Climate change in the social and health sector

Climate change adaptation plan of Ministry of Social Affairs and Health (2021–2031)

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Climate change in the healthcare and social welfare sector – Climate change adaptation plan of Ministry of Social Affairs and Health (2021–2031)

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Author(s)	Päivi Meriläinen, Mikko Paunio, Virpi Kollanus, Jaana Halonen, Jouni Tuomisto, Suvi Virtanen, Sakari Karvonen, Elina Hemminki, Heli Kuusipalo, Riitta Koivula, Henna Mäkelä, Sari Huusko, Liina Voutilainen, Lena Huldén, Susanna Raulio, Ilmo Keskimäki, Timo Partonen, Satu Mänttäri, Anna-Kaisa Viitanen, Pauliina Kangas, Sirpa Sarlio, Krista Lyyra, Seija Viljamaa and Kristiina Mukala		
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Abstract

Climate change affects people's health and wellbeing in Finland both directly and indirectly. It is important to be prepared for variations in the weather and climate and for extreme weather and climate conditions and their effects even in the current circumstances. This will also help us adapt to future climate variations and changes. The Adaptation Plan is based on the National Climate Change Adaptation Plan 2022 and the climate change and adaptation work carried out in the healthcare and social welfare sector.

The Adaptation Plan focuses particularly on health protection and the adaptation of healthcare in the administrative branch of the Ministry of Social Affairs and Health. The aim of the Adaptation Plan is to assess the current state of adaptation and the structures supporting it, to identify current and new adaptation measures in the health and wellbeing sector and to translate the measures into more concrete terms and clarify them in the area of responsibility of the Ministry of Social Affairs and Health's administrative branch. The intention is to introduce the Adaptation Plan to healthcare and social welfare operators and to increase risk awareness in the healthcare and social welfare sector.

The Adaptation Plan contains 43 objectives and 92 recommendations for measures. The measures cover areas relating to environmental health, health and social services (incl. occupational safety and health), social effects, mitigation measures and repercussions. The Ministry of Social Affairs and Health is responsible for implementing, monitoring and assessing the Adaptation Plan.

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Kuvailulehti

1.12.2021

Ilmastonmuutos sosiaali- ja terveyssektorilla – Sosiaali- ja terveysministeriön ilmastonmuutokseen sopeutumisen suunnitelma (2021–2031)

Sosiaali- ja terveysministeriön julkaisuja 2021:36

Julkaisija Sosiaali- ja terveysministeriö

Tekijä/t Päivi Meriläinen, Mikko Paunio, Virpi Kollanus, Jaana Halonen, Jouni Tuomisto, Suvi Virtanen, Sakari Karvonen, Elina Hemminki, Heli Kuusipalo, Riitta Koivula, Henna Mäkelä, Sari Huusko, Liina Voutilainen, Lena Huldén, Susanna Raulio, Ilmo Keskimäki, Timo Partonen, Satu Mänttäri, Anna-Kaisa Viitanen, Pauliina Kangas, Sirpa Sarlio, Krista Lyyra, Seija Viljamaa ja Kristiina Mukala

Toimittaja/t Päivi Meriläinen

Kieli englanti **Sivumäärä** 113

Tiivistelmä

Suomessa ilmastonmuutos vaikuttaa suoraan ja välillisesti kansalaisten terveyteen ja hyvinvointiin. Jo nykyisissä olosuhteissa on syytä varautua sään ja ilmaston vaihteluihin ja sään ääri-ilmiöihin sekä niiden vaikutuksiin, sillä se auttaa sopeutumaan myös tuleviin ilmaston vaihteluihin ja muutoksiin. Sopeutumissuunnitelman perustana on Kansallinen ilmastonmuutoksen sopeutumissuunnitelmaa 2022 sekä sosiaali- ja terveydenhuollon sektorilla tehty ilmastonmuutos- ja sopeutumistyö.

Sopeutumissuunnitelman painopiste on terveydensuojelussa sekä terveydenhuollon sopeutumisessa sosiaali- ja terveysministeriön (STM) hallinnonalalla. Sopeutumissuunnitelman tavoitteena on selvittää sopeutumisen ja sitä tukevien rakenteiden nykytila, tunnistaa nykyisiä ja uusia sopeutumistoimia terveyden ja hyvinvoinnin toimialueella, konkretisoida ja selkeyttää toimenpiteitä STM:n hallinnonalan vastuualueella. Sopeutumissuunnitelmaa pyritään myös jalkauttamaan sosiaali- ja terveydenhuollon toimijoille ja lisäämään riskitietoisuutta sosiaali- ja terveydenhuollon sektorilla.

Sopeutumissuunnitelmassa on määritelty 43 tavoitetta ja niihin liittyviä toimenpidesuosituksia 92. Toimenpiteet kattavat ympäristöterveyden, sosiaali- ja terveyspalveluiden (ml. työterveys), sosiaalisten vaikutusten sekä hillintätoimien ja heijastevaikutusten alueita. STM vastaa suunnitelman toimeenpanosta, seurannasta ja arvioinnista.

Asiasanat vesihuolto, ilmastonmuutokset, terveydenhuolto, ympäristöterveys, ilmastonmuutokseen sopeutuminen

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Presentationsblad

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Klimatförändringen inom social- och hälsovårdssektorn – Social- och hälsovårdsministeriets plan för anpassning till klimatförändringen (2021–2031)

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Referat

Klimatförändringen påverkar allmänhetens hälsa och välbefinnande i Finland både direkt och indirekt. Redan under nuvarande förhållanden finns det anledning att förbereda sig på omväxlingar i vädret och klimatet och på extrema fenomen samt på de konsekvenser som dessa har eftersom det också hjälper oss att förbereda oss på framtida omväxlingar och förändringar i klimatet. Grunden för anpassningsplanen är den nationella planen för anpassning till klimatförändringen 2022 samt det klimat- och anpassningsarbete som gjorts inom social- och hälsovårdssektorn.

I anpassningsplanen prioriteras hälsoskydd och anpassning av hälso- och sjukvården inom social- och hälsovårdsministeriets förvaltningsområde. Avsikten med anpassningsplanen är att utreda nuläget i fråga om anpassningen och de strukturer som stöder anpassningen, identifiera nuvarande och nya anpassningsåtgärder inom sektorn för hälsa och välfärd samt konkretisera och förtydliga åtgärder inom ansvarsområdet för social- och hälsovårdsministeriets förvaltningsområde. Avsikten är också att anpassningsplanen ska etableras hos aktörerna inom social- och hälsovården och skapa en större riskmedvetenhet inom social- och hälsovårdssektorn.

I anpassningsplanen har det slagits fast 43 mål och 92 åtgärdsförslag i samband med dessa mål. Åtgärderna omfattar områden som miljöhälsa, social- och hälsovårdstjänster (inklusive företagshälsovården), sociala konsekvenser samt begränsande åtgärder och återverkningar. Social- och hälsovårdsministeriet ansvarar för att genomföra, övervaka och utvärdera planen.

Nyckelord	vattentillgång, klimatförändring, hälsovård, miljöhälsa, folkhälsan		
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Contents

CONCEPTS

Indirect impacts	Indirect climate-related health impacts can be transmitted in ecosystems and the services they provide, for example via changes in water, soil and air quality. Changes that occur through changes in the activities of people and communities (including states) are also counted as indirect impacts. Changes in populations of species, on the other hand, affect the availability of food or the distribution of animal-transmitted diseases.
Knock-on effect	Knock-on effects of climate change occurring outside Finland's borders that also cause impacts in Finland.
Mitigation	Mitigation of climate change refers to preventing the warming of climate and reducing its consequences.
Climate sustainability	Solutions for climate change mitigation and adaptation are planned and implemented taking into account climate risks and their prevention and mitigation.
Resilience	Anticipatory ability to act flexibly in disruptions and changes and to adapt to them. In the context of climate change, society has the capacity to recover and develop its activities and preparedness after a disruption.
Adaptation	Adaptation aims to reduce the harmful impacts of climate change in society.
Direct impact	Climate change can affect our health directly or indirectly via changes in the environment. Solar radiation, temperature, extreme weather phenomena such as storms, heavy rainfall and floods are environmental factors directly affecting humans.
Preparedness	Active preparation of the harmful impacts of climate change.

EXTENDED SUMMARY

In Finland, climate change has a direct and indirect impact on the health and well-being of citizens. It is important to be prepared for variations in the weather and climate and for extreme weather and climate conditions and their effects even in the current circumstances. This will also help us adapt to future climate variations and changes.

The plan for climate change adaptation in the administrative branch of the Ministry of Social Affairs and Health contributes to the implementation of the National Climate Change Adaptation Plan 2022 and supports the UN's 2030 Sustainable Development Goals. In accordance with the national adaptation plan, the ministries are responsible for the implementation, monitoring and evaluation of the plan in their administrative branches. The objective is that society can manage risks related to climate change and to adapt to changes taking place in climate.

In the administrative branch of the Ministry of Social Affairs and Health, the focus of the adaptation plan is on health protection and the adaptation of health care. In addition, the adaptation possibilities of social welfare have been considered to some extent, but social security, for example, and with it a large part of the examination of adaptation of social welfare has been excluded from this plan. The objective of the adaptation plan of the administrative branch of the Ministry of Social Affairs and Health is to determine the current state of adaptation and the structures supporting it in Finland, and to identify existing and new adaptation actions in the area of health and welfare. In addition, the aim is to make the actions presented in the National Adaptation Strategy more concrete and to clarify them in the area of responsibility of the Ministry of Social Affairs and Health's administrative branch. The aim is also to implement the adaptation plan among social welfare and health care actors and to increase risk awareness in these sectors. More detailed sector-specific objectives can be found in tables 1–3.

The adaptation plan is based on the National Climate Change Adaptation Plan 2022 and the climate change and adaptation work carried out in the social welfare and health care sector. The Adaptation Plan contains 43 objectives and 92 recommendations for actions. The objectives apply to, for example, a heat warning system, various guidelines and action programmes, the examination of the impacts of climate change and adaptation measures, cross-sectoral measures and the consideration of education and communication.

The measures cover the themes of environmental health, social welfare and health care (including occupational health care), social impacts, mitigation measures and knock-on

effects. The Ministry of Social Affairs and Health is responsible for the implementation, monitoring and evaluation of the plan. The implementation of the adaptation plan is monitored annually by the Ministry of Social Affairs and Health, using a monitoring matrix, and the plan is reviewed every five years.

Table 1. The objectives of the adaptation actions of the Ministry of Social Affairs and Health's administrative branch for the direct impacts of climate change.

Priority area	Objective of adaptation actions
Hot weather	1. Establish a national overall view of the short-term and long-term measures needed to prevent health hazards in the various operating sectors. National targets, recommendations and guidelines guide preparedness at the regional and local levels.
	2. The key to adaptation is to protect vulnerable population groups. To prevent serious health hazards, preparedness for hot weather needs to be strengthened, especially in social welfare and health care units.
Slipping	3. Inform about the prevention of slipping by continuing existing information campaigns.
	4. Examine in more detail the impact of climate change on slippery conditions and slipping accidents in Finland.
Indoor air quality	5. Examine links between climate change and indoor air quality in Finland.
	6. Examine the possibilities for adaptation to climate change in Finland from the point of view of indoor air.
Mental health	7. Increasing the capacity to act in the event of traumatic psychological crises and stress disorders due to extreme weather phenomena, improving the efficiency of treatment to prevent the increased disease burden caused by summer heat cycles, and increasing the use of timed lighting to prevent adverse effects due to increasingly dark winter days.
	8. Enhance adaptation actions for construction, land use and housing to prevent mental health hazards.
	9. Monitoring: The implementation of adaptation actions is monitored via health care quality registers, specifically itemised by groups of disruption
Waterborne diseases	10. Preparation of a national action plan on preparing for climate change in water management and formulation of the related guidelines.
	11. Develop the monitoring of contamination and accidents in water services to investigate the current level of preparedness and improve preparadness.

Priority area	Objective of adaptation actions
Vector-transmitted diseases	12. Monitor the occurrence of vector-borne communicable diseases with the help of the communicable diseases register of the Finnish Institute for Health and Welfare (THL) and other national registers. Monitoring will be enhanced by producing risk assessment data, which is developed especially with respect to tick-borne encephalitis.
	13. Enhance research and cooperation. Survey a national network of actors for vector-borne diseases and aim to establish an expert network.
	14. Develop communication to raise public awareness, especially with respect to tick-borne diseases.

Table 2. The objectives of the adaptation actions of the Ministry of Social Affairs and Health's administrative branch for the indirect impacts of climate change.

