern for the future is therefore mainly the safety of the country's population.<sup>10,11</sup> It is focusing on protection against the effects of climate change that will be felt most keenly in the Netherlands, such as the rising sea level and flooding.

## Approach

The Netherlands is partly responsible for global environmental changes and is also experiencing the consequences. The causes can only be tackled effectively at the international level; this applies to reducing CO<sub>2</sub> emissions, for example. This type of international cooperation also has the support of the EU's population, at least with regard to climate change.<sup>12,13</sup> Even if this all goes well, unwanted environmental changes will probably only be partially preventable at best, a case in point being the rising sea level. Protective measures are therefore also necessary. Some of these can be taken at the national level, as the consequences and solutions differ from continent to continent and country to country. Examples of measures in the Netherlands include increasing the height of dykes and establishing inundation areas.

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## Health effects of global environmental changes

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Sections 3.1 and 3.2 of this chapter provide an overview of the impact of global environmental changes on public health in the Netherlands based on the report *Mondiale milieuveranderingen en volksgezondheid: stand van de kennis*.<sup>2</sup> Section 3.3 discusses the significance that should be given to the findings for the research agenda discussed in the report by drawing attention to developments that could possibly encounter difficulties. In section 3.4 the Committee makes a number of concluding comments on the health effects of global environmental changes that it believes warrant particular attention and it indicates *the type* of research that may be especially helpful to obtain greater clarity.

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### 3.1 Importance of the report on current knowledge of global environmental changes and public health

The aforementioned report on current knowledge of global environmental changes and public health discusses global processes and their effects on public health in the Netherlands: atmospheric changes (climate change and damage to the ozone layer), changes in land cover and use, depletion of freshwater resources and a decline in biodiversity. The latter development is mainly a result of the first three. As in international publications<sup>5,14</sup> a distinction is made between:

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- the effects of direct exposure to individual environmental factors (such as an increased mortality rate during heatwaves or additional cases of skin cancer attributable to higher levels of UV radiation from the sun),
- effects that occur indirectly (such as the consequences of deforestation, erosion, soil depletion, the use of fertilizers, and water pollution),
- effects that not only concern the physical environment but also the social environment because they are based on social, economic and demographic crises – the extremely indirect effects, such as outbreaks of infectious diseases on account of large numbers of refugees in the wake of flooding related to climate change.

The Committee believes that the report is a clear and informative document. Its novel value is the focus on the situation in the Netherlands; it provides the Dutch government with important scientific information for policy decisions.

The report makes clear that many questions about the health effects of global environmental changes are still unanswered, both at the global scale and in the Netherlands. The report's authors believe that the seriousness of the situation calls for research to enable effective and appropriate measures to be taken to protect public health. The Committee shares this opinion. The next section provides an overview of the potentially harmful effects and assesses how likely they are to occur in the Netherlands.

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### **3.2 Health effects**

Table 1 provides an overview of potential effects on public health in the Netherlands of various environmental changes. The table shows the extent to which a link between an environmental change and a given health effect has been empirically substantiated and whether the specific effect could occur in the Netherlands. The table is based on the aforementioned report on current knowledge of global environmental changes and public health.

The overview shows that the effects on public health of atmospheric changes (climate change and damage to the ozone layer) have been researched most and are the most widely known. The potential effects of the other types of global environmental changes are generally more indirect and less well researched. This makes them more difficult to indicate.

Table 1 Health effects of global environmental changes.

Environmental changes	Effects	Knowledge	Relevance for the Netherlands
<i>Climate change</i>			
Direct effects	Increasing disease and mortality rates owing to more heatwaves and cold waves. Less cold winters may lead to fewer deaths and disease. Disease manifests as an exacerbation of disorders of the respiratory system and cardiovascular diseases. Adverse effects on the quality of air and water owing to rising temperatures, and the resulting increased likelihood of diseases. Increasing likelihood of food spoiling and thereby food poisoning.	The impact of heatwaves on disease and mortality rates has been documented. The fact that climate change would lead to more heatwaves (and possibly more cold waves) seems plausible. The remaining effects are plausible with higher average temperatures.	The impact of heatwaves on disease and mortality rates has also been documented for the Netherlands. The extent to which the other effects are important depends on the management of water quality and measures to reduce air pollution. Food spoilage appears to be less important for the situation in the Netherlands.
Indirect effects	Changes in seasons and plant growth may extend the length of the pollen season and may increase the incidence of atopic disorders. Changes in insect populations alter the distribution patterns of existing vector-related diseases. New vectors may survive leading to the emergence of new vector-related diseases. An increase in coastal flooding as a result of the rising sea level with direct effects on residents and indirect effects through deteriorating housing conditions (including infectious diseases owing to poor quality surface water and respiratory disorders caused by damp housing). Extremely high and low water levels in rivers may occur more frequently and have consequences for the biological and chemical quality of water; flooding, for example, may lead to local soil pollution entering rivers and extremely dry periods may result in discharges being less diluted. Low water levels threaten water supplies and energy supplies, owing to the use of cooling water.	There are indications of changes in seasons, pollen counts and the distribution patterns of vector-related diseases but it is difficult to determine the extent to which climate change is also responsible for them. The consequences of flooding have been documented but there is still a considerable lack of information about the interplay between a rising sea level, extreme weather conditions and climate change. The same applies to increased flooding in periods of low water levels in rivers.	A longer growing season and shifts in the pollen season have been observed in the Netherlands. It therefore seems plausible that the Netherlands will be confronted with the consequences of changes in seasons and changes in the distribution of vector-related diseases. The Netherlands is susceptible to an increased risk of flooding, a subject which has long been the focus of attention. Problems that result from low water levels in rivers are also important for the Netherlands.
Extremely indirect effects	Heatwaves and higher average temperatures may lead to water shortages and in turn economic and social disruption. Flooding attributable to a rising sea level may have similar social consequences.	The occurrence of the effects mentioned is not only plausible but also documented. However, the time, place, nature and extent are difficult to predict and depend on other social conditions. The effects merge with those of other global environmental changes.	The significance for public health in the Netherlands is not known.

Table 1 Health effects of global environmental changes.

Environmental changes	Effects	Knowledge	Relevance for the Netherlands
<i>Damage to the ozone layer</i>			
Indirect effects <sup>a</sup>	Damage to the ozone layer leads to higher levels of UV radiation from the sun reaching the earth's surface. This may increase the incidence and mortality rate associated with basal cell and squamous cell carcinomas and may affect the incidence and mortality rate associated with melanomas. Similarly, there are indications that certain types of cataracts are caused by exposure to UV radiation from the sun. In many regions, increased exposure to sunlight (UV radiation) is beneficial for the vitamin D status and therefore for bone development. It is also associated with a reduced incidence of certain types of cancer, other than skin cancer. Moreover, there are indications that UV radiation suppresses the immune system. UV radiation may affect plant growth and agricultural yields too, as well as the reproduction of animals, such as fish.	The relationship between UV radiation and skin cancer is well documented, except in the case of melanomas. This is not so much the case for eye disorders. However, it is certain that UV radiation plays a role in them. The relationship between UV radiation from the sun and vitamin D status is well documented, as is the effect of vitamin D on bone development. Regardless of whether through vitamin D production or otherwise, the degree to which exposure to sunlight counteracts the emergence of certain types of cancer, other than skin cancer, is the subject of scientific debate. It is unclear whether increased UV radiation leads to an increase in the incidence of infectious diseases owing to damage to the immune system. The effects on plants and animals are plausible and converge with those of other global environmental changes.	The Netherlands is facing these effects; the increase in the level of UV radiation has been confirmed by measurements. <sup>16</sup> The initial risk to health seems to be limited, provided the usual precautions are taken in the summer, such as staying in the shade and using sun lotions. The effects on plants and animals do not appear to be a cause for great concern in the Netherlands as regards the food supply.
<i>Changes in the use of land</i>			
Indirect effects	Changes in the use of land may disrupt natural systems and the environmental functions that those systems fulfil. This may in turn lead to a decline in biodiversity and to extra CO <sub>2</sub> emissions and a reduction in CO <sub>2</sub> uptake, thereby accelerating climate change. Agricultural land may be lost to erosion and desertification.	The effect of the change in land use is plausible and also documented. It is more difficult to indicate the effects on health as they also depend on many other developments. The effects merge with those of other global environmental changes.	Changes in the use of land in the Netherlands appear to be less important as the Netherlands actually has a cultural landscape. The consequences for public health in the Netherlands will therefore manifest indirectly through flooding and economic mechanisms.
Extremely indirect effects	The indirect effects may lead to economic and social disruption and also be a factor in armed conflicts; the result may be food and water shortages and high levels of migration.	The occurrence of the effects mentioned is not only plausible but also documented. However, the time, place, nature and extent are difficult to predict and depend on other social conditions.	The significance for public health in the Netherlands is not known.