Priority area	Objective of adaptation actions
Nutrition and health	15. Climate change and sustainability (incl. biodiversity and food security) more strongly included in nutrition recommendations.
	16. Implementation of nutrition recommendations, for example in public food service and food procurement, including nutrition and responsibility.
	17. Development of monitoring systems for the composition of food and the nutrition of the entire population.
Occupational health and well-being	18. Increasing competence on and awareness of the impacts of climate change on work ability and occupational health and safety.
	19. Preparedness for and adaptation to employees' thermal load and the resulting effects on work ability and occupational health and safety.
	20. Preparing for and adapting to the effects of the circular economy on work ability and occupational health and safety.
Social impacts	21. All welfare regions (provinces) have plans for adaptation to climate change in social welfare and health care, which describe how adaptation to climate change is taken into account in the activities and relate any special features of the region that should be considered in adaptation.
	22. The adaptation plans for welfare regions (provinces) specify adaptation actions that exceed the boundaries of administrative sectors (e.g. the health and climate impacts of school food, anticipation of employment trends in the region, changes in the age structure and their role, for example, in municipal construction projects, waste food etc.).
	23. Determine the prerequisites for the municipality and the welfare region (province) to take climate change adaptation into account in public procurements (what are essential procurements, whether legislative changes are needed) and opportunities for socially and ecologically sustainable local actions (e.g., distribution of waste food as shared meals or collective kitchens, recreational activities of children and the related transport, repair of used goods at workshops).
Health effects of climate change mitigation actions	24. Nutrition advice identifies people's climate motives, and communication relies on both climate and heallth perspectives.
	25. In municipal transport planning, prepare for an increase in muscle-powered and electrically assisted traffic, ensure a smooth flow of lightweight traffic and secure adequate opportunities for people with impaired mobility.
	26. Take health and recreational values into account when planning and implementing urban green areas and forest carbon sinks.
	27. In guidelines for small-scale burning of wood, inlcude both the health and climate perspectives.

Table 3. The objectives of the adaptation actions of the Ministry of Social Affairs and Health's administrative branch for the consequential impacts of climate change on administrative processes.

Priority area	Objective of adaptation actions
Health care	28. For their part, health care and social welfare services must respond to changes in the social situation and health of the population. A sufficient knowledge base is a prerequisite for systematic activities. Up-to-date monitoring of the population's health and social situation at the national and regional levels should be developed and resources allocated for it.
	29. The resilience of social welfare and health care must be increased to respond to possible changes in the operating environment or sudden shocks; due to knock-oneffects, some of them may be realised relatively quickly. Preparedness is a good tool for identifying potential threats and vulnerable groups.
	30. Health care, in particular, depends on the functioning of the general infrastructure, such as transport routes and means of transport, electricity and digital infrastructure. Health care technology (including medicines) is currently dependent on imports. Health care actors must actively work with other administrative branches to ensure the functioning of social welfare and health care in different circumstances.
	31. Assessing the benefits and costs of adaptation actions in health care and the related information needs.
Social welfare services	32. Analyse the information needs related to the health and well-being impacts of social welfare workers and prepare a training programme to satisfy the information needs.
	33. Promote the construction of social welfare information resources and the usability of information, especially from the perspective of ecosocial social work.
	34. Streamline local practices in ecosocial social work and strengthen community work (e.g. urban social work).
Cross-sectoral impacts	35. Participate in climate change adaptation at the government level: Participate in the implementation, monitoring and evaluation of the National Strategy for Adaptation to Climate Change.
	36. Participate in the preparation of the EU's adaptation strategy.
	37. Examine the impact of climate change progression on cross-sectoral impacts with other administrative branches.
Knock-on effects	38. Consideration of environmental problems, including climate change, combating them and adaptation to them in the need for services in the social welfare and health care sectors.
	39. Considering knock-on effects when making investments.
	40. Investigate knock-oneffects in Finland, and as a part of it, investigate knock-on effects in social welfare and health care.

Priority area	Objective of adaptation actions
Research activities, international cooperation, education, scenarios and communication	41. The Ministry and the research institutes in the administrative branch promote research activities and interaction concerning adaptation and mitigation.
	42. Comprehensively examine the health impacts related to climate change, the effectiveness of adaptation actions (including economic impacts), and the need for training in the field.
	43. Communication in the administrative branch supports climate change adaptation.

FOREWORD

The plan for adaptation to climate change in the administrative branch of the Ministry of Social Affairs and Health contributes to the implementation of the National Climate Change Adaptation Plan 2022, according to which the ministries are responsible for the implementation, monitoring and evaluation of the plan in their administrative branches. The goal is that our society can manage risks related to climate change and to adapt to changes taking place in climate. The aim of the implementation is to integrate adaptation into the normal planning and operation of all branches and actors.

The Climate Change Act (609/2015), which entered into force in 2015, provides for a climate policy planning system. The system includes a medium-term climate policy plan approved by the government once during the parliamentary term as well as a long-term climate policy plan and a national adaptation plan for climate change, both approved at least once every ten years. International climate policy is guided under the UN Climate Change Agreement by the Paris Agreement on the post-2020 period, all parties to which are expected to increase efforts to combat and adapt to climate change.

The objective of the adaptation plan for social and health administration is to identify the most important tasks of each sector to promote adaptation in the next few years. The basis of the plan is to examine the current state of adaptation and the structures supporting it in Finland, to identify current and new adaptation actions in the area of health and welfare, to make the actions presented in the national adaptation strategy more concrete and clear in the area of responsibility of the administrative branch of the Ministry of Social Affairs and Health, to implement the adaptation plan for social welfare and health care actors, and to mainstream adaptation to climate change by increasing risk awareness.

The Adaptation Plan has been prepared and coordinated by the working group on adapting to climate change in social welfare and health care: Päivi Meriläinen, Virpi Kollanus, Jaana Halonen, Jouni Tuomisto, Suvi Virtanen, Sakari Karvonen, Elina Hemminki, Heli Kuusipalo, Riitta Koivula, Henna Mäkelä, Sari Huusko, Susanna Raulio, Ilmo Keskimäki and Timo Partonen of the Finnish Institute for Health and Welfare, Satu Mänttäri, Anna-Kaisa Viitanen and Pauliina Kangas of the Finnish Institute of Occupational Health, Lena Huldén of the University of Helsinki and Mikko Paunio, Sirpa Sarlio, Krista Lyyra, Seija Viljamaa and Kristiina Mukala of the Ministry of Social Affairs and Health. The arranging of the basic work, stakeholder survey and stakeholder event regarding the adaptation plan

was carried out by Päivi Meriläinen from the Finnish Institute for Health and Welfare. In addition, several dozen experts from research institutes, universities, associations, hospital districts, ministries, municipalities and regional state administration have commented on and contributed to the plan. Warm thanks to all contributors.

1 Introduction

1.1 Background and objectives

The first National Climate Change Adaptation Plan was drawn up in 2005 after the UN climate agreement. In Finland, the Climate Change Act entered into force in 2015 (Climate Change Act 609/2015), at which time adaptation to climate change was also integrated into climate policy. The reform process of the Climate Change Act has been recorded in the 2019 government programme, and the reform is to be completed in 2021. In addition, Finland prepared "Finland's National Strategy for Adaptation to Climate Change 2022" in 2014 (Ministry of Agriculture and Forestry 2014), the aim of which is to promote society's ability to manage risks related to climate change and adapt to changes in climate. According to the national adaptation plan, the ministries are responsible for the implementation, monitoring and evaluation of the plan in their respective administrative branches, and an action plan should be drawn up in each administrative branch to promote adaptation. The Ministry of Agriculture and Forestry (MAF) coordinates a group that monitors and develops the national climate change adaptation plan. The working group also includes the Ministry of Social Affairs and Health (MSAH) and the Finnish Institute for Health and Welfare (THL).

According to the IPCC, adaptation to climate change means adaptation to existing or expected climate and its impacts. In systems maintained by humans, adaptation aims at mitigating or avoiding damage or seizing the arising opportunities (IPCC 2014). Climate change mitigation reduces the need for adaptation, but as the climate inevitably changes, active adaptation is necessary. Climate change adaptation supports several UN Sustainable Development Goals 2030 (Ministry for Foreign Affairs 2020). The new EU's climate change adaptation strategy also includes health as part of adaptation (EU 2021). The aim of the new strategy is to build a climate-resilient society by improving knowledge of climate impacts and adaptation solutions, by enhancing adaptation planning and climate risk assessment, by speeding up adaptation actions and by helping to strengthen climate resilience globally. The EU's jurisdiction in health matters is limited, but within the given framework, the Health Emergency and Response Authority is being set up, with the aim of preparing for and responding to health emergencies. The European Climate and Health Observatory is the first measure of the EU's adaptation strategy, with the aim to better monitor, analyse and prevent the effects of climate change on human health by providing relevant information and tools. It also supports the exchange of information and cooperation between relevant international, European, national and non-governmental actors (https://climate-adapt.eea.europa.eu/observatory).

In line with the EU's adaptation strategy, systemic thinking should be considered in adaptation to climate change also from a health perspective (EU 2021). According to the Planetary health concept, human and environmental health are interdependent (Whitmee et al. 2015). In addition to climate change, other human-made changes in natural systems, such as loss of biodiversity, soil degradation, overuse of natural resources and pollution, have a detrimental effect on human health. Due to systemic impact chains, these changes are linked to climate change, so these changes should also be curbed, and preparations should be made for the health impacts caused by these changes.

Climate change strengthens the probability of risks posed by global warming and extreme weather conditions. Global reduction of greenhouse gases is the key means of reducing these risks, and, in addition to adaptation, mitigating climate change is also the key task of the Climate Change Act, which will be revised in 2021. Many measures are already being taken in Finland to promote adaptation to the impacts of climate change, and one of the key objectives of this plan is to identify adaptation work already underway. In accordance with the Lancet Countdown report (2015), Finland too must be prepared to move from planning to action on a relatively rapid schedule and strengthen the basis of health care to improve climate resilience (Whitmee et al. 2015). For example, the WHO guidelines and good practices in other countries can be taken into practice.

In international terms, global warming affects the poorest and most climate-sensitive regions the most. However, Finland is not protected from the effects of climate change, and knock-on effects may also be visible in Finland. Especially in the north, the effects of climate change are already tangible, as global warming in the Arctic area is twice as fast as the Earth's average. Despite the long timescale of the impacts of climate change, some of the impacts are already visible to us, and therefore adaptation must also be sufficiently proactive, considering rapidly developing changes in, for example, extreme weather phenomena. In Finland, the impacts of climate change vary regionally, and therefore the regional and local perspective must be taken into account in adaptation measures.

The mid-term evaluation of the implementation of the national adaptation plan (Mäkinen et al. 2019) revealed that the Ministry of Social Affairs and Health did not yet have an action plan for adaptation to climate change. Climate change has not been considered in the Ministry's strategy-level reviews, although health aspects related to climate change have been brought up in cooperation with various actors. The fields of activity of the Ministry of Social Affairs and Health are falling behind other sectors in climate change adaptation, including in terms of preparedness for direct impacts.

Many normal routines and legislative work in the administrative branch of the Ministry of Social Affairs and Health are part of the so-called silent adaptation work. These routines include cooperation with other ministries to ensure environmental health care and the

monitoring of diseases maintained through cooperation between health care services and the Finnish Institute for Health and Welfare. This work is done regardless of whether it is considered part of the climate work or not. The administrative branch of the Ministry of Social Affairs and Health has been working on climate change adaptation for decades. The Ministry of Social Affairs and Health participated actively in the preparation of the first strategy for adaptation to climate change. With its working groups, it has also had extensive international contacts with the adaptation discussions conducted within the framework of the World Health Organisation through the European ministry of the environment and health process throughout the 2000s.

Adaptation chains related to the health and welfare impacts of climate change are complex and have links to many administrative branches. Due to the cross-sectoral and knock-on effects, the impacts of climate change in society and its links with adaptation to them must be taken into account when planning actions concerning adaptation in the administrative branch of social welfare and health care. International and national risk assessments should be considered when planning adaptation measures. In addition, the action plans for adaptation of other administrative branches must be considered to clarify work and responsibilities. The adaptation plan serves as a concise knowledge base for future adaptation work.

In the administrative branch of the Ministry of Social Affairs and Health, the focus of the adaptation plan is on health protection and the adaptation of health care. In addition, the possibilities of social welfare in adaptation have been considered to some extent, but social security, for example, and with it a large part of the examination of adaptation has been excluded from this plan.

The objective of the Ministry of Social Affairs and Health's adaptation plan within its own administrative branch is to:

1. determine the current state of adaptation and the structures supporting it in Finland,
2. identify existing and new adaptation actions in the area of health and welfare,
3. concretise and clarify the actions set out in the national adaptation strategy within the responsibility area of the administrative branch of the Ministry of Social Affairs and Health,
4. deploy the adaptation plan for social welfare and health care actors, and
5. mainstream adaptation to climate change by increasing risk awareness.