Table 1 Health effects of global environmental changes.

Environmental changes	Effects	Knowledge	Relevance for the Netherlands
<i>Change in freshwater supplies</i>			
Indirect and extremely indirect effects	Dry periods, low water levels in rivers and depletion of groundwater reservoirs threaten freshwater supplies in various regions. This may also lead to social and economic disruption. High water levels in rivers threaten the biological quality of the water, which may also jeopardise drinking water supplies.	The occurrence of the effects mentioned is not only plausible but also documented. However, the time, place, nature and extent are difficult to predict and depend on other social conditions.	The significance for public health in the Netherlands is not known.
<i>Loss of biodiversity</i>			
Indirect and extremely indirect effects	How loss of biodiversity affects the global environment is uncertain. It is clear that the stabilising role of natural systems declines. This may lead to less CO <sub>2</sub> uptake, thereby accelerating climate change. Biodiversity is also cited as an example of a source of food crops and medicines; damaging it therefore jeopardises this function.	Knowledge of mechanisms and consequences is still extremely limited. There is no scientific certainty about the effects on the global climate system. There are also uncertainties about the effects of climate change on biodiversity.	The significance for public health in the Netherlands is not known.

<sup>a</sup> In 1994 the Health Council assessed the health effects of damage to the ozone layer; the situation has changed negligibly in relation to the relatively good level of knowledge available at the time <sup>15</sup>

Some effects – particularly of climate change and damage to the ozone layer – already appear to be occurring, such as a higher mortality rate related to heat-waves and increased incidence of respiratory allergies. However, as yet unfamiliar effects could also appear, such as new infectious diseases, which have not previously manifested on a wide scale in the Netherlands, and the consequences for public health of high levels of migration owing to conflicts that are also rooted in environmental damage resulting from global environmental changes, in the form of water shortages, for example. However, health threats will indubitably be partially attributable to factors other than global environmental changes, such as an increase in the incidence of infectious diseases as a result of the growth in international passenger travel and trade. This would increase the likelihood of disease and of new diseases being spread rapidly around the world by disease-carrying people, insects and other disease-carrying animals. The process of globalisation is an important factor in a more general sense.

The Netherlands may therefore face an exacerbation of effects that already occur in the country combined with the appearance of a number of unfamiliar effects. In every case, the more distant in time the threat is, the greater the uncer-

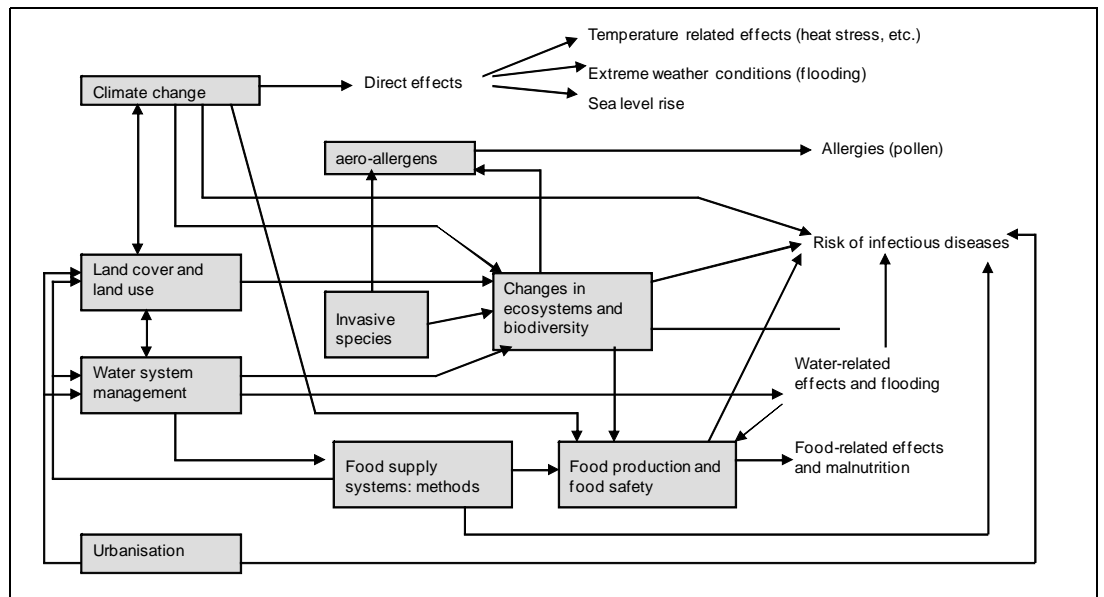


Figure 1 Diagram of the main mechanisms through which climate change could affect public health.<sup>2</sup>

tainty. Unknown tipping points could also lead to surprises.<sup>17</sup> When a tipping point is reached, a slight disturbance of the balance can lead to a major and possibly irreversible change.

All sorts of interactions occur between the various change processes; climate change might lead to changes in ecosystems, for example, thereby changing the range of species. These would not be separate developments. This explains the lack of information on the effects of the individual processes on public health.

Figure 1 shows what the relationship between climate change and public health might be like and what the impact of other environmental changes at this level might be. The diagram illustrates the difficulty of unravelling how health will be affected by the various environmental changes.

Not all the effects on public health of the global change processes that are underway will be adverse for the population of the Netherlands. Some effects will be beneficial. Against the adverse effects of climate change there may be a decrease in the mortality rate related to cold winters. Further, indirect effects are conceivable, for example via better crop yields. However, the overview shows that something serious is occurring. The Committee therefore suggests intensifying policymaking concerned with providing protection against the adverse effects.

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### 3.3 Research agenda

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#### 3.3.1 *Four criteria for drawing up a research agenda*

According to the authors of the aforementioned report on current knowledge of global environmental changes and public health, four criteria are important for drawing up a research agenda:

- the extent of the long-term health effects in the Netherlands (after 2030) in terms of the incidence of additional premature deaths
- the degree of certainty about the consequences for the Netherlands
- the extent to which Dutch policy could influence the effects
- the degree to which research into the effects is possible.<sup>2</sup>

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#### 3.3.2 *Priorities*

The reporters used the four criteria as the basis for a rough comparison of the issues and concluded that the score for climate change and damage to the ozone layer was higher than the scores for changes in land use, freshwater supplies and biodiversity, as more detailed knowledge is available about the effects of these.

The reporters saw climate change and damage to the ozone layer as fields in which public health gains could be achieved relatively quickly through investing in research. However, they thought that research priorities should not be based on this reason alone. The remaining global environmental changes would inevitably be given a lower place in the prioritisation of issues requiring further research owing to uncertainties about the health risks, the lack of scope for influencing them and the limited options for conducting research into them. The reporters therefore proposed taking other factors into account, such as the combination of potentially large but also very uncertain risks that are found with global environmental changes of this kind. They therefore proposed that a research programme should include a balance between investment in research for which the benefit to public health in the Netherlands could be achieved relatively soon and with a reasonable degree of certainty, and investment in research that could help reduce the uncertainties in the long term.

The Committee stresses the latter point and subscribes to the proposal. It would be unwise to focus research solely on effects that are either reasonably certain or very plausible. It is therefore important to conduct research into the least certain effects, such as those resulting from changes in land use, freshwater supplies and biodiversity. This approach would avoid insufficient investment in

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research into uncertain but potentially major risks. Moreover, policy measures can be applied to reasonably certain and plausible effects. This can be done by taking action to curb environmental changes, such as additional measures to reduce CO<sub>2</sub> emissions, and by taking action to limit the consequences, such as providing protection against the effects of heat. However, with measures of this kind there is the question of which groups are affected and how they can best be enabled to cope.

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### 3.4 Conclusion

The Committee concludes that there is a lack of knowledge of how global environmental changes will affect public health in the Netherlands. However, the amount of knowledge has grown since the publication of the Health Council's first advisory report. It is now clear that climate change can damage health. This is also clear with regard to damage to the ozone layer but the picture has not changed substantially since the Health Council last assessed the consequences for health. It is plausible that changes in land use, depletion of freshwater resources and a decline in biodiversity will lead to adverse effects but empirically this is less well substantiated. There are indications that the effects are also partially attributable to other factors. They are all plausible, serious and relevant for the Netherlands. The issues involve effects that already occur as well as possible new phenomena.

Given the advance of environmental changes and the range of possible effects on public health, the Committee views this as an urgent matter. The Dutch government has adopted a leading international role in taking action to counteract environmental changes because living conditions are under threat worldwide.<sup>18</sup> Action has also been taken to limit the consequences in the Netherlands but these are almost all concerned with spatial planning in the Netherlands with a view to providing safeguards against the rising sea level and extreme river drainage. According to the Committee, the potential severity and extent of the health risks means they should also definitely be on the policy agenda. A group of British scientists also reached the same conclusion recently.<sup>19</sup>

The considerable lack of information on what the effects on public health will be of the various global environmental changes in general, and in the Netherlands in particular, is not surprising, as the features of the changes concerned make it extremely difficult to study their effect on public health; they cover an enormously wide area, are insidious, expand in time and space, have numerous causes, a wide range of impacts and are interdependent. Moreover, other factors

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also affect public health, such as the level of affluence and the quality of health services, and these factors are affected by global environmental changes (see for example <sup>20</sup>). These aspects will have to be taken into account to obtain reliable results from further research into the health effects.

Looking at these issues from a broad perspective, the Committee takes the view that it would be advisable to invest in research into the health effects of global environmental change processes. The Committee also stresses the importance of remembering that the changes involve interdependent developments. They concern more than the four changes (see chapter 2). There is, for example, also air pollution and the pollution and acidification of seas and oceans, whereby the former involves a strong local component and can adversely affect health in a relatively short time (disorders of the respiratory system and cardiovascular diseases). Specific attention should be paid to the difficult task of conducting research into ways of reducing uncertainties about how health will be affected by changes in land use, freshwater supplies and biodiversity, even if the research results are unlikely to lead to policy-based solutions in the near future.

Further research into the effects on public health of climate change and damage to the ozone layer could be linked to various research programmes that are currently underway, such as those into respiratory disorders and infectious diseases. The remaining global environmental changes will have to do without any such research framework. Moreover, the formulation of hypotheses in this field is still in its infancy; however, there are some initiatives towards this.<sup>21</sup>

So much is already known about the health effects of climate change that it would be advisable for part of the research to focus on possibilities for us to adapt, for example by paying more attention to identifying risk groups and how the health threats they face can be reduced. This is less important in the case of damage to the ozone layer because effective global measures (banning the use of gases that damage the ozone layer) have been taken which are expected to result in the ozone layer being restored in due course. Concerning other environmental changes, a lot more research is required into the nature of the health threats, how extensive they will be and where and when they will occur.

A coherent analysis of the subject is essential for obtaining greater understanding of how global changes in the living environment will affect public health. It is true that many observations have been made and hypotheses formulated but knowledge of the links between the various phenomena – environmental changes and their possible causes and effects, including those on public health – is very sparse. It is therefore essential to obtain clarity about the links. The Committee cites in this context clarification of the structure of the network of linked effects

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which includes global environmental changes and their health effects. The analysis should also take into account other determinants of public health, such as the level of affluence and the quality of health services. Adopting systems thinking in this way will provide the greatest insight into relationships and therefore about effective and cost-effective measures. The next chapter discusses this in depth.

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## **Systems thinking approach for public health**

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This chapter discusses why systems thinking is appropriate for obtaining a better insight into the relationships between global environmental changes and public health in the Netherlands. Section one outlines ‘the system’, the network of linked effects which includes global environmental changes and their causes (section 4.1). This is followed by an indication of the significance of systems thinking for clarifying the links between environmental changes and public health and for determining the effectiveness of policy (section 4.2). The best way to approach systems thinking is discussed after this (section 4.3). The chapter ends with the Committee’s conclusions (section 4.4).

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### **4.1 Determinants of health**

Various factors determine public health (‘determinants’). Various conceptual models exist for these. The basis for this advisory report is the model shown in figure 2, which was specifically developed for describing the links between global change processes and public health. The model only includes effects from external sources; it does not consider genetic factors, which also determine health. The model identifies four types of determinants of public health. Besides determinants in the environmental domain, such as air quality and climate, the other determinants are in the institutional, economic and sociocultural domains. The institutional domain refers to society’s political and administrative organisation. Education is an important factor in this domain. Economic determinants are

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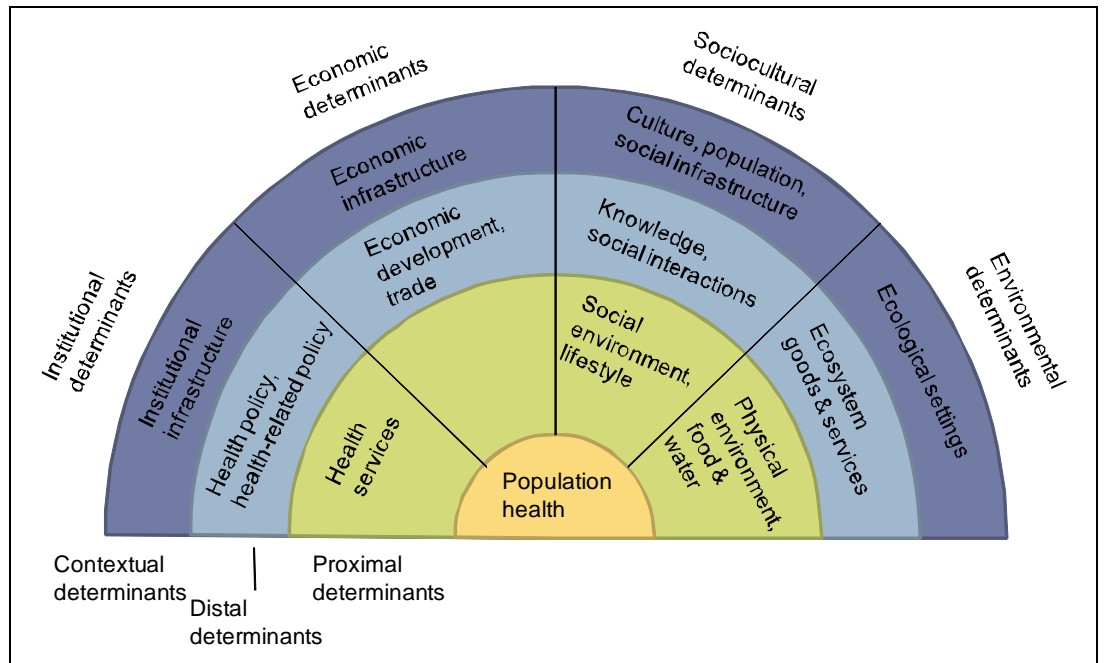


Figure 2 Determinants of health.<sup>22</sup>

concerned with issues such as the effect of economic developments and prosperity on public health. The social domain relates to matters such as lifestyle and social cohesion.