The adaptation plan has been prepared for 2021–2031. The implementation of the adaptation plan is monitored annually by the Ministry of Social Affairs and Health, using a monitoring matrix, and the plan is reviewed every five years. It was approved by the management group of the Ministry of Social Affairs and Health on 29 March 2021.

1.2 Implementation of the adaptation plan

Adapting to the health and welfare threats of climate change requires that society actively change its ways to a climate-sustainable basis. The premise of the adaptation plan of the Ministry of Social Affairs and Health is to identify factors that support and thus protect or promote the climate resilience of society and that affect human health and welfare as well as social and health services. This applies in particular to the administrative branch of the Ministry of Social Affairs and Health, where adaptation is either the main responsibility, partial responsibility or can be promoted by statements or through other cross-administrative measures. The adaptation plan draws attention to the actions required by extreme climate events (heat cycles, storms) and to the related responsibilities of the authorities in the field of health protection. The focus of the adaptation plan is on health protection and the adaptation of health care in the administrative branch of the Ministry of Social Affairs and Health, and social security, for example, has been excluded from the already extensive scope.

The adaptation plan surveys the ongoing adaptation work in the social welfare and health care sectors and compiles the actions necessary in the future to promote adaptation, with concrete recommendations. The aim is to integrate adaptation to climate change into practical work (by officials) that supports health protection through climate resilience. The plan focuses only on adaptation to climate change in the administrative branch of the Ministry of Social Affairs and Health and does not comment on health care actions to mitigate climate change. Climate change mitigation actions are addressed in the plan to the extent that they have a direct impact on adaptation actions in the social welfare and health care sector as the effects of climate change and its mitigation cannot be fully separated from each other. The adaptation plan also qualitatively reflects on the possible indirect global knock-on effects of climate change on Finland. Adapting to climate change begins by adapting to extreme weather phenomena in the current climate but increasing climate resilience also requires long-term adaptation to the impacts of climate change and mitigation actions caused by human activity.

Social welfare and health care staff are essential in several adaptation actions, which are often implemented locally and regionally. Therefore, action plans, guidelines and communication at regional and local levels are important. However, most adaptation

activities are carried out by other sectors, and there the task of social welfare and health care is to raise awareness of the need for adaptation actions and of risks.

Monitoring the implementation and success of adaptation actions and updating the adaptation plan are needed in a changing situation to develop the progress of the adaptation plan.

The adaptation plan was drawn up between 2020 and 2021 in the following stages:

1. Review of action plans for adaptation of other countries and administrative branches.
2. Identification of existing adaptation actions.
3. Identification of adaptation needs.
4. Finishing the adaptation plan.

Phase 1 examined the action plans for adaptation in various administrative branches in Finland and the Nordic countries. In phases 2 and 3, the working group compiled climate change impacts, current adaptation actions and future adaptation needs. This was accomplished both by the working group's own expert work and by means of a stakeholder survey and a stakeholder event organised in 2020. Based on these, the working group finalised the adaptation plan at the turn of 2021, and the draft adaptation plan was publicly available at the beginning of 2021 for commenting on the otakantaa.fi platform.

2 Health impacts of climate change

Climate change affects health and welfare through climate and weather changes (e.g. warming up, increasing extreme weather phenomena) and changes in the social and physical environment. Climate change is combated through various measures, and it is difficult or impossible to distinguish the intended and unintended health and welfare impacts of these measures from the impacts of climate and weather changes. The Intergovernmental Panel on Climate Change (IPCC) (2014) outlined three main forms of health impacts: direct health effects caused by extreme weather phenomena, such as storms, floods and heat waves, impacts transmitted through natural systems, such as aquatic and vector-borne diseases (including pandemics), and indirect effects from nutrition (volume and quality).

The World Health Organisation estimates that, from 2030 onwards, climate change will cause 250,000 extra deaths in the world every year, mainly in developing countries. In addition to an increasing mortality rate, climate change will increase morbidity, discomfort caused by the deterioration of living conditions and social vulnerability, all of which have a global impact on large human populations regardless of their place of residence.

According to the IPCC, at global level, health impacts have been predicted to come mainly from three different issues (IPCC 2014). First, food production may deteriorate in many areas, which in turn may increase the price of cereals and cause hunger and the resultant refugees and many health impacts. The weakness caused by reduced yields has been predicted to be the greatest health impact of climate change. This probably already explains some of the famine in North Africa. Second, warming can increase the spread of infectious diseases, especially insect-borne diseases, of which malaria is one example. In addition to malaria, other communicable diseases are predicted to increase, some of which are vector-borne diseases, while others are diseases related to food and water hygiene. The third predicted health impact is the impact on health of various extreme weather phenomena. Global warming increases heat waves that are always associated with increased mortality and morbidity. In 2003, the severe heat wave in Central Europe was estimated to have caused over 70,000 premature deaths in Europe (Robine et al. 2008). To prevent mortality, morbidity and social problems, adaptation to climate change is necessary.

In addition to climate change, other ongoing environmental disasters directly and indirectly affect health and welfare: loss of biodiversity, pollution of the physical environment and lack of clean water. The impact of these environmental disasters

cannot be completely separated from the effects of climate change, as the problems are intertwined. They are all largely the result of the overuse of natural resources and the disturbing of the circulation of materials, and therefore the prevention actions and consequences are interlinked. However, in accordance with the mandate, this report focuses on climate change.

In Finland, direct health risks related to climate change have been examined in, for example, the national risk assessment prepared in the SIETO project (Tuomenvirta et al. 2018). In addition to direct health impacts, climate change also has indirect impacts on health and welfare, which also require adaptation.

2.1 On the direct health impacts of climate change

In the national risk assessment in Finland, climate change has been estimated to have an impact on health hazards caused particularly by heat waves, waterborne epidemics, zoonotic infectious diseases, slipping accidents, humidity damage in buildings and the occurrence/spread of new allergenic species (Tuomenvirta et al. 2018). Direct health impacts can be roughly divided into three categories: 1) effects due to global warming, i.e. increase in average temperature, (e.g. additional burden for sick people from heat, interactions with air pollution, effects of changes in ranges of microbes and the animals spreading them on communicable diseases, effects of changes in the surfaces of passageways on accidents), 2) effects due to the increase of extreme weather phenomena (heat waves, storms, heavy rainfall, floods, drought, forest fires), and 3) mental health effects (e.g., depression and climate anxiety). These are discussed in more detail in section 5.

2.2 On the health impacts of climate change mitigation

Efforts are increasingly being made to mitigate climate change by various means (European Commission 2019). Some of the mitigation actions impact health and welfare directly, and some by slowing down climate change. These impacts can be positive or negative. The reduction/cessation of burning fossil fuels has direct positive health effects, especially on respiratory and cardiovascular health. Other significant positive health impacts will likely be attained through chances in diet, mobility, working coditions and construction technology. Mitigation actions may also have negative health impacts, for example, due to excessive isolation of buildings, reduced useuse of disposable products (reduced hygiene) and increase in alternative forms of energy and digging (additional needs from electrification). The health and welfare impacts of climate change mitigation are discussed in chapter 5.

2.3 On the indirect health impacts of climate change (knock-on effects)

In addition to having a direct impact on the health and well-being of citizens, phenomena related to climate change can also affect the functioning of health care and the societal structures that support it. In addition, the socio-economic impacts of climate change in Finland and other countries can be reflected in many ways in the health and welfare of Finns. In the future, the sensitivity of the population to the impacts of climate change will increase due to ageing and the growing prevalence of chronic illnesses. Urbanisation may increase vulnerability to some impacts.

Knock-on effects are caused especially by matters outside Finland. These are discussed in chapter 9. The impacts of climate change are particularly strong in climate-sensitive areas, which means that the impacts are lower than average in Finland on a global scale. In addition to favourable climatic starting points, the adaptation of Finnish society to the impacts of climate change is promoted by functional social welfare and health care and other social infrastructure. On the other hand, warming in northern areas is considerably greater than on average, and the warming of Arctic regions may also have direct impacts on Finland.

3 Adaptation in Finland and elsewhere

Actions promoting adaptation to the health impacts of climate change have been implemented internationally, nationally and locally. The most common international and national actions have been the assessment of health risks caused by climate change and the surveying of adaptation to them. More concrete adaptation actions have been carried out especially at the local level, many of these being small-scale experiments and examples (Austin et al. 2016). In many countries, a policy outline has been drawn up for examining national climate (health) risks and preparing an adaptation strategy (Biesbroek et al. 2010). However, due to the different administrative structures between countries, roles and responsibilities in the adaptation strategies are divided in different ways (Bauer et al. 2012). In some countries, adaptation measures are considered in legislation, which enables institutional arrangements for the consistent promotion of public health in different sectors of society (Lesnikowski et al. 2011; Bowen et al. 2015). Legislation and inter-administrative coordination have sometimes been prerequisites for successful adaptation (Bowen et al. 2015; Amundsen et al. 2010; Glaas et al. 2010). However, the legislative implementation of the adaptation strategy is not realised everywhere, because in some countries the state government has not taken a centralised authoritative or coordinating role in climate change adaptation. In such countries (such as Canada and Ireland), public health adaptation is promoted through the autonomous actions of certain authorities and state institutions (Austin et al. 2015; Department of Environment, Community and Local Government 2012).

The reports and guidelines published by the WHO are one example of international adaptation actions (WHO 2003; WHO 2013; WHO 2018b; WHO 2020). In particular, the WHO's guidelines for the organisation of climate-resilient health care emphasise the need for enough skilled health actors as one of the most important interventions in meeting environmental challenges. Another example is the European forum for adaptation to climate change founded jointly by the European Commission and the European Environment Agency (EEA) (Climate-ADAPT, https://climate-adapt.eea.europa.eu). The EU's new climate change adaptation strategy brings adaptation to all administrative regions and levels (EU 2021). In addition, the European Climate and Health Observatory, which started in spring 2021, provides information and tools for adaptation (https://climate-adapt.eea.europa.eu/observatory).

Strategies have also been developed in the United States to promote public health adaptation to the impacts of climate change. The adaptation strategies utilise the

programme of the US Centers for Disease Control and Prevention (CDC) for climate resilience (Building Resilience Against Climate effects (BRACE)) (https://www.cdc.gov/climateandhealth/BRACE.htm), within whose framework a guide has been prepared for health care institutions, for example, on assessing the vulnerability of health impacts of climate change (Manangan et al. 2016). A guide for health care actors on climate change impact assessment has also been prepared (Anderson et al. 2017), which describes measures to prevent health hazards. National guidelines on the adaptation of health and social welfare institutions to climate change can be found, for example, in the United Kingdom (NHS 2018).

Action programmes for adaptation have been published in many administrative branches in Finland. In addition to the National Climate Change Adaptation Plan 2022, the Ministry of the Environment has published its own action plan (ME 2016), the Ministry of Agriculture and Forestry has published a climate change adaptation action plan 2011–2015 (MAF 2011), the Ministry of Transport and Communications has published a climate policy programme 2009–2020 (MTC 2009), and the Defence Forces has published an energy and climate programme 2018–2021 (PV 2018). A report on the implementation, adequacy and effectiveness is to be submitted at least once in every electoral term as part of the annual climate report. The state of implementation of the national climate change adaptation plan was reported to the parliament in the 2020 annual climate report (ME 2020). In addition to state government, the guide for the development of preparedness of the Association of Finnish Local and Regional Authorities highlights how municipalities address climate change and what actions are involved in environmental health and social and health services, for example (Association of Finnish Local and Regional Authorities 2020).

Finland also has publications that complement regional adaptation strategies, such as the review by Helsinki Region Environmental Services (HSY) of the challenges and solutions of adaptation in the Helsinki metropolitan area (HSY 2017) and the Sustainable Urban Agenda programme (HSY 2020). The Finnish Climate Change Panel has examined Finland's adaptation situation in climate policy and what kind of adaptation measures are available to prevent key health and welfare impacts of climate change in the social welfare and health care sector (Juhola et al. 2020). Organisations have been active in communicating about the health impacts of climate change, and SOSTE (Finnish Federation for Social Affairs and Health) published a report entitled "Climate change and the social welfare and health sector" in 2020, which highlights the role of the social welfare and health care sector and the related associations in climate change mitigation and adaptation (Mayer et al. 2020).

The following sections examine Nordic adaptation strategies and adaptation actions. The Nordic plans have many perspectives that can also be directly applied to adaptation actions concerning Finland due to climate and social similarities.

3.1 Sweden

Sweden adopted the current national climate change adaptation strategy in 2017, which considers the potential direct and indirect health impacts of climate change. The strategy groups these impacts as follows:

1. Direct effects of extreme weather phenomena, including effects on mental health,
2. Zoonotic threats,
3. Infection threats communicated via domestic water,
4. Air quality and heat safety in outdoor areas (ground-level ozone, forest fires and urban thermal island phenomenon); and
5. Deterioration of indoor air quality (moisture damage, mould, ticks and heat).

In Sweden, different administrative branches prepared sector-specific adaptation plans. The Swedish public health authority (Folkhälsomyndigheten) thus prepared a national adaptation plan "Folkhälsa i ett förändrat klimat" 2017 (Folkhälsomyndigheten 2017). It recognises that there is little knowledge of health impacts, but the plan emphasises the active monitoring of the above-mentioned threats, which has been incorporated as part of the normal activities of the competent authorities by 2020. A large part of this work is carried out by the public health authority under the guidance of Miljöbalk, the environmental code of the national health authority. This means, for example, active routine monitoring of the responsible authorities' health indicators. Various projects promoting the management of heat waves, risk assessment reports on infectious diseases and training have been used to support official activities. In addition to the five areas mentioned above, the impacts of climate change have been included in new plans related to disruptions. Sector-specific official responsibilities were defined in 2017–2020. The above-mentioned tasks and responsibilities of health authorities, like other authorities, were also defined in adaptation to climate change.

A network of authorities for adaptation to climate change has been established in Sweden, in which the authority responsible for zoning and planning plays a key role. Like Finland, Sweden has municipal self-government, and most of the adaptation work is done in municipalities. In Sweden, a guide on safeguarding water supply has been prepared to support both public and private water bodies and the authorities supervising them in order to meet the challenges of the changing climate. This guide is an example of network-like cooperation between different administrative branches. The Swedish public health authority is one of the ten authorities that have cooperated to contribute to the guide (Livsmedelsverket 2019).

3.2 Norway

A committee report on adaptation to climate change (Norwegian ministry of climate and environment 2010) was published in Norway in 2010. Since then, in 2012–2013, a so-called white paper was produced for Norway's Stortinget called "Climate Change Adaptation in Norway" (Norwegian ministry of climate and environment 2013). The fundamental premise is that Norway is a highly developed country in which significant public health impacts caused by climate change are not expected.

The risk assessment is very similar to that in Sweden, with the difference that Norway possesses special threats from geography and topography related to landslides, avalanches and floods. This means that grey water management plays a key role in the prevention of threats. In Norway, the threat assessment draws particular attention to threats communicable via domestic water, as most of the raw water sources in Norway originate from surface waters. In Norway, however, no problems are expected in agglomerations with more than 20,000 inhabitants, where water is distributed by large water establishments.

As in Sweden, threat assessments are associated with potentially increasing negative effects of heat cycles, the prevention of infections communicable via water/food, or potentially increasing allergies as a result of the warming climate. Norway also draws attention to changes in the incidence of various vector-borne diseases. In Norway, climate change is also expected to have a positive impact on health, as deaths associated with the cold climate will decrease.

At the end of 2018, an update of the threat assessment prepared by consultants was published in Norway, clarifying threat assessments to some extent, but without quantitative estimates of potential health threats. The mental health impacts of climate change were also highlighted as potential risks in the update. The threat assessment presented as a new item a model published in 2015 of the economic and social impacts of climate change and their reflection on health and the need for health services by 2090. However, it was estimated here that the impacts would be smaller than in the rest of Europe.

Norway has not prepared a climate change adaptation programme, but it has prepared guidelines for the planning of climate change adaptation for both central and local government. In addition, Norway has conducted a separate study on indirect global threats and opportunities related to climate change in five different areas: agriculture/fishery, infrastructure, finance, human communities and geopolitics. The knock-on health effects on Norway in these areas have been examined in the report. In the report, opportunities are considered smaller than indirect negative impacts and threats. Despite this, health impacts are associated with a lack of information related to threats.

The strong health infrastructure in Norway and throughout Europe is expected to reduce the indirect impacts of climate change on Norway.

3.3 Denmark

Denmark's climate change adaptation strategy was completed in 2008 (Danish government 2008). As far as health is concerned, the threat scenarios closely resemble those of Sweden and Norway regarding infectious diseases that are increasing through food and water. Denmark has also paid attention to sunbathing and accidents in the adaptation programme. In 2012, both national and local climate change adaptation action programmes were completed in Denmark (Danish government 2012). These provide guidelines for risk management, mainly due to risks caused by rainfall and changes in sea level, in national or local water management.

In Denmark, health does not have such a strong position regarding adaptation to climate change as in Sweden. However, health has been mentioned in various reports as one of the sectors examined in terms of climate change adaptation.

In Denmark, the Ministry of the Environment and Food, the Ministry of Industry and Trade and the Ministry of Energy and Climate coordinate climate change adaptation horizontally. Thus, the Ministry of Health does not belong to this group. In Denmark, the Ministry of the Environment and Food is responsible for environmental health care, i.e. the safety of food, domestic water and bathing waters. Health authorities – though programmatically not part of climate change adaptation – monitor, as part of official work, changes in the incidence of infectious diseases and respond appropriately to them or respond to heat cycles by sharing information related to adaptation (Ministry of the Environment and Food of Denmark 2020).

4 Climate resilience in health protection and social welfare and health care

Comprehensive adaptation to future weather and climate changes is necessary in all sectors of society, including social welfare and health care. We are all responsible for building a sustainable society in the future, and building a sustainable society in a comprehensive manner requires efforts from everyone. Health care infrastructure is dependent on general societal infrastructures and preparedness measures: food production and water supply, waste management, transport routes and means, electricity and other energy, communication and digital infrastructure. General infrastructure is dependent on economic and trade development. This section discusses the role of health protection and the services supporting it in maintaining and strengthening adaptation in Finnish society. Special attention is paid to water management and housing standards by way of example. In addition, the basic structures of social welfare and health care are reviewed to support adaptation to climate change in the administrative branch of the Ministry of Social Affairs and Health.

4.1 Basic structure of health protection and services supporting it in adaptation

Health and social welfare and the related problems depend on everything that happens in the surrounding social and biological environment. Health care and social welfare are linked to other activities of society, so changes in society are also immediately reflected in the activities of the social welfare and health care sector. The Finnish health care sector has good opportunities to adapt to climate change, because the society is developed and its climate and economic starting points are good. However, this does not mean that we would avoid the effects of climate change, but it is possible to manage the increase in risk probability through adaptation. A prerequisite for systematic adaptation is a sufficient knowledge base and a functioning and reliable society, provided that knock-on effects do not undermine the functioning of society and sufficient resources.

The Ministry of Social Affairs and Health is responsible for the general planning and steering of health protection. The purpose of health protection is to maintain and promote the health of the population and to prevent, reduce and eliminate factors that may cause

danger or harm to human health and the environment. Health protection is based on the Health Protection Act, which is the responsibility of the Ministry of Social Affairs and Health. The health of the population is protected, for example, by monitoring and investigating the adverse health effects caused by domestic and bathing water, housing, shared living areas and waste, and by influencing land use in a preventive manner. Health protection guidelines and regulations include:

- Health Protection Act 763/1994
- Housing health instructions
- Decree on housing health
- Decree of the Ministry of Social Affairs and Health Relating to the Quality and Monitoring of Water Intended for Human Consumption 461/2000
- Minor Decree of the Ministry of Social Affairs and Health Relating to the Quality and Monitoring of Water Intended for Human Consumption 401/2001
- Decree of the Ministry of Social Affairs and Health Relating to Bathing Waters 177/2008 and the application guide of the Bathing Waters Decree
- Minor Decree of the Ministry of Social Affairs and Health Relating to Bathing Waters 354/2008

General preparedness measures in society, which include food supply, water supply, waste management, transport routes and equipment, electricity and other energy, the internet and other digital infrastructure, affect the operative reliability and security of supply of health care. Health care and social welfare are influenced by actions in many other administrative branches, on which health care has little influence, such as livelihoods (e.g. agriculture), income distribution, migration, infrastructure, trade, transport, communications, zoning, construction, housing standards and housing occupancy rate. In addition, basic infrastructure and services supporting health protection play a key role in ensuring effective social welfare and health care. These include securing energy supply, electricity and data transfer and water supply. In addition, each sector has its own adaptation needs, which means that the adaptation of the social welfare and health care sector depends on the climate risks of many other administrative branches and their adaptation.

4.1.1 Water supply and supporting infrastructure in health protection

Approximately 150 years ago, with the adoption of the Health Care Act, the building of water supply infrastructures in urban areas in Finland for both hygiene and fire safety

reasons was started. This made it possible to increase the hygiene level in households and large households, but also in industry and hospitals.

In developing countries, where no water supply infrastructure has been built, only about 20% of children's diarrhoea diseases are mediated via drinking water; 80% of diarrhoea diseases are caused by poor environmental hygiene in different ways. In developed countries, the relationship is virtually the opposite, and the incidence of diarrhoea diseases is very low compared to developing countries, because in developed conditions, the above 80% are prevented by washing out the pathogens in many different ways. This is one of the main reasons why developing countries are much more vulnerable to the impacts of climate change, such as changes in rainfall or changes in the incidence of communicable diseases caused by weather extremes. Another basic reason is that developing countries lack, in practice, the continuous sufficient electricity supply required for safe food and water management (including stormwater management), which also enables the central cornerstone of health protection, the cold chain. All these reasons lead to the fact that the prevention of infections in developed countries is easier in principle than in developing countries.

In Finland, the Ministry of Agriculture and Forestry is responsible for organising water supply and the related steering. However, this is done in close cooperation with the Ministry of Social Affairs and Health and the Ministry of the Environment. The Ministry of Social Affairs and Health supervises the quality of domestic water, while the Ministry of the Environment is responsible for water protection in both water abstraction plants and for waste and stormwater management.

Chapter 8 (reference) of the fifth assessment report of the United Nations Panel on Climate Change (IPCC) examines climate resilience in urban areas. The significance of water supply, including stormwater management and sanitation, for the climate resilience of society is described as follows:

"By reducing the deficiency in basic services and building resilient infrastructure systems (water supply, sanitation, stormwater and other sewerage, electricity, transport and telecommunications, health care, education and emergency/disaster preparedness), the vulnerability associated with climate change can be significantly reduced, especially for the weakest and most vulnerable population groups."

A Water Safety Plan (WSP), which is based on the model recommended by the WHO (WHO 2009) for the comprehensive risk assessment of water utilities, is used in the promotion of water safety and the prevention of water epidemics in different countries. Finland has its own standard WSP risk management method, and the risk assessment of a plant supplying domestic water can be carried out using an online WSP tool (https://wspssp.fi). The tool

takes into account flood risks (caused by increasing rainfall) as one of the risk factors affecting water quality. WSP is used in the EU, for example in the Netherlands (van den Berg et al. 2019), and outside the EU, for example, in Australia and New Zealand. In Finland, water utilities feel they are able to respond adequately to the problems caused by weather fluctuations (Meriläinen et al. 2019).

4.1.2 Housing standards in health protection

The northern location of our country emphasises the importance of thermal safety and thus housing standards in health protection. Good, sustainable dwellings built in the right place provide protection against extreme weather phenomena.

The Ministry of the Environment is responsible for maintaining the collection of building codes, as well as for the steering and advance supervision associated with the regulations. The Ministry of the Environment also handles legislation regulating the zone planning of housing, which controls the construction of dwellings in places that are less susceptible to extreme weather phenomena or floods. The government under the Ministry of Social Affairs and Health issues statements on changes related to zone planning and construction legislation from the perspective of health protection, and works in close horizontal cooperation with the Ministry of the Environment on these issues at all levels of administration.

The Ministry of Social Affairs and Health includes retrospective supervision of housing health hazards, for which legislation and other guidelines have been drafted by the ministry to determine the health of living conditions. The Ministry of Social Affairs and Health guides both regional and local health protection authorities in the retrospective monitoring of housing health hazards.

The eighth chapter of the fifth assessment report of the United Nations Panel on Climate Change (IPCC 2014) looks at climate resilience in urban areas. The significance of good living conditions for adaptation to climate change and climate resilience is described as follows:

> *"High-quality, affordable housing built in the right place can reduce exposure and harm and promote adaptation to climate change in urban environments."*

4.2 Social welfare and health care services in adaptation

4.2.1 Health care

The duty of health care is to anticipate, prevent and treat the health risks and problems of the population and to promote welfare and health. These duties in health care are implemented by means of health care and medical care, but also by means of preventive health care and health counselling. Health care professionals are experts in population health issues in their communities. According to the Health Care Act, the aim of health care in Finland is also to reduce health differences between population groups. All these health care tasks and objectives play a key role in protecting the health and wellbeing of the population from the consequences of climate change.