Various levels at which determinants can affect health are identifiable within the domains, namely proximal, distal and contextual. Proximal factors affect public health directly. Distal determinants operate further down the chain through a number of intermediate causes; the effect of distal determinants is therefore always indirect. Ultimately, contextual factors are seen as circumstances at the macro level at which distal as well as proximal factors operate and develop; their effect is even more indirect than that of distal determinants. For example, in the institutional domain contextual factors include the form of government and general legislation. Distal determinants in this domain include every type of preventive health policy, such as anti-smoking regulations but also policy in other areas that affects public health, such as policy on food supplies or working conditions ('health-related policy'). Proximal determinants in the institu-

tional field are concerned with the existence of all manner of services regarding medical treatment and care, including access to those services.\*

Consequently, many factors have an effect but there is also interaction and feedback between determinants in a single domain and between determinants in different domains, and their levels may also differ. The following is an example of feedback. Part of the institutional domain, the organisation of health services (a distal determinant), affects public health. However, the link between the two also operates in the opposite direction: improving public health affects the organisation of health services. Various biochemical cycles (especially those for the elements carbon, nitrogen, phosphorous and sulphur) are responsible for interactions in the environmental domain, as they form links between the various environmental change processes.

The occurrence of interaction and feedback means that the whole can be considered as a coherent network which acts together as a determinant for public health. Meaningful statements on the contribution of individual public health determinants are only possible if this relationship is taken into account.

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## 4.2 Importance of the systems thinking approach

The complexity of the network described above and the lack of information on some components makes it difficult to expose the links between changes in the living environment and public health, let alone describe them reliably in figures. Various simplifications are therefore used in practice to assess an environmental factor's effect on public health. For example, it is assumed that no interaction exists, in other words, if one factor is removed, the effects of other factors on life expectancy are assumed to remain the same.

To change this situation we need to obtain a better understanding of the system. This calls for an integrated analysis of the subjects, taking into account the dynamics of the factors that affect public health, including known interactions, feedback and tipping points. This is the only way to make substantial progress in determining the effect of global environmental changes on public health, in the Netherlands in particular, and in determining the effectiveness of measures to tackle the causes of the changes and to limit the consequences, regardless of the domain in which the measures are taken. This approach is known as systems thinking or the systems approach; a system is an explanatory description of a delineated component of reality comprising a number of components between

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\* Scientists' opinions differ on precisely where the borders between direct, indirect and extremely indirect should be drawn.

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which interaction occurs.<sup>23</sup> For the purposes of this advisory report, the system is the network of linked effects made up of the four domains. The added value of using systems thinking is mainly found in the assessment of effects that manifest over a long period. In practice, necessity compels researchers to limit their research to network components of various sizes.

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### 4.3 Systems thinking approach

The essence of systems thinking is the analysis of the whole. This requires the combination of insights, information and analytical methods from various fields. Focusing systems thinking on the health effects of global environmental changes requires the integration of disciplines such as epidemiological, biomedical and ecological research into health effects with research in the fields of economics and social science. The part of the system studied determines the level of input required from the various fields.

The initial aim of systems thinking is a qualitative description of possible processes, links, interactions, feedback and tipping points. Some system components can be cast in a quantitative mould and lend themselves to making calculations. Quantitative and qualitative analysis therefore go together, whereby the latter is mainly used in the service of the former.

The main instruments used in systems thinking are systematic data collection, system models and scenarios.

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#### 4.3.1 *Using models and scenarios*

Computer simulation models can be used to obtain insights into the behaviour of a system or some of its components. Including links, interactions and feedback in the models creates an advanced form of integration between the components (sub-models). The way the system works can be better understood by making calculations.

The Committee only uses the term system analysis in relation to making model calculations.\* A lack of data for system analysis does not necessarily bring systems thinking to an end; after all the principles of the systems thinking approach continue to apply.

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\* Not everyone makes this distinction between systems thinking and system analysis; the terms are often used interchangeably.<sup>24-26</sup>

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## Models

Systems thinking is often used in the environmental field as a tool for obtaining an insight into global environmental change processes as well as their causes and effects. It is important to distinguish between two types of computer models: scientific and integrated-assessment models.<sup>27-30</sup> The difference between them is illustrated by two characteristics: comprehensiveness and complexity. Comprehensiveness relates to the extent to which the system is covered by the model; this refers to the number of processes included (only environmental changes for example, or also economic developments). Complexity refers to the model's complexity (whether it covers all known subprocesses and natural variations in input data, for example, or only average values and key processes).

Scientific models are primarily used to obtain more knowledge of how the system or parts of it operate. All processes are modelled as accurately as possible, including their natural variations. There are numerous scientific models in the environmental field that can describe chemical, physical and biological processes on Earth<sup>31</sup>; examples include studies of climate changes over time on different continents (climate models).

Integrated-assessment models are used for applying available knowledge for policymaking. Models of this kind generally cover a larger part of the system. They include several chemical, physical and biological processes that are at the root of global environmental changes and the processes are integrated with social functioning (the institutional, economic and sociocultural domains).<sup>30,32-34</sup> The various components of integrated-assessment models are highly simplified variants of the scientific models. They also only comprise key processes and, where necessary and possible, they work with average values. Consequently, in comparison with scientific models, integrated-assessment models generally score well for comprehensiveness and less well for complexity.

Analyses conducted using integrated-assessment models can be helpful in assessing and comparing individual policy options or combinations of options to determine their desirable and undesirable consequences and they can also provide an impression of which policy can be used to achieve a particular objective.<sup>32,35</sup> This applies for the complete range of measures, from curbing global environmental changes (by reducing greenhouse gas emissions, for example) to limiting the health effects (such as through building regulations, organising health services and information on drinking and movement in the case of heat problems).

## Scenarios

Unrealistic expectations are a major pitfall when working with system models, namely expectations of being able to predict future developments. However, it is practically impossible to make predictions that go beyond exploring possible future developments. This requires using system models in combination with scenarios.

Here the term scenarios means alternative pictures of the future within which various perspectives of developments in the past, present and future are shown.<sup>36</sup> They place varying degrees of emphasis on prosperity or sustainability and solidarity for example. Moreover, a specific time horizon can be chosen, such as ten, fifty or a hundred years. Depending on the model used and the issue concerned, an analysis can be made for the world as a whole, a continent, groups of countries or individual countries.

## Uncertainty

Systems thinking gives shape to available knowledge, especially in relation to identifying, elucidating and explaining critical uncertainties.

Uncertainty arises from variability and ignorance. Variability is an inherent characteristic of our observation of the natural environment. Ignorance is the absence of knowledge. Variability and ignorance cannot be entirely separated because the absence of knowledge may be caused by variability in data but also by a complete lack of data. Variability and ignorance may lead to doubts about the causality of an assumed link or discussions about the nature and comprehensiveness of a model, for example. Moreover, uncertainty arises from a lack of information on feedback and tipping points, for example. Ignorance of this kind can in principle be remedied. There is also ignorance for which no remedy exists, as in the case of future social developments.

An extensive discussion of the uncertainties involved in systems thinking and the various techniques that can be used to delineate uncertainties when drawing conclusions is beyond the scope of this report. One method was mentioned above: working with scenarios is a way of dealing with uncertainties about social developments. Scenarios provide an insight into limitations on the extent to which policy could be enacted and what the consequences of this would be. More information on uncertainty and uncertainty analysis is provided by, amongst others <sup>32,37-44</sup>.

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### 4.3.2 *Collect data*

Systems thinking enables international as well as specifically Dutch questions to be addressed in relation to global environmental changes and their consequences for health. However, the success or failure of using systems thinking as an option for examining the problem and reaping the benefits depends on the availability of data. Given the nature of the problem, the data required as input for systems thinking must be obtained partially in the Netherlands and partially elsewhere.