At least in the short term, the threats posed by climate change to the health of the population in Finland are probably largely well managed by existing? means of health care. The likelihood of extreme weather conditions causing major health threats is low, even though relative changes in the climate in the northern parts of the country are large. However, the number of patients suffering from health problems and accidents related to the consequences of climate change may increase considerably, which should be prepared for in health care.

Climate change adaptation applies in particular to preventive health services and health advice. In these services, a special role is played by various vulnerable groups, such as elderly people, people with chronic illnesses, families with children and homeless people, who are particularly vulnerable to health threats associated with exceptionally warm periods, for example.

In the planning of adaptation measures, it is necessary to increase the resilience of health care (flexibility of change) to respond to changes in the operating environment or to climate change-related shocks, some of which may also occur relatively quickly due to natural disasters, migration and refugees or disturbances in international production chains. Preparing for and planning adaptation measures require action at different levels based on preparedness that recognises threats. Regional administration of health care and cooperative steering and planning structures enable the consideration of regional special features and risk assessments in adaptation measures.

4.2.2 Social welfare services

Social welfare is, in particular, the security of people who are vulnerable in different ways in society (e.g. children, elderly people, people with disabilities). Social welfare activities rely on the values, resources and distribution of resources prevailing in society. People

resorting to social welfare often have less resources than average, for one reason or for another, i.e. their ability to act flexibly in changing situations is more limited than that of the average population. Traditionally, social welfare and social services have been local community services. Knowledge of local conditions has been considered important because it also makes it possible to anticipate potential problems and to influence, for example, the development of regions and their social sustainability through structural social work. Thus, the importance of social welfare for adapting to climate change is not only in the services offered, but also in the knowledge of local conditions and the area. Furhtermore, information on vulnerable groups and their needs is increasingly accumulating in social welfare services. If this information is systematically collected, it can be used to assess the impacts of different adaptation mechanisms on different population groups at regional and local level.

4.2.3 Occupational health care and workplaces

According to Statistics Finland (31 December 2018), there are 3.4 million working-age people (15–65 years) in Finland, which is approximately 62% of the total population in Finland. As the population ages and the birth rate declines, the demographic dependency ratio in Finland is worryingly growing, and support measures for the employment and work ability of the working-age population are of paramount importance to retain Finland's welfare society. When planning and implementing health care for the working-age population, preparedness for the impacts of climate change is also important.

By law, an employer must organise occupational health care for persons working as employees (Occupational Health Care Act 1383/2001). In fact, occupational health care services contribute significantly to the production of health care services for approximately 2 million Finns. The task of occupational health care, laid down in the Occupational Health Care Act and belonging to all employees, emphasises support measures for work ability and the surveying and prevention of health hazards arising from work. For some employees, an occupational agreement concluded by the employer also extensively covers medical care services. Occupational health care as a service system integrates social welfare and health care into working life.

Occupational health care has good opportunities in cooperation with the workplace to promote the adaptation of employees to climate change. Together with the workplace and occupational safety and health services, occupational health care can, for example, analyse the increasing thermal load caused by climate change or the risk of slipping accidents, and plan measures to manage health and work ability problems related to these. The task of occupational health care is to promote the health and safety of work and the working environment, as well as the health and working and functional capacity

of employees (Occupational Health Care Act 1383/2001). For example, with the systematic monitoring of health checks, workplace surveys, doctor's appointments and reports of visits to occupational health care, sick leaves and diagnostic reports, occupational health care has a good opportunity to take a preventive approach. Occupational health care has a "front row position" to monitor the health of the working population and also to identify health risks related to climate change, to provide employees and employers with information on the health and work ability impacts of climate change, and to react proactively to health risks observed at work. To make optimal use of the potential of occupational health care to protect the working population against health risks caused by climate change, training and other measures are needed to raise awareness regarding climate changes as well as the related means of preparedness and adaptation of occupational health care and workplaces.

According to the Occupational Safety and Health Act, the employer must investigate and identify the harms and hazards caused by work, workspace, other work environment and working conditions, i.e., carry out a risk assessment. In this work, the employer must, if necessary, use the assistance of an external expert, such as an occupational health care service (Occupational Safety and Health Act 2002/738). The Occupational Safety and Health Act establishes, for example, the framework for working in a hot working environment, even though no actual standard for temperature conditions has been specified. The risk of endangering employees' health in a special situation must always be assessed as widely as possible, and measures must be taken to prevent the risk of endangering health. If work-related risks cannot be eliminated, their relevance to the safety and health of the worker must be assessed.

5 Health and social welfare

This section presents the objectives of adaptation to and adaptation measures related to non-communicable diseases, communicable diseases, nutrition and health, occupational health and well-being at work, social impacts and health impacts of mitigation measures. For more extensive descriptions of the state of adaptation in different areas, see appendix 1. For more detailed recommendations on adaptation needs, see appendix 2.

5.1 Non-communicable diseases

5.1.1 Health hazards from heat

Climate change directly affects the health risks caused by the ambient temperature, which arise from both cold and hot weather in countries with cool and warm climatic conditions(Gasparrini et al. 2015). With climate change, temperatures rise, and heat waves become more common and stronger. Thus, adaptation to climate change primarily requires preventing the adverse effects of heat. In the future, the likelihood of health hazards caused by temperature extremes will be increased not only by climate change but also by the ageing and urbanisation of the population.

Hot weather and heat waves are already causing significant health hazards in Finland. The mortality rate of the population increases considerably when the average daily temperature exceeds approximately 20 degrees (Ruuhela et al. 2017). A prolonged heat cycle lasting 3–4 weeks may cause several hundred deaths (Kollanus & Lanki 2014). The most sensitive to the adverse effects of heat are elderly people, small children and those suffering from chronic illnesses. The risk of serious health effects is particularly high for people over 65 years of age. During heat waves, mortality increases considerably among both elderly people in health and social care institutions and those living at home.

Some measures have been taken in Finland to combat health hazards from heat. The Finnish Meteorological Institute has issued heat warnings since 2011. The most significant legislative measure has been the action thresholds specified by the Ministry of Social Affairs and Health in the Decree of the Ministry of Social Affairs and Health on Health-related Conditions of Housing and Other Residential Buildings and Qualification Requirements for Third-party Experts (Ministry of Social Affairs and Health 545/2015) for

the high temperature of room air outside the heating season. Efforts have also been made to influence the temperature conditions of buildings in the Ministry of the Environment decree on the energy efficiency of a new building (ME 1010/2017). In addition, guidelines on the prevention of adverse effects have been published for municipal health protection authorities, health care and care institutions and the general public (Hassi et al. 2011, Kujala et al. 2013, Ministry of Social Affairs and Health 2014, thl.fi/fi/web/ymparistoterveys/ilmasto-ja-saa/helle, kuumainfo.fi).

The most significant development needs in the fight against health hazards from heat are related to the preparedness of social welfare and health care units, as a large number of people who are sensitive to adverse effects are placed within the scope of these services and care institutions. Finland lacks a national action plan aimed at preventing health hazards from heat, which has been drawn up in many other European countries (Bittner et al. 2014, Casanueva et al. 2019, Martinez et al. 2019). The action plan should preferably cover both short-term and long-term actions in all relevant operating sectors. Actions aimed at preventing health hazards during heat cycles should be connected to the heat warning system. More detailed information on heat-related health hazards and their prevention is presented in appendix 1.

Objectives

The general objective is to have a broad understanding of the impact of climate change on health hazards caused by heat and to prevent adverse effects through national and local actions. The following more detailed objectives guide the recommendations for measures presented in appendix 2:

1. Establish a national overall view of the short-term and long-term actions needed to prevent health hazards in the various operating sectors. National targets, recommendations and guidelines guide preparedness at the regional and local levels.

2. The key to adaptation is to protect vulnerable population groups. To prevent serious health hazards, preparedness for hot weather needs to be strengthened, especially in social welfare and health care units.

5.1.2 Slipping accidents

With climate change, the days of slippery weather will become more common in a large part of Finland, as the temperature varies more frequently on both sides of zero Celsius degrees (Pilli-Sihvola et al. 2018). Nowadays, tens of thousands of Finns apply for medical treatment due to slipping accidents every winter. Slipping accidents can lead to congestion in health care emergency units and cause significant financial costs through

sick leave among working-age people. The number of slipping accidents in Finland has been reported in, for example, the working paper "Suomalaiset tapaturmien uhreina 2009 – Kansallisen uhritutkimuksen tuloksia" (Haikonen and Lounamaa 2010). The Ministry of Social Affairs and Health has published a Target Programme for the Prevention of Home and Leisure Accident Injuries 2021–2030 (Ministry of Social Affairs and Health 2020), proposing, for example, actions related to pedestrian safety. The actions will promote the prevention of winter slipping accidents during commuting and leisure time, for example by drawing attention to footwear safety. The Ministry of Transport and Communications strives to increase the proportion of walking and cycling as modes of transport, which both increases health benefits and mitigates climate change, but as the proportion increases, preparations must also be made for increasing risk of accidents. The safety of winter walking will be secured by improving the safety and accessibility of the living environment. To prevent slipping, footwear, correct material for shoe soles and heel pads and slipping barriers are taken into account. In the prevention of slipping, physical fitness and balance are also important in all age groups, which is emphasised with ageing (Havulinna et al. 2017).

Slipping accidents can be prevented by means of information campaigns, in which citizens are instructed on preparing for slippery conditions and moving on slippery roads. It is also important to pay attention to winter maintenance of streets and roads and the prevention of slippery roads. In Finland, the Finnish Meteorological Institute publishes pedestrian weather warnings. Information on the risks of slippery weather has been provided in, for example, the "Stay upright" campaign, the aim of which is to promote the safety of winter pedestrian traffic (https://thl.fi/ajankohtaista/kampanjat/voi-hyvin-talvella/pysy-pystyssa-liukkaalla-saalla). The Finnish Red Cross has also aimed to prevent falling accidents by providing information on the use of slipping barriers. The maintenance and winter maintenance of walking and cycling routes are also discussed in the Finnish Transport Agency's instructions for planning pedestrian and cycling paths. It should be noted that preventing slipperiness with sanding causes harm to respiratory and cardiac health. Street dust in particular increases the use of health services for older people, people with respiratory illnesses and cardiovascular diseases and their mortality. Climate change adaptation actions therefore do not always only promote one's health.

Objectives

The general objective is to have sufficient awareness of the significance of climate change in planning and decision-making for the prevention of slipping accidents. The following more specific objectives guide the recommendations for actions set out in appendix 2:

1. Inform about the prevention of slipping by continuing existing information campaigns
2. Determine in more detail the impact of climate change on slippery conditions and slipping accidents in Finland

5.1.3 Indoor air quality

Climate change will affect the building stock and construction in Finland and increase humidity damage to buildings in Finland (Tuomenvirta et al. 2018). This is influenced by the increasing precipitation, the proliferation of slanted rain that hits the walls of buildings, the change of the precipitation from snow to water, the increase in flood risks and the relative humidity of the air, and the increase in temperature. The insulation thickness of buildings is also increasing to save energy and mitigate climate change, which further increases the risk of damage to the structures. In addition, to save energy, ventilation needs to be managed more closely than before, which, if poorly implemented, can increase the risk of all indoor air pollutants and also exacerbate temperature damage and heat risks.

Poor indoor air quality and humidity damage in buildings are currently causing significant health and well-being costs due to symptoms, illnesses and their examination, loss of working capacity and reduced work efficiency. On the other hand, 45% of Finland's national wealth is committed to the current building stock. Finding effective and efficient ways to adapt to climate change requires comprehensive, versatile research and solutions.

Adaptation needs related to indoor air problems include anticipating changing weather conditions, repairing risk sites and investing in optimal structural solutions in both new and renovation construction. Adaptation requires the assessment of new operating methods in property maintenance; climate change highlights the importance of careful maintenance of buildings and the adequacy and regulation of ventilation.

Objectives

The general objective is to have sufficient awareness of the significance of climate change in planning and decision-making for the quality of indoor air. The following more detailed objectives guide the recommendations for actions set out in appendix 2:

1. Determine the links between climate change and indoor air quality in Finland
2. Determine the possibilities for adaptation to climate change in Finland in regard to indoor air

5.1.4 Mental health effects

Climate change leads to mental health impacts not only indirectly but also directly. Climate change directly increases anxiety, probably depression and possibly suicides (Berry et al. 2018, Burke et al. 2018, Gammans 2020). Little research has been carried

out as of yet with Finnish data. Challenges arise from the variation of solar radiation in different ways during different seasons because of climate change (Ruuhela et al. 2012). These impacts are likely to appear indirectly as a result of the increase in extreme weather phenomena. The physical and psychological morbidity of people with mental health problems will also increase during heat waves (Zander et al. 2015, Parks et al. 2020). The stress on the respiratory and cardiovascular systems increases, sleep deficit increases and recovery is slower if the body cannot cool down at night. In addition to temperature, the amount of light is also important.

In Finland, climate change reduces the brightness of the outdoor environment due to increasing cloudiness and shorter snow coverage periods during the winter months. The increasingly dark winters can lead to more widespread seasonal affective disorder, with many direct effects on well-being. Darkness affects the regulation of the internal human clock. In addition, repeated weight gain in particular every winter may, in a few years, result in significant adverse health effects, which are indirectly reflected in work ability and the national economy as a whole. Seasonal affective disorder accounts for about one tenth of all mood disorders, which can lead to an impact in the magnitude of up to €800 million annually (Laine et al. 2018). The scarce light of winter months may also be a factor that makes people more susceptible to suicides, because the less solar radiation there is outdoors, the more suicides there are in winter months (Ruuhela et al. 2009).

In part of the population, climate change causes environmental or climate anxiety (Pihkala 2019). Climate anxiety, symptoms related to darkness and, for example, reduction in the opportunities for physical winter activity because of lack of snow may have a significant impact on the working and functional capacity of Finns. Taking mental health into account and ensuring that society and individuals are resilient is also associated with many other phenomena, such as post-traumatic stress reactions involving refugees.

Taking into account the scale of the national economic impact of mental health problems and seasonal affective disorders, it would be justified to include indicators for mental health in the national climate change adaptation indicator framework, which can be used to monitor the effectiveness of adaptation actions.

The aim of adaptation is to prevent the mental health hazards from heat and frost periods and the period of winter darkness. In social welfare and health care, the actions include increasing the capacity to act in the event of traumatic psychological crises and stress disorders due to extreme weather phenomena, improving the efficiency of treatment to prevent the increased disease burden caused by summer heat cycles, and increasing the use of timed light to prevent adverse effects due to increasingly dark winter days. Construction, land use and housing actions include increasing and introducing systems to enhance cooling (heat cycles), heating (frost periods) and lighting (winter darkness).

In adaptation, mental health resilience should be strengthened, for example from the stress and strain situations increasing as a result of the increase in refugees, and this should also be taken into account in teaching, and the mental-health resilience skills should be strengthened across the line in the social welfare and health care sector and in cooperation with other sectors.

Objectives

The general objective is to ensure that awareness of the significance of climate change in preventing and controlling mental health hazards is high and that efforts are made to prevent mental health hazards from heat periods, freezing seasons and winter darkness periods. The following more detailed objectives guide the recommendations for actions set out in appendix 2:

1. Increasing the capacity to act in the event of traumatic psychological crises and stress disorders due to extreme weather phenomena, improving the efficiency of treatment to prevent the increased disease burden caused by summer heat cycles, and increasing the use of timed light to prevent adverse effects due to increasingly dark winter days.
2. Enhance adaptation actions for construction, land use and housing to prevent mental health hazards.
3. Monitoring: The implementation of adaptation actions is monitored via health care quality registers, specifically itemised by groups of disruption

5.2 Communicable diseases

Epidemics and pandemics caused by communicable diseases are occasionally a threat to global health (Simpson et al. 2020, Morse et al. 2012, Smolinski et al. 2003). Evidence suggests that the risk of such new and threatening communicable diseases has increased over time with increased international tourism and trade, livestock farming, growing population density and changing interactions between humans and wild animals (Smolinski et al. 2003, Jones et al. 2008). All the variables listed above are likely to continue to grow in the future, and in addition to these, environmental change, the destruction of the environment and, for example, climate change increase the risk of such diseases (Smolinski et al. 2003, Oppheim et al. 2019).

Climate change may partly accelerate the spread of waterborne and vector-borne diseases. The World Health Organisation (WHO) lists pathogens that it considers to be

the most important threats to public health worldwide as priority areas for research and development. In 2018, "Disease X" was added to the list of these diseases to allow for an unknown disease (WHO 2018). The large-scale international mobility of people has been the main factor in the global spread of diseases, as has also been the case with the COVID-19 pandemic.

5.2.1 Waterborne diseases

In international comparison, Finland's water supply is of a high standard, and Finland is well equipped to adapt to the additional risks posed by climate change in water supply. Climate change can increase the risk of waterborne epidemics, because increasing rainfall and rising temperature will reduce the microbiological quality of water systems. Extreme weather phenomena (storms, drought, etc.) and flood risk will also affect the threat of aquatic epidemics and the operation of water facilities as a result of climate change. Water facilities must guarantee safe water supply, which means that attention has been paid for a long time in legislation to the management of water risks.

Risk management actions relevant to adaptation to climate change to prevent water epidemics include monitoring the microbial removal efficiency of water treatment processes and optimising processes as the quality of raw water changes, to minimise the risk of infection (Meriläinen et al. 2019). A Water Safety Plan (WSP), based on the model recommended by the WHO for the comprehensive risk assessment of water utilities, is used in promoting water safety and preventing water epidemics (WHO 2009). In Finland, water epidemics are monitored via a municipal investigation team in the event of an epidemic, and water epidemics are reported to the reporting system for food and waterborne epidemics (RyMy). Climate change also increases the risk of waterborne epidemics on beaches (appendix 1).

Flood preparedness and adaptation are guided by the Flood Risk Management Act (620/2010), and floods are prepared for with regional flood maps and flood risk management plans (Parjanne et al. 2018). In addition, floods are warned about on the Flood Centre's website (Flood Centre 2013), which also contains forecasts of different types of floods for use by water plants. In addition to minimising or preventing construction in flood-sensitive areas, provision can be made for the harmful effects of floods, for example by adding green areas, embankments, flood dams and walls to land use planning. In addition, improving the drainage network and river canals is one of the ways of adapting as well as improving water retention capacity by restoring waters and through afforestation. In addition, flood insurance is a commonly known tool to provide financial security for increased flood risk.

More detailed information on adaptation to waterborne communicable diseases can be found in appendix 1 and recommendations for adaptation actions in appendix 2.

Objectives

The general objective is that in water supply and the prevention of water epidemics, awareness of the significance of climate change is high and that climate change and adaptation to it are taken into account in planning and decision-making concerning water supply and the prevention of water epidemics. In addition, monitoring of water quality and water epidemics and contamination situations enables monitoring of the adaptation situation at national level. The following more detailed objectives guide the recommendations for actions set out in appendix 2:

1. Preparation of a national action plan on preparing for climate change in water management and of the related guidelines.
2. Develop the monitoring of contamination and accident situations in water services in order to investigate the current preparedness situation and improve preparedness.

5.2.2 Vector-transmitted diseases

Vector-borne diseases are bacterial, viral and parasitic diseases that infect humans through vectors such as mosquito or tick bites or stings (WHO 2020). The spread of vector-borne diseases is an equation that consists primarily of three factors: the pathogen, the vector and the carrier of the disease. Each of these factors has different climate dependencies, which makes it difficult to predict the spread of vector-borne communicable diseases, and there is a continuous need for up-to-date research information. The most significant vector-borne diseases in Finland are Lyme borreliosis and tick-borne encephalitis (TBE) spread through ticks. Mosquito-borne diseases of public health significance in Finland are Pogosta disease (Jalava et al. 2013) and tularaemia.

For example, the warmer winters in Finland and the increasing water precipitation in the winters have an impact on insects wintering in forest litter (Ruosteenoja 2013, Turnock and Fields 2005, Nordman 1952). For example, the population of ordinary ticks and taiga ticks has been predicted to increase as a result of climate change (Laaksonen et al. 2018, Estrada-Peña et al. 2017).

In addition to vector-borne communicable diseases occurring in Finland, the health of Finnish tourists is also affected by tropical communicable diseases in other parts of the

world, the incidence of which climate change will change greatly both geographically and quantitatively.

One of the key objectives of adaptation actions is to produce up-to-date monitoring and risk assessment data for different actors to reduce health risks. The Finnish Institute for Health and Welfare monitors the occurrence of vector-borne diseases both nationally and internationally using various monitoring systems and produces situation and risk assessment reports to support adaptation actions. Risk assessment data is also part of the evaluation process of the national vaccination programme and other vaccination recommendation areas related to vaccination for tick-borne encephalitis. Tick-borne encephalitis and the vaccines against it are a good example of how it is important to involve preventive vaccines in the national vaccination programme in a timely manner. As the climate changes, it is a good idea to prepare for the fact that communicable diseases may occur in Finland that we have not had in the past. This should be taken into account both in matters covered by the national vaccination programme and in matters of security of supply.

A key part of reducing the health risks associated with vector-borne diseases is human behaviour and its change. This also plays a key role in adaptation to the impacts of climate change (WHO 2020). For this reason, key objectives and actions include increasing information and risk communication for both citizens and key actors. More detailed information on vector-borne diseases and adaptation to them can be found in appendix 1, and recommendations for adaptation actions in appendix 2.

Objectives

The general objective is to have sufficient awareness of the significance of climate change in planning and decision-making for the prevention of vector-borne diseases. The following more specific objectives guide the recommendations for actions set out in appendix 2:

1. Monitor the occurrence of vector-borne communicable diseases with the help of the communicable diseases register of the Finnish Institute for Health and Welfare (THL) and other national registers. Monitoring will be enhanced by producing risk assessment data, which is developed especially with respect to tick-borne encephalitis.

2. Monitoring vector-borne communicable diseases and producing risk assessment data. Enhance research and cooperation. Survey a national network of actors for vector-borne diseases and aim to establish an expert network.

3. Develop communication to raise public awareness, especially with respect to tick-borne diseases.

5.3 Nutrition and health

Climate change affects the entire food environment, from the production factors in the food chain to the nutritional quality of food and the composition of the diet. Weather fluctuations caused by climate change make global food production more difficult and may also affect food security, food availability and nutrition and health in Finland. Dietary changes also provide an opportunity to mitigate climate change. The government has set an ambitious target for Finland to be carbon neutral by 2035. One of the objectives of the government programme is a climate-friendly and environmentally friendly food system in which, among other things, the share of domestic plant products and domestic fish is increased in accordance with nutrition recommendations and low-carbon targets. Not all measures have been decided on to achieve the carbon neutrality target, but the VTT report anticipates major changes to the Finnish diet (VTT 2020). The report examined several scenarios, and reaching the target would require, for example, a 15%–25% reduction in meat consumption and otherwise a vegetarian-emphasised diet. In the EU too, mitigation actions are starting to change food production, as the aim is to reduce emissions by 55% by 2030 (https://ym.fi/euroopan-unionin-ilmastopolitiikka). Indeed, the communication published by the Commission in January 2020 suggests that up to 40% of the agricultural budget is directed to mitigation measures (McEldowney 2020). Diet has the potential to play a major role in combating climate change. In Finland, the chain of food production and consumption from field to table causes about a third of the environmental impacts of all production and consumption. In addition to consumption choices, food loss and production methods affect land use, eutrophication and acidification of the environment, and the reduction of biodiversity.

Therefore, the impact of these expected changes on the Finnish diet and food security should be assessed and possible adaptation needs considered. As a whole, the situation is mainly favourable from a health point of view, as a vegetarian diet based on nutrition recommendations reduces the climate impacts and other environmental burdens of food and promotes health. A vegetarian diet is linked to better weight management and reduced prevalence of several non-communicable diseases, such as type 2 diabetes, cardiovascular diseases and some types of cancer. A vegetarian diet also enriches micro-organisms that are beneficial to health in the body. On the other hand, we must also be prepared for the possibility of individual-nutrient intake being reduced, so that it is necessary to supplement the diet to ensure sufficient nutrition. This is necessary if the composition of the diet becomes unbalanced or if the quality of the food deteriorates.

A sustainable and healthy diet can be promoted as one climate change adaptation measure in different policies, for example by using fiscal means, food services and public procurement, education and information, research and product development, and by influencing the food environment. The change in the food system towards a sustainable and healthy diet requires a wide range of cross-administrative actions. The potential

of public food services in the development of health and environmentally responsible activities is based not only on supply and waste prevention, but also on the food education aspect. Municipalities and joint municipal authorities must take into account responsibility, sustainable development and climate, including climate change mitigation and adaptation, in the municipal strategy, as well as outlining how they can be seen in food service and food procurement.