An international trend has been observed towards better data accessibility and exchangeability. However, this does not guarantee that links between data from different sources can be established. This is often made difficult by differences in the scale of the data collection, for example. A point for special attention is therefore the way in which different types of data can be linked.

#### Cohort studies in the Netherlands

An extensive discussion of the types of data and research methods that are important for using systems thinking to obtain insight into how global environmental changes will affect public health is beyond the scope of this report. However, the Committee makes an exception to this by referring to an overview of Dutch epidemiological research. It may be possible to use the research in question for systems thinking relating to global environmental changes and their effects on public health in the Netherlands. It was highlighted in the RGO advisory report on assuring data on public health in the Netherlands now and in the future, which was published last year: ‘Van gegevens verzekerd. Kennis over de volksgezondheid in Nederland nu en in de toekomst’.<sup>45</sup> The aforementioned advisory report included a list of large-scale and long-term cohort studies that are currently underway in the Netherlands and called for measures to ensure the availability of empirical data on public health in the Netherlands (including measures to establish a register of data collections, to improve facilities for linking the various types of data to each other, and to make it easier for third parties to use the data). The Committee underscores the importance of the RGO advisory report for the issue of global environmental changes and their effects on public health in the Netherlands. However, it must be taken into account that the aforementioned studies were not set up to answer questions on this subject.

## Monitoring

The Committee also calls for monitoring. The Health Council's advisory report 'Health and the environment: monitoring options' defined monitoring as the periodic measurement, analysis and interpretation of indicators for environmental factors which are relevant to health, or for health problems which can be ascribed to environmental factors.<sup>46</sup> Indicators are variables which enable changes to be measured that provide information on characteristics or conditions that cannot be measured or observed directly.<sup>47</sup> Examples of relevant environmental and health indicators are the annual average of daily temperatures (an indicator for climate change) and the percentage of new cases of hay fever (an indicator for respiratory allergies).

Long series of measurements taken without interruption and collected using similar methods can be useful for detecting and demonstrating trends or – if such a link is plausible – expressing them in figures. Monitoring can also be useful for determining how effective adaptive or protective measures really are (a reduction in the mortality rate associated with heatwaves, for example).

Systems thinking can be helpful in tracing unknown effects and determining which variables make suitable indicators.

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### 4.3.3 *Scope of the systems thinking approach*

#### Focus thus far

Systems thinking gained a firm foothold in the environmental field. Scientific endeavours have thus far primarily focused on fathoming physical, chemical and biological environmental change processes and their causes (see chapter 2). The analyses examined the interaction between the environmental domain and the institutional, economic and sociocultural domains.

Some of the research also focused on determining the consequences, the options for taking action and the effects of the action taken. Measures at the international level have focused on tackling the causes and limiting the effects. The focus in the Netherlands is on the latter, with protection against flooding being the principal aim. Here too, the emphasis is on the safety of the Dutch population.

## Scientific role of the Netherlands

Dutch scientists were involved in the use of systems thinking in environmental policy from the outset and in the development of various integrated-assessment models (see for example <sup>48-52</sup>). Models with a significant contribution from scientists in the Netherlands have played a prominent role in the analyses included in the MA, IPCC and GEO4 reports.<sup>5,6,8</sup>

## Public health

Thus far the research world has mainly concentrated on global environmental changes and their causes, and the options available for curbing them; insofar as research into the effects has been conducted, little, if any, of it was concerned with the effects on public health (see chapter 3). Systems thinking on this point is accordingly incomplete.

However, work is underway to improve this. Dutch scientists are involved in these developments too.<sup>53-58</sup> The emphasis has thus far mainly been on major global causes of disease and premature death – such as malaria, malnutrition and unhygienic drinking water – as well as their determinants. The emphasis for the Netherlands should be on other diseases and threats, such as cardiovascular diseases and disorders of the respiratory system.<sup>59,60</sup>

To determine the degree to which a worsening situation can be avoided, an integrated approach to thinking about these subjects should not be limited to the effects on public health but should also extend to identifying risk groups as well as options for adapting and their effectiveness. For example, options during a heatwave include increasing the extent of health services, issuing building directives, providing information on behaviour changes in relation to drinking, movement and so forth. Applying systems thinking would possibly also ultimately enable a survey of matters such as the required number of vaccinations for a new disease, the required infrastructure and staff for administering the vaccinations, plus the necessary care provided by general practitioners and specialists, bearing in mind a possible increase in the number of cases of asthma and allergies.

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### 4.3.4 *Bring professional fields together*

There is a major impediment to increasing what is known about the effect of global environmental changes on public health. Systems thinking in the environmental field is mainly the domain of system modellers and scientist from a wide range of fields in the natural and social sciences, such as physicists, physico-

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chemists, biologists, sociologists, psychologists and economists. These researchers mainly know a great deal about the technical side of modelling and about part of the system, namely the system's environmental change processes and their causes and links to institutional, economic and sociocultural domains; they know little about public health and its determinants. They seldom work with medical doctors and other health scientists with experience in empirical health research and who therefore have the necessary expertise to further unravel the links between the environment and health and to shape the part of the system concerned. In the Committee's opinion, close cooperation between these two groups is crucial for achieving success. This is the only way that they can learn from each other's insights and clearly describe the problems.

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#### **4.4 Conclusion**

The Committee takes the view that systems thinking is a precondition for surveying future public health in relation to global environmental changes. Systems thinking is an instrument that gives available knowledge structure and coherence while also contributing to gaining a better understanding of the system's operation. It can therefore be used to assist in decision-making on future policy. Adopting this approach places surveys of the effects on public health that can be expected within reach; such surveys are useful for policy applications. It also provides information on the effectiveness of policy and on any undesirable side-effects.

The Committee points out that systems thinking in the field of effects on public health has been left behind systems thinking in the field of global environmental changes and their causes. Given the potentially severe and extensive effects concerned here, the Committee believes that this point warrants additional investment. This requires close cooperation between scientist from two fields that currently hardly ever meet. On the one hand this refers to system modellers and scientists from a wide range of fields in the natural and social sciences and, on the other hand, medical doctors and other health scientists. Thanks to the strong scientific position the Netherlands has in systems thinking in the environmental field, researchers in the Netherlands can play a significant role in improving the situation. This would benefit Dutch as well as international public health interests.

In the Committee's opinion, the key areas of research into the relationship between global environmental changes and public health in the Netherlands, whereby the systems thinking approach to the relationship could be expanded, are:

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- empirical research into the health effects of global environmental changes
- the development and application of scenarios to explore the health effects of global environmental changes and thereby gain an understanding of their nature and magnitude and the time when they will occur
- determination of relevant indicators
- identification of risk groups
- research into possible measures for alleviating the health effects of global environmental changes and into the effectiveness of any such measures.

The research into climate change and damage to the ozone layer can partially focus on the latter two points; in the case of the other global environmental changes the remaining points still require a lot of work.



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## Conclusions and recommendations

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Scientific knowledge of the global environmental changes that are underway and their consequences has increased considerably in recent decades. However, in contrast with this, we still know little about how the changes will affect public health over time. This applies globally as well as in the Netherlands in particular. A summary of what we know about this was provided in a recent Dutch report on current knowledge of global environmental changes and public health in the Netherlands: 'Mondiale milieuveranderingen en volksgezondheid: stand van de kennis'.<sup>2</sup> The Committee observes along with the report's authors that there are still many gaps in the available knowledge.

Nevertheless, it is an established fact that climate change has adverse health effects and that the Netherlands will not be able to escape them; this is something that was unclear more than twenty years ago when the Health Council first examined the subject. It is likewise an established fact that damage to the ozone layer can be harmful to health, as previously noted by the Health Council (1994).<sup>15</sup> Public health is also likely to suffer from other environmental changes, such as changes in the use of land, depletion of freshwater resources and a decline in biodiversity but the indications for this are less clear. Nonetheless, the possible effects are relevant, and potentially severe and extensive. However, it is not possible to say when they will occur, how often, and how extensive they will be.