Ensuring food safety and food security is essential for health. Climate change increases extreme weather phenomena and crop damage and also increases the harmful effects of various plant diseases and plant pests and the leaching of nutrients from the soil. This is why versatile primary production is also important for health. Safe and ethical production is also supported by serious experiences of the spread of swine fever in China, where the disease brought the production of pig meat to a collapse and even shook global markets. The growing production of vegetable proteins for human consumption protects the functional capacity and independence of production sectors as crises strike.

Objectives

The general objective is versatility and flexibility in food production and consumption to ensure food security and healthy food in changing production conditions. The following more detailed objectives guide the recommendations for actions set out in appendix 2:

1. Climate change and sustainability (incl. biodiversity and food security) more strongly included in nutrition recommendations
2. Implementation of nutrition recommendations, including public food service and food procurement, including nutrition and responsibility
3. Development of monitoring systems for the composition of food and the nutrition of the entire population

5.4 Occupational health and well-being

Climate change affects Finnish working life and the working-age population in many ways. In the short term, the direct impacts of climate change on work and occupational health can be predicted to be lower than the impacts of preparedness for climate change. Sanna Marin's government programme includes a target for carbon-neutral Finland by 2035 (government programme 2019), and achieving this target requires measures that change working life in many ways. For example, it is likely that work will be reduced in sectors that rely on fossil fuels. New technologies are being developed and new work

duties are emerging, which means that the ways in which work is done and the needs for competence change in several sectors. As working life changes, possible impacts on the occupational health, safety and well-being of employees should also be taken into account. For example, several biological, chemical and physical hazards have been identified in relation to the circular economy (Laitinen et al. 2017). More research data is needed on occupational exposure and other occupational safety risks related to different sectors.

Direct impacts of climate change on work, workers' health and work ability can also be expected to occur. These impacts can already be observed, for example, as the heat load increases in many tasks. Prolonged heat cycles affect the morbidity of employees as described in section 5.1.1. Heat also has a clear impact on work ability and functional capacity and thus on the productivity of work. This phenomenon can be observed in work requiring physical and cognitive performance alike (Hübler et al. 2008, Dunne et al. 2013). Increased thermal load can also increase the likelihood of occupational accidents (Schulte et al. 2016, NIOSH 2016). In addition, thermal loading and chemical exposure have combined effects (Gatto et al. 2016, Schulte et al. 2016). Most of the slipping accidents requiring medical visits occur in the working-age population (Rantala et al. 2015, Tuomenvirta et al. 2018), and with climate change, the increasing risk of slipping in winter (see section 5.1.2) will be significant in terms of work ability and occupational safety in Finland in the coming years.

In addition to the direct impacts from climate change and from preparing for it, working life in Finland will also be affected by the knock-on effects of climate change, i.e., the interaction chains caused by climate change, which originate outside Finland's borders but whose impacts will also be reflected in Finland. The knock-on effects that are significant for Finland are related to energy supply, industry, tourism and population structure (Hildén et al. 2016). According to Deloitte's report to the Confederation of Finnish Industries (Deloitte 2020), key phenomena that will emerge in business life as a result of climate change are circular economy, directing investments to low-risk targets with respect to climate change, changes in supply chains and the need for competence development.

The adaptation needs of occupational health and well-being are discussed in more detail in appendix 1.

Objectives

The general objective is to have sufficient awareness of the significance of climate change in occupational health care and well-being as well as in the planning and decision-making

of harm prevention. The following more detailed objectives guide the recommendations for actions set out in appendix 2:

1. Increasing competence in and awareness of the impacts of climate change on work ability and occupational health and safety.
2. Preparedness for and adaptation to employees' thermal load and the resulting effects on work ability and occupational health and safety.
3. Preparing for and adapting to the effects of the circular economy on work ability and occupational health and safety.

5.5 Social impacts

In Finland, socio-economic health inequalities are already relatively large to begin with, so as the possibilities for adaptation vary depending on socio-economic status, these differences may also increase health inequalities. A stable financial position facilitates, for example, adaptation to extreme weather phenomena, such as making energy-efficient and cost-effective air conditioning decisions in households. At worst, climate change adaptation will increase the division lines of society, as different types of climate-friendly housing and mobility are available for some of the population, while some will have to settle for old technology, the price of which will probably also increase in the future. If the structural change in society continues to mean the destruction of jobs in industrial and old technologies, attitudes may become even less favourable to policies promoting adaptation. At worst, strong societal divisions can lead to the strengthening of so-called identity policies if, for example, vegetarian food and cycling are strongly linked to a certain urban lifestyle in which there is no desire to participate.

In international comparisons, Finland has a large public sector. It can facilitate adaptation when effective adaptation models can be introduced in different parts of the country, and they can be applied while taking local conditions into account. As such, the average welfare impacts do not describe very different situations, but it must be possible to investigate them at a national level and also at the regional and local levels. For example, shutting down some sectors when moving towards carbon-neutral Finland may have a significant impact on employment in a region and thus on the well-being there. As a result of the structural change, it should be possible to offer people who will become unemployed some positive prospects for the future. The regional perspective should therefore be taken into account to reduce inequality. In addition, consideration of different population groups in both social welfare and health care should be kept in mind, considering especially children and young people and the indigenous Sámi people. For

example, the availability of social welfare and health care services in the Sámi people's own language (Northern Sámi, Skolt Sámi, Inari Sámi) must be ensured.

Criteria may be included in public procurement that support adaptation to climate change so that welfare is also strengthened, for example taking into account the ecological nature of procurements and enabling and favouring local services. Strong regional and municipal administration creates opportunities for effective adaptation to climate change, taking local conditions into account. Adaptation to climate change requires long-term and systematic decision-making. It is supported by research and investigation data on how and by what mechanisms public sector measures promote welfare and health. This is a clear link with Sanna Marin's government's resolution on the promotion of welfare, health and safety, the implementation of which is being prepared by the Advisory Board on Public Health. The consequences of the actions of the climate change adaptation plan are diverse, covering health and social impacts and economic impacts as well as their interconnections. The aim is to cover these consequences by means of the so-called welfare perspective, which also enables learning from good practices in other countries.

The special characteristics of the indigenous Sámi people must be taken into account when adapting to climate change. Climate change increases the risks of accidents for the Sámi, possible mental health impacts and indirect increase in diseases of animal origin (e.g. diseases spread by ticks) (Näkkäläjärvi et al. 2020).

Objectives

The general objective is to have sufficient awareness of the significance of climate change in planning and decision-making for the prevention of social impacts. The following more specific objectives guide the recommendations for actions set out in appendix 2:

1. All welfare regions (provinces) have plans for adaptation to climate change in social welfare and health care, which describe how adaptation to climate change is taken into account in the activities and any special features of the region that should be taken into account in adaptation.
2. The adaptation plans for welfare regions (provinces) specify adaptation actions that exceed the boundaries of administrative sectors (e.g. the health and climate impacts of school food, anticipation of employment trends in the region, changes in the age structure and taking these into account in, for example, municipal construction projects, waste food etc.).
3. Determine the prerequisites for the municipality and the welfare area (province) to take into account adaptation to climate change in public procurement (what are essential procurements, whether legislative changes

are required) and possibilities for socially and ecologically sustainable local actions (e.g. distribution of waste food in joint meals or collective kitchens, recreational activities of children and related transport, repair of used goods in workshops).

5.6 Health impacts of climate change mitigation actions and adaptation to them

Climate change can affect health in many different ways, and the mitigation actions also have health impacts. They should therefore be assessed at the same time as appropriate actions are selected or justified to the public. If mitigation actions cause adverse health effects, they must also be adapted to. On the other hand, some mitigation actions are also necessary for health reasons (Thurston 2013). It has also been noted that health benefits motivate people in climate issues (Maibach 2010). In other words, the links between mitigation, health and motivation are diverse and should be taken into account in social planning. This chapter briefly discusses the key health impacts related to mitigation actions and the possibilities of adapting to them. Climate change mitigation actions in social welfare and health care other than from the perspective of adaptation are excluded from this review.

The greatest health benefits of mitigation actions in Finland are likely to be achieved through, for example: climate-friendly food is often also healthy; shifting from motorised mobility to active mobility improves physical shape; and moving away from fossil fuels reduces air pollutants. Some of the health impacts in Finland are speculative, but there is also evidence of many effects in some parts of the world (Harlan and Ruddell 2011). For example, green areas in cities serve many aspects of adaptation: during heat waves, green building curbs the heat island effect, improves air quality, curbs stormwater floods, serves as a carbon sink and offers recreational opportunities.

Reducing combustion processes is particularly beneficial for health when intake fractions are high. Intake fraction refers to the share of the emissions that ultimately turns into exposure, in other words, in the case of air pollution, ends up inhaled. Thus, for example, Helsinki's decision to close the Hanasaari coal power plant in the city centre and replace it with a combination of heat pumps and heat stores is a significant climate action but a surprisingly small matter in terms of health: the discharge from a tall smokestack is diluted quickly before exposure (Tuomisto et al. 2015). On the other hand, exposure to traffic and small-scale burning of wood often occurs close to the source of emissions, and the relative health impact is high (Salonen et al. 2015).

The WHO (WHO 2011) describes how energy-efficient and climate-friendly housing improves the living environment and increases health, for example by reducing indoor air pollution. However, these benefits are particularly evident in countries where the quality of housing is poor. It should be noted that country-specific differences in mitigation factors and health benefits may be substantial.

Objectives

The general objective is to also take into account the health impacts in the planning and implementation of climate change mitigation actions. They can be additional motivating benefits as well as threats that require changes and adaptation. The following more detailed objectives guide the recommendations for actions set out in appendix 2:

1. Nutrition advice identifies people's climate motives, and communication relies on both climate and health perspectives.
2. In municipal transport planning, prepare for an increase in muscle-powered and electrically assisted traffic, ensure a smooth flow of lightweight traffic and secure adequate opportunities for people with impaired mobility.
3. Take health and recreational values into account when planning and implementing urban green areas and forest carbon sinks.
4. In guidelines for small-scale burning of wood, take into account both the health and climate perspectives.

5.7 Other effects

It has been estimated that climate change will increase the symptoms of pollen allergy, as the pollen season for many plant species is likely to occur earlier both in Finland and in regions where pollen is transported. In addition, the pollen season may grow longer, and the amount of pollen may increase. The pollen season of the birch has already been found to occur earlier and the amount of pollen has increased. Monitoring and informing about the pollen situation implemented by the Pollen Information Centre (www.norkko.fi) is also a good way of adapting in the future. Invasive alien species gradually spreading to Finland may also increase the symptoms of pollen, for example common ragweed. Another invasive alien species of significance to health that has already spread to Finland and continues to spread is the Heracleum persicum group of plants.

With global warming, the levels of ozone in the troposphere causing adverse effects on human health and vegetation are increasing in many regions of Europe, too. As a result of

climate change, more mercury and permanent organic compounds may be transferred to Northern Finland if substances that have already left the cycle are released into circulation, for example as glaciers melt. Climate change also affects forest fires, which have worsened in many areas, such as southern Europe. In Finland, forest fires are usually small, but forest fire smoke transported from abroad can also cause health damage in Finland. Monitoring air and environmental pollution is the most important means of adaptation that can be used to monitor possible changes in the situation.

It is possible that global warming will change people's behaviour and increase their outdoor recreation. On the one hand, this promotes health and welfare, but also increases exposure to UV radiation, which, without adequate protection, increases skin cancers and cataracts. Providing information on the UV index and protection from UV will help to adapt to a potentially changing situation.

Climate change has an impact on radioactivity in the environment and indoor air. As rainfall increases, mines will experience more problems with water management, and as a result, more radioactive substances can enter the environment. Global warming may affect radon concentrations in indoor air. A decrease in the temperature difference between indoor and outdoor air may reduce radon leaks into homes. The difference in temperature has the biggest impact on houses with a gravity ventilation system. On the other hand, gravity ventilation works less efficiently when the temperature difference decreases, which leads to an increase in the radon concentration. In addition, the water content in the soil due to rainfall in winter and the overall increase in rainfall may increase radon concentrations.

Due to climate change, an increase in flooding and a possible increase in storms may also increase the number of accidents in Finland. It is likely that they are not as common in Finland as in many other regions of the world, as extreme weather phenomena are not predicted to be as extreme in Finland as in many other regions in the world. However, strong storms may cause personal injuries, for example as a result of falling trees and other accidents. Extreme weather phenomena also affect health through increased slipping and traffic accidents. Typical adaptation actions for traffic include active roadside alarms and pre-trip passenger information systems, variable speed limits, vehicle restrictions (e.g. truck restrictions in heavy winds), route restrictions, road surface anti-freezing actions, ploughing and a traffic sign system that reacts to weather. It is clear that, in order to function well and reliably, these actions require extensive changes in infrastructure maintenance. This also demonstrates the dependence of the adaptation of the health sector on the adaptation of other sectors of society.