Therefore, according to the Committee, the health aspects of global environmental changes should definitely be on the policy agenda. The effects are par-

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tially attributable to determinants other than the environmental changes in question. However, knowledge of their combined action is scarce.

Establishing a proper balance between implementing policy renewals and conducting further research would be in keeping with a precautionary strategy that incorporated the aforementioned elements.

The Committee makes nine recommendations to this end.

**1 Pay more attention in policy and research to the consequences for health of global environmental changes**

The consequences for health of global environmental changes are important but have thus far not been paid sufficient attention in policy and research. This certainly applies to the environmental changes that are least clearly understood, such as changes in land use, depletion of freshwater resources and a decline in biodiversity. Consequently, the Committee recommends paying specific attention to the latter processes when drawing up a research programme, while also bearing in mind that these are not separate developments.

**2 Research into health threats and protective measures**

Sufficient information is already available on the health effects of climate change to enable part of the research to focus on possibilities for us to adapt, for example by paying more attention to identifying risk groups and how the health threats they face can be reduced. This is less important in the case of damage to the ozone layer because measures at the international level have been taken which appear to be effective and are expected to result in the ozone layer's restoration in due course. Concerning other environmental changes, a lot more research is required into the nature of the health threats, how extensive they will be and where and when they will occur.

**3 Adopt systems thinking**

Numerous factors affect public health, not just environmental factors such as the global changes discussed here but also institutional, economic and sociocultural factors. Taking the factors as a whole – including global environmental changes – we know or can reasonably assume that some of them are influenced by each other's effects. However, there are still many gaps in our knowledge of how they are interrelated. Nevertheless, meaningful statements on how the various global environmental changes affect public health – both in general and specifically in

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the Netherlands – can only be made if these interrelationships are taken into account. Obtaining greater understanding of the interrelationships is therefore crucial. The core of this systems thinking approach is the merging of knowledge from various disciplines.

The Committee takes the view that systems thinking is a precondition for surveying future public health in relation to global environmental changes. It is an instrument that gives available knowledge structure and coherence while also contributing to gaining a better understanding of how the system or parts of it operate. Systems thinking can make a valuable contribution to improving our understanding of how global environmental changes will affect public health in the Netherlands. It can therefore be used to assist in decision-making on future policy. Systems thinking places surveys of the effects on public health that can be expected within reach; such surveys are useful for policy applications. It also provides information on the effectiveness of adopted policy.

Systems thinking demands the compilation of adequate data. In part, such data will need to be specific to the situation in the Netherlands.

#### 4 Bring two groups of researchers together

The Committee notes that systems thinking is becoming established in the field of global environmental problems but does not yet generally extend into the relationship to public health. Given the potentially severe and extensive effects concerned here, the Committee believes that this point warrants additional investment. This requires close cooperation between scientists from two fields that currently hardly ever meet. On the one hand this refers to system modellers and researchers from a range of fields in the natural and social disciplines and, on the other hand, medical doctors and other health scientists. Input from this group is essential to enable public health to have a place in systems thinking about global environmental changes. This input could be achieved by making grants available to support research in which the two scientific fields are integrated.

#### 5 Exploit leading position

The Netherlands is a pioneer in the development of systems thinking in the environmental field. The Committee therefore takes the view that it would be advisable to examine the extent to which its recommendations can be implemented in international cooperation involving a major role for Dutch scientists. After all, their strong scientific position in this field means that investments in research in which they are involved are highly likely to be successful.

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## 6 Implement policy that works on several fronts

The transnational nature of the problem makes international coordination essential for measures and agreements intended to tackle the causes. It will also be possible to take specific adaptive measures domestically. A particular aspect of any such measures is that they often have an impact on more than one front simultaneously, which means that they are helpful in tackling more than one environmental issue.<sup>61,62</sup> For example, energy saving not only reduces the use of natural resources but also greenhouse gas emissions, and reducing dependence on fossil fuels for vehicles and transport improves air quality while also reducing greenhouse gas emissions. This is all beneficial to public health.

## 7 Ongoing monitoring

A major part of policy based on precautionary action is monitoring developments over time to ascertain whether the severity of the problem and the uncertainties remain the same and also, of course, to determine the effectiveness of adopted policy and to make any necessary adjustments. Especially given the extent of the uncertainty in which policy decisions have to be made, it may well be that a chosen course of action fails to work or has undesirable side-effects. Systems thinking can be an aid in finding the relevant indicators for research of this kind, for both environmental changes and public health.

## 8 Take extra care with communication

The particular characteristics of the issue of global environmental changes and their effect on public health in the Netherlands make it more difficult to communicate about risks and the options available for controlling them, not least because of the international dimension. It is therefore necessary to exercise exceptional care in communication.

The essence of this is that various processes may have far-reaching consequences for public health but there is still a great deal of uncertainty about the nature and extent of the risks and timescale over which they will manifest. Moreover, various points of view exist in the community about the urgency of the problem and the desirability of measures to combat the suspected changes or prepare ourselves for them. This calls for a type of decision-making ('governance') based on participative dialogue with those involved, namely authorities, citizens, social parties and experts. The parties include the business community, trade unions and consumer and environmental protection organisations. The Commit-

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tee sees communication as a two-way exchange of information plus discussions between the parties concerned, without underestimating the importance of providing information on scientific findings and explanations of policy options.

## 9 Set the agenda

This advisory report is in the form of an agenda. The details of research proposals can be worked out in line with the usual procedures for encouraging and giving shape to scientific research programmes, and in line with current processes for concluding international research agreements, such as those that can be used to reduce the knowledge gaps that were identified in the 'Millennium Ecosystem Assessment'<sup>21</sup>.



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## References

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- 1 Gezondheidsraad: Commissie CO<sub>2</sub>-problematiek. CO<sub>2</sub>-problematiek. Wetenschappelijke inzichten en maatschappelijke gevolgen. Den Haag: Gezondheidsraad; 1986: Publicatienr. 1986/32.
  - 2 Huynen MMTE, de Hollander AEM, Martens P, Mackenbach JP. Mondiale milieuveranderingen en volksgezondheid: stand van de kennis. Bilthoven: RIVM; 2008.
  - 3 Gezondheidsraad. Voorzorg met rede. Den Haag: Gezondheidsraad; 2008: publicatienr. 2008/18.
  - 4 The Millennium Ecosystem Assessment. Internet: <http://www.millenniumassessment.org/en/index.aspx>.
  - 5 Intergovernmental Panel on Climate Change (IPCC). Climate change 2007. Geneva: World Meteorological Organization and United Nations Environment Programme; 2007.
  - 6 Reid WV, Mooney HA, Cropper A, Capistrano D, Carpenter SR, Chopra K *et al.* Millennium Ecosystem Assessment. Ecosystems and Human Well-Being: Synthesis. Washington DC: Island Press; 2005.
  - 7 EEA. The pan-European environment: glimpses into an uncertain future. Copenhagen: European Environment Agency; 2007: Report No 4/2007.
  - 8 United Nations Environment Programme (UNEP). The Fourth Assessment, Global Environment Outlook: Environment for Development (GEO4). Nairobi, Kenia: United Nations Environment Programme; 2007. Internet: [http://www.unep.org/geo/geo4/report/GEO-4\\_Report\\_Full\\_en.pdf](http://www.unep.org/geo/geo4/report/GEO-4_Report_Full_en.pdf).
  - 9 KNMI. De toestand van het klimaat in Nederland 2008. De Bilt: KNMI; 2008.
  - 10 Deltacommissie. Samen werken met water. Een land dat leeft, bouwt aan zijn toekomst. Bevindingen van de Deltacommissie 2008. Haarlem: Synergos Communicatie; 2008. Internet: <http://www.deltacommissie.com/doc/2008-09-03%20Advies%20Deltacommissie.pdf>.
-

- 11 Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer; Ministerie van Verkeer en Waterstaat; Ministerie van Landbouw, Natuurbeheer en Voedselkwaliteit; Ministerie van Economische Zaken; Interprovinciaal Overleg; Vereniging van Nederlandse Gemeenten; Unie van Waterschappen. Maak ruimte voor klimaat! Nationale adaptatiestrategie - de beleidsnotitie. 2007. Internet: <http://www.maakruimtevoorklimaat.nl/onderzoeken-rapporten.html>.
- 12 Attitudes of European citizens towards the environment. Special Eurobarometer. European Commission: Directorate General Environment; 2008. Internet: [http://ec.europa.eu/public\\_opinion/archives/eb\\_special\\_en.htm](http://ec.europa.eu/public_opinion/archives/eb_special_en.htm).
- 13 TNS Opinion and Social. Europeans' attitudes towards climate change. Brussels: European Commission: Directorate General for Communication; 2008: Special Eurobarometer 300. Internet: [http://ec.europa.eu/public\\_opinion/archives/ebs/ebs\\_300\\_full\\_en.pdf](http://ec.europa.eu/public_opinion/archives/ebs/ebs_300_full_en.pdf).
- 14 Confalonieri U, McMichael A (editors). Global environmental change and human health. Science plan and implementation strategy. Paris: Earth System Science Partnership; 2009: ESSP Report no. 4. Internet: <http://www.essp.org/index.php?id=31>.
- 15 Gezondheidsraad: Commissie Risico's UV straling. UV straling uit zonlicht. Den Haag: Gezondheidsraad; 1994: publicatienr. 1994/05.
- 16 Outer PN den, Slaper H, Tax RB. UV radiation in the Netherlands: Assessing long-term variability and trends in relation to ozone and clouds. *J Geophysical Res* 2005; 110(D02203, doi: 10.1029/2004JD004824)
- 17 Lenton TM, Held H, Kriegler E, Hall JW, Lucht W, Rahmstorf S *et al*. Tipping elements in the Earth's climate system. *Proc Natl Acad Sci U S A* 2008; 105(6): 1786-1793.
- 18 Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer. Cramer naar internationaal topperleg klimaat. Internet: <http://www.vrom.nl/pagina.html?id=42514>.
- 19 Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R *et al*. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *Lancet* 2009; 373(9676): 1693-1733.
- 20 Stern N. Stern Review Report on the Economics of Climate Change. London: HM Treasury; 2006. Internet: [http://www.hm-treasury.gov.uk/sternreview\\_index.htm](http://www.hm-treasury.gov.uk/sternreview_index.htm).
- 21 ICSU-UNESCO-UNU. Ecosystem change and human well-being. Research and monitoring priorities based on the findings of the Millennium Ecosystem Assessment. Internet: <http://www.icsu-asia-pacific.org/img/MA%20Final%20Report.pdf>.
- 22 Huynen MMTE, Martens P, Hilderink HBM. The health impacts of globalisation: a conceptual framework. *Globalization and Health* 2005; 1(14) doi:10.1186/1744-8603-1-14.
- 23 Rotmans J, De Vries B. Perspectives on global change: the TARGETS approach. Cambridge, UK: Cambridge University Press; 1997.
- 24 Costanza R, Graumlich L, Steffen W, Crumley C, Dearing J, Hibbard K *et al*. Sustainability or collapse: what can we learn from integrating the history of humans and the rest of nature? *Ambio* 2007; 36(7): 522-527.
-

- 25 Schellnhuber HJ, Crutzen PJ, Clark WC, Hunt J. Earth system analysis for sustainability. *Environment* 2005; 47(8): 11-25.
- 26 Serman JD. All models are wrong: reflections on becoming a systems scientist. *System Dynamics Review* 2002; 18(4): 501-531.
- 27 Leemans R. Hoe spelen modelleers met het systeem aarde? In: Dietz T, den Hertog F, van der Wusten H (editors). *Van natuurlandschap tot risicomaatschappij. De geografie van de relatie tussen mens en milieu*. Amsterdam: Amsterdam University Press; 2008.
- 28 Rotmans J. Geïntegreerd denken en handelen: een noodzakelijk goed. Oratie. Universiteit Maastricht; 1998. Internet: <http://www.icis.unimaas.nl>.
- 29 Rotmans J, van Asselt MBA. Integrated assessment: Current practices and challenges for the future. In: Abaza H, Baranzini A (editors). *Implementing sustainable development: integrated assessment and participatory decision-making processes*. Cheltenham, UK: Edward Elger; 2002.
- 30 Harvey D, Gregory J, Hoffert M, Jain A, Lal M, Leemans R *et al*. An introduction to simple climate models used in the IPCC Second Assessment Report. IPCC Technical Paper. Geneva: Intergovernmental Panel on Climate Change; 1997. Internet: <http://www.ipcc.ch/pdf/technical-papers/paper-II-en.pdf>.
- 31 Warner JC, Perlin N, Skillingstad ED. Using the model coupling toolkit to couple earth system models. *Environmental Modelling & Software* 2008; 23: 1240-1249.
- 32 Sluijs JP van der. Anchoring amid uncertainty. On the management of uncertainties in risk assessment of anthropogenic climate change. *Houvast zoeken in onzekerheid. Over het omgaan met onzekerheden in risicoanalyse van klimaatverandering door menselijk handelen (proefschrift)*. Universiteit Utrecht; 1997.
- 33 Claussen M, Mysak LA, Weaver AJ, Crucifix M, Fichefet T, Loutre M-F. Earth system models of intermediate complexity: closing the gap in the spectrum of climate models. *Climate Dynamics* 2002; 18: 579-586.
- 34 Goodess CM, Hanson C, Hulme M, Osborn TJ. Representing climate and extreme weather events in integrated assessment models: a review of existing methods and options for development. *Integrated Assessment* 2003; 4(3): 145-171.
- 35 Ebi KL. Healthy people 2100: modeling population health impacts of climate change. *Climatic Change* 2008; 88: 5-19.
- 36 Asselt MBA van. Perspectives on uncertainty and risk. *The PRIMA approach to decision support*. Boston/Dordrecht/London: Kluwer Academic Publishers; 2000.
- 37 Kann A, Weyant JP. Approaches for performing uncertainty analysis in large-scale energy/economic policy models. *Environmental Modeling and Assessment* 2000; 5: 29-46.
- 38 Kinzig A, Starrett D, *et al*. Coping with uncertainty: a call for a new science-policy forum. *Ambio* 2003; 32(5): 330-335.
- 39 Refsgaard JC, van der Sluijs JP, Højberg AL, Vanrolleghem PA. Uncertainty in the environmental modelling process - framework and guidance. *Environmental Modelling & Software* 2007; 22: 1543-1556.
-

- 40 Sluijs JP van der. Uncertainty management in integrated modelling, the IMAGE case. In: Zwerver S, van Rompaey RSAR, Kok MTJ, Berk MM, editors. Climate change research: evaluation and policy implications. Studies in environmental science 65 B. Amsterdam: Elsevier Science B.V.; 1995: 1401-1406.
- 41 Walker WE, Harremoës P, Rotmans J, van der Sluijs JP, van Asselt MBA, Janssen P *et al.* Defining uncertainty. A conceptual basis for uncertainty management in model-based decision support. *Integrated Assessment* 2003; 4(1): 5-17.
- 42 Knol AB, Petersen AC, van der Sluijs JP, Lebre E. Dealing with uncertainties in environmental burden of disease assessment. *Environmental Health* 2009; 8(1): 21. Internet: <http://www.ehjournal.net/content/8/1/21>.
- 43 Rotmans J. Integrated assessment models. Uncertainty, quality and use. In: Geïntegreerde modellen: brug tussen onderzoek en beleid? Verslag van een Studieconferentie dd 29 maart 1999. Den Haag: Raad voor Milieu- en Natuuronderzoek; 1999: 91-120. Internet: [http://www.rmno.nl/files\\_content/pdf/R\\_139.pdf](http://www.rmno.nl/files_content/pdf/R_139.pdf).
- 44 Sluijs JP van der, Craye M, Funtowicz S, Kloprogge P, Ravetz J, Risbey J. Combining quantitative and qualitative measures of uncertainty in model-based environmental assessment: the NUSAP system. *Risk Anal* 2005; 25(2): 481-492.
- 45 RGO. Van gegevens verzekerd. Kennis over de volksgezondheid in Nederland nu en in de toekomst. Den Haag: Gezondheidsraad; 2008: RGO nr. 58.
- 46 Gezondheidsraad. Gezondheid en milieu: mogelijkheden van monitoring. Den Haag: Gezondheidsraad; 2003: publicatie nr. 2003/13.
- 47 Passchier WF, Albering HJ, Amelung B, Anderson HR, Briggs DJ, Caratti P *et al.* Healthy Airports. A proposal for a comprehensive set of airport environmental health indicators. Maastricht: Universiteit Maastricht, Department of Health Risk Analysis and Toxicology; 2002. Internet: <http://www.personeel.unimaas.nl/wf.passchier/products.htm>.
- 48 Alcamo J, Shaw R, Hordijk L (editors). The RAINS model of acidification. Dordrecht: Kluwer Academic Publishers; 1990.
- 49 Hordijk L. Use of the RAINS model in acid rain negotiations in Europe. *Environmental Science & Technology* 1991; 25(4): 596-603.
- 50 Sluijs JP van der. Integrated Assessment. In: Encyclopedia of Global Environmental change, Vol. 4. Responding to global environmental change. Chichester: John Wiley and Sons, Ltd; 2002: 250-253.
- 51 Bouwman AF, Kram T, Klein Goldewijk K (editors). Integrated modelling of global environmental change. An overview of IMAGE 2.4. Bilthoven, the Netherlands: Netherlands Environmental Assessment Agency (MNP); 2006.
- 52 Rotmans J. IMAGE: an Integrated Model to Assess the Greenhouse Effect. Dordrecht: Kluwer Academic Publishers; 1990.
- 53 Hilderink HBM. World population in transition: an integrated regional modelling framework. Thesis. Amsterdam: Thela Thesis; 2000.
-



- 54 Huynen MMTE, Martens P, Hilderink HBM. The health impacts of globalization: a conceptual framework. Bilthoven/Maastricht: International Centre for Integrative Studies, Maastricht University/Netherlands Environmental Assessment Agency; 2005: Report 550012007/2005. Internet: <http://www.rivm.nl/bibliotheek/rapporten/550012007.pdf>.
- 55 Hilderink HBM, Lucas PL (editors). Towards a Global Integrated Sustainability Model. GISMO1.0 status report. Bilthoven: Netherlands Environmental Assessment Agency; 2008: report nr. 550025002.
- 56 Martens WJM. Global atmospheric change and human health: an integrated modelling approach. *Climate Research* 1996; 6: 107-112.
- 57 Jetten TH, Martens WJM, Takken W. Model simulations to estimate malaria risk under climate change. *J Med Entomol* 1996; 33(3): 361-371.
- 58 Martens P, Kovats RS, Nijhof S, de Vries P, Livermore MTJ, Bradley DJ *et al*. Climate change and future populations at risk of malaria. *Global Environ Change* 1999; 9: S89-S107.
- 59 Nationaal Kompas Volksgezondheid. Internet: [http://www.rivm.nl/vtv/object\\_document/o1676n18840.html](http://www.rivm.nl/vtv/object_document/o1676n18840.html).
- 60 Melse JM, Essink-Bot ML, Kramers PG, Hoeymans N. A national burden of disease calculation: Dutch disability-adjusted life-years. Dutch Burden of Disease Group. *Am J Public Health* 2000; 90(8): 1241-1247.
- 61 Bollen JC, Brink CJ, Eerens HC, Manders AJG. Co-benefits of climate policy. Bilthoven: Netherlands Environmental Assessment Agency (PBL); 2009: PBL Report no. 500116005. Internet: <http://www.pbl.nl/en/publications/2009/Co-benefits-of-climate-policy.html>.
- 62 Holland MR. The co-benefits to health of a strong EU climate change policy. Brussels: Climate Action Network Europe, Health and Environment Alliance, World Wildlife Fund; 2008. Internet: <http://www.climnet.org/Co-benefits%20to%20health%20report%20-september%202008.pdf>.
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A The committee

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## Annex



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## The committee

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The Health and Environment Surveillance Committee has the task of bringing subjects concerning health and the environment to the attention of the government and Parliament, and of highlighting threats and opportunities. This may be in relation to new issues but may equally concern topics that require attention once again.

The Committee was established on 22 October 2007. Its mandate ends on 22 October 2011.

Composition of the Committee:

- Professor W.F. Passchier, Emeritus Professor of Risk analysis, Maastricht University, *chairman*
  - Professor J.W. Erisman, Professor of Integrated Nitrogen Issues, VU University, Amsterdam, and Unit Manager of Biomass, Coal & Environmental Research, Energy Research Centre of the Netherlands, Petten
  - P.J. van den Hazel, physician, specialist in environmental medicine, Public Health Service Central Gelderland, Arnhem
  - Professor D. Heederik, Professor of Health Risk Analysis, Institute for Risk Assessment Sciences, University of Utrecht
  - Professor R. Leemans, Professor of Environmental Systems Analysis, Wageningen University
  - Dr J. Legler, toxicologist, Institute for Environmental Studies, VU University, Amsterdam
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- Dr. J.P. van der Sluijs, researcher in Science Technology and Society, Copernicus Institute for Sustainable Development and Innovation, University of Utrecht
- Professor D.R.M. Timmermans, Professor of Risk Communication and Patient Decision Making, EMGO Institute, VU University Medical Centre, Amsterdam
- Dr P.W. van Vliet, Health Council of the Netherlands, The Hague, *secretary*

The Health Council's secretarial department drew up draft versions of this advisory report which were discussed in Committee meetings. The advisory report was then presented to the Standing Committee on Health and Environment, which is one of the Health Council's permanent bodies of experts, and to a number of other experts including some in the Health Council. The Committee took the comments into account in the final draft.

The following persons were consulted:

- Dr. H.B.M. Hilderink, demographer, PBL (Netherlands Environmental Assessment Agency), Bilthoven
- Dr. M.M.T.E. Huynen, environmental health expert, International Centre for Integrated Assessment and Sustainable Development, Maastricht University
- Professor J.P. Mackenbach, Professor of Public Health, Erasmus MC, Rotterdam
- Professor P. Martens, Professor of Sustainable Development, International Centre for Integrated Assessment and Sustainable Development, Maastricht University
- F. de Pater, M.Sc., water and environment scientist, VU University, Amsterdam
- Professor P. Vellinga, Professor of Climate Change and Flood Safety, Wageningen University, and Professor of Climate Change and Societal Implications, VU University, Amsterdam

#### The Health Council and interests

Members of Health Council Committees – which also include the members of the Advisory Council on Health Research (RGO) since 1 February 2008 – are appointed in a personal capacity because of their special expertise in the matters to be addressed. Nonetheless, it is precisely because of this expertise that they may also have interests. This in itself does not necessarily present an obstacle for membership of a Health Council Committee. Transparency regarding possible conflicts of interest is nonetheless important, both for the President and members

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of a Committee and for the President of the Health Council. On being invited to join a Committee, members are asked to submit a form detailing the functions they hold and any other material and immaterial interests which could be relevant for the Committee's work. It is the responsibility of the President of the Health Council to assess whether the interests indicated constitute grounds for non-appointment. An advisorship will then sometimes make it possible to exploit the expertise of the specialist involved. During the establishment meeting the declarations issued are discussed, so that all members of the Committee are aware of each other's possible interests.