6 Health and social services

6.1 Health care

In adapting to climate change in health care, changes affecting the need for health services or counselling in the population are to be taken into account, which are related to the effects caused by the range of diseases or changed conditions. On the other hand, the need for services may also reflect changes in the living conditions of different population groups caused by climate change adaptation actions in other sectors and the impacts of these actions on the operating environment of health care.

Most phenomena related to climate change are progressing slowly and can be anticipated at least partly. It is therefore possible to prepare for changes in the long term, assessing the need for development in the various sectors of health care and regionally. Concrete examples used of such phenomena are the spread of some vector-borne diseases in connection with global warming or the health and accident risks associated with extreme climate phenomena. The potential impacts of climate change on health care are even more complex, and they also involve issues taking place in other sectors and society in general and adaptation actions that require adaptation also in health care. The general requirements for improving the efficiency of the use of resources and energy are also reflected in health care, which is responsible for a significant part of the total production of societies and the use of resources. Adaptation actions in other sectors may also be reflected in the availability or prices of various raw products and raw materials (e.g. medicines) used by health care, which should be taken into account in the planning of health care.

Many health care actions that can be implemented to adapt to climate change are related to other health care development objectives. These include shifting the focus to preventive actions and basic health care, as well as curbing cost growth and material loss. When planning and implementing adaptation actions, it should be noted that at the same time the aim is to improve the quality and effectiveness of health services.

Making health care more efficient is one of the most essential ways in which the health care sector can adapt to climate change. In order to minimise the adverse effects of climate change, it is essential that the limited available resources be allocated to adaptation actions with maximum health impacts. Improving efficiency in adaptation is also essential because of cross-sectoral impact chains, because enhancing efficiency can minimise possible cross-sectoral impacts in health care.

So far, the role of social welfare and health care personnel in adaptation has been neglected. When drawing up the plans, it may happen that the practical implementation and execution of the actions are not taken into account. Practices do not change by themselves, and care work, for example, is carried out with the resources made available to the work. At the moment, there is no budget for time or resources for development actions and rethinking matters in the operative work. Due to tightened local government finances, the work focuses solely on coping with core functions. It is important to anticipate changes in the budgeting of social welfare and health care, which is reflected in the well-being at work of employees and the persistence of staff in strengthening resilience. The social welfare and health care reform and its changes in the administrative structure offer a new opportunity to examine as a whole how the services can be best adapted to the challenges posed by climate change in terms of their structures and functions.

It is essential that the social and health impacts caused by climate change be taken into account throughout all decision-making, including social welfare and health care. The WHO's report (2021) on the quality criteria for national health care adaptation plans provides decision-makers and health ministries with good practices and quality criteria in health adaptation planning. Management should therefore be taken into account in the planning of health care.

The assessment of the benefits and costs of adaptation and the related information needs should also be taken into account in health care. Health care actions must be prioritised, and economic analysis of health impacts together is essential in all adaptation actions in the social welfare and health care sector. The cost-effectiveness assessment requires combining environmental and health economics and the health impacts of the actions with the same analysis, for example in accordance with the calculation models recommended by the WHO. (WHO 2013).

Climate change affects health care through many mechanisms, either directly or indirectly, as a result of changes in the operating environment. The following lists some of the potential impacts of climate change, assessed as either the most important or the first to come.

- Changes in the economy and business life affect, for example, where people live due to migration within the country or the spread of remote working. This affects the accessibility of health care and the need to reassess the location of hospitals and health centres and the centralisation of services.
- Changes in the economy may also be reflected in the resources available to general government finances and also in the prevalence of social problems, for example as a result of changed income distribution.

- The size or structure of the population in Finland may change due to such factors as immigration and refugees. In the future, more and more people will also live alone. In particular, the needs of those living at home covered by social welfare and health care services need to be surveyed, as more and more people with long-term illnesses, people with disabilities and elderly people may live at home.
- The range and distribution of diseases and, consequently, the focus of services will change. Health risks associated with the environment in various ways may become more common, which increases the significance of environmental health care and the need to treat diseases of environmental origin.
- The same changing requirements related to energy use, living and working environment and construction related to climate change apply to health care infrastructure and building stock as to the rest of society. This should be taken into account in health care investments.
- The possibility of using existing materials and raw materials will change, which may be reflected in e.g. the use of disposable items and health care hygiene practices. The availability of medicines and other technologies may become more difficult due to changes in international trade.
- Several actions in the control of climate change (e.g. reducing/ending oil and coal burning, shift of diets to vegetarian focus, reducing mobility by car) reduce the prevalence of long-term diseases and reduce the pressure on health care.
- At present, health care institutions are highly dependent on the continuous full operation of the general infrastructure, such as internet-based information systems and electricity networks. Ensuring the availability of digital information systems and electricity is important (together with other actors). Infrastructure threats also have implications in practices and training.
- There are currently regional differences in the availability of health care services. Safeguarding the availability of services, including emergency care and medical transport, is particularly important during heat waves.
- The availability of medicines and other health care technologies and supplies may be compromised as climate change progresses. Most of these are manufactured outside of Finland and Europe, and especially in countries that are sensitive to climate change (e.g., India). Finland should start a discussion on the security of the current system and plan the necessary actions, both at national and EU level.

– The changes described above bring new competence and training needs to health care professionals. Research, statistics and monitoring needs will also change.

Objectives

The general objective is to have sufficient awareness of the significance of climate change in planning and decision-making for health care. The following more detailed objectives guide the recommendations for measures set out in appendix 2:

1. For their part, health care and social welfare services have to respond to changes in the social situation and health of the population. A sufficient knowledge base is a prerequisite for systematic activities. Up-to-date monitoring of the population's health and social situation at the national and regional levels should be developed and resources allocated for it.
2. The resilience of social welfare and health care (flexibility of change) must be increased to respond to possible changes in the operating environment or sudden shocks; due to knock-on effects, some of them may be realised relatively quickly. Preparedness is a good tool for identifying potential threats and vulnerable groups.
3. In particular, health care depends on the functioning of the general infrastructure, such as transport routes and means of transport, electricity and digital infrastructure. Health care technology (including medicines) is currently dependent on foreign imports. Health care actors must actively work with other administrative branches to ensure the functioning of social welfare and health care in different circumstances.
4. Assessing the benefits and costs of adaptation measures in health care and the related information needs.

6.2 Social welfare services

Approximately one in five Finns use social welfare services annually. Social welfare services can be used to reach vulnerable population groups. In adaptation, perhaps the most important social welfare services are mobility support services, institutional services, housing services, home care and home services, but social work, social guidance and family work can also promote adaptation to climate change.

The backbone for mobility-supporting services pursuant to the Social Welfare Act is public transport, in the use of which the client can be supported. If the use of public transport is not possible, other modes of transport will be involved (e.g., escort service, group transport and other transport). Transport emissions in these transports can be reduced by using biofuels, electric cars and improving the energy efficiency of vehicles. Municipalities should be provided with sufficient tools to be able to make an assessment of solutions that are economical overall, as these solutions are reflected in municipal residents and service users in general. Intelligent transport solutions are also those whose technology requires national coordination, even though the welfare benefits of the solutions can vary significantly from one region to another.

In social welfare, social services are classified by means of service tasks and the social services provided in them. Social services related to housing in services for older people include temporary housing, sheltered housing, enhanced sheltered housing and institutional services. In services for disabled people, social services include professional family care (established practice), sheltered housing, enhanced sheltered housing and institutional services. In the service task of substance abuse services, social welfare services include supported housing, temporary housing, sheltered housing, enhanced sheltered housing and institutional services. Social services are granted, for example, on the basis of an assessment of service needs. The decision on the service to be granted is made by an official. In institutional services, the client is in a care relationship with the institution.

In housing services, the customer's housing is based on the housing management relationship, which means that the customer has access to a residential space that is available to them alone. Housing services are provided to persons who, for a particular reason, need help or support in housing or in arranging their housing. Sheltered housing refers to housing and services arranged in sheltered housing. The services include nursing care and care appropriate to the customer's needs, activities that maintain and promote functional capacity, meal services, clothing care, washing and cleaning services, and services that promote inclusion and social interaction. In enhanced sheltered housing, services are arranged 24 hours a day, as required by the customer. Especially in the institutional care of social welfare, where care and rehabilitative activities are continuous, the public sector actor providing the service (or purchasing it) has a major responsibility to ensure that the conditions do not become unreasonably uncomfortable during hot weather or other extreme weather phenomena. In institutional care, vulnerable groups are housed with few opportunities to influence their living conditions.

The population receiving housing services and institutional care is quite diverse and partly regionally different, but the condition of older people may also vary significantly in housing services provided by one service provider. Housing services and institutional

services also include persons who in practice do not have the opportunity to choose their place of residence. In housing services and institutional services, housing technology (including passive solutions) can facilitate adaptation to extreme weather phenomena, but solutions based on information are also needed for these technical solutions: what are cost-effective methods in different parts of Finland, in buildings of different ages and sizes, for different customer groups. In addition to ensuring thermal comfort in the public sector, this criterion can also be included in public procurement.

Municipal home services can be provided to people living alone and families to cope with everyday tasks. Home service is granted on the basis of the assessment of service needs and can be obtained when functional capacity has decreased due to illness, childbirth or other similar reason or a special family and life situation. Home service employees are home nurses, home assistants and practical nurses. Home services thus have information on persons who, for example, cannot leave their homes independently and who may not be reachable in the event of a power outage. Home services also reach people with low resources as a principle. If the services work well, there is a confidential relationship between the worker and the customer; the services can provide advice and guidance on how to cope with extreme weather phenomena, for example. In any case, these are services that should be able to operate at the forefront when, for example, a heat wave arrives in Finland or a blizzard has broken the power lines. These services are easy to operate locally. So far, however, there are no national guidelines on what kinds of preparedness plans should be made in municipalities, welfare areas or provinces, what threshold values should be reacted to, and how preparedness and adaptation measures should be organised at the level of municipalities, welfare areas or provinces.

In social work, social guidance or family work, it is possible to use a little more creativity in adapting to climate change. Social workers and counsellors usually know well the marginalisation and integration processes in their area and see how structural change in society and structural changes in the area shape relationships between people and the environment. Social work also includes the orientation of ecosocial work, in which the task of social work is to demonstrate the structural problems of society that occur in the local community. In adapting to climate change, social work can strengthen climate-awareness by making available to everyone communal operating models that support people's wellbeing in a changing environment. Examples of these include shared kitchens and various workshops for repairing old goods. There are many different operating models, but they share in common the idea that they are implemented together with people and that access to them is not dependent on financial resources. Strong local communities (e.g., urban district associations) promote adaptation to climate change and offer opportunities for local organisation. Social networks, resources available and knowledge of climate change affect the ability to adapt to the situation and to remedy the damage caused by the situation, although social welfare is directly involved with people's social networks.

However, the task of social welfare is, for its part, to act in a preventive manner in climate change, to support people by means of advice and guidance in adapting to climate change and to take it into account in the whole of social welfare measures.

Objectives

The general objective is to have sufficient awareness of the significance of climate change in planning and decision-making for social welfare. The following more detailed objectives guide the recommendations for measures set out in appendix 2:

1. Analyse the information needs related to the health and well-being impacts of social welfare workers, and prepare a training programme to satisfy the information needs
2. Promote the construction of social welfare information resources and the usability of information, especially from the perspective of ecosocial social work
3. Streamline local practices in ecosocial social work and strengthen community work (e.g. urban social work)

6.3 Occupational health

In order to be able to prepare for the impacts of climate change and to mitigate the associated health and work capacity risks, it is important to increase awareness and competence in occupational health care and at workplaces. The aim is to identify and systematically take into account health threats to the working-age population related to climate change in the planning of occupational health care and workplace activities. In assessing the risks of work and the working environment at the workplace, aspects related to climate change should be better taken into account in the future. Occupational health care services must have the capacity to carry out a health significance assessment on the basis of a risk assessment. Preparations should also be made for exceptional situations related to climate change, such as floods, storms and power outages. Guidance targeted at occupational health care and workplaces is needed, which can be produced, for example, by means of various training events and campaigns.

Key actors in organising these include the Finnish Institute of Occupational Health and the Centre for Occupational Safety. The awareness and competence of occupational health physicians can be improved by adding content on the health and work-capacity impacts related to climate change to the specialist training provided by universities in

occupational health care. A key part of preparedness for climate change in occupational health is surveying research needs related to the topic and increasing high-quality research.

Instructions related to the management of heat conditions and heat load and identification of risks should be updated if necessary, and communication with employers, employees, occupational safety and health organisation and occupational health care must be intensified in order to ensure adaptability. By integrating adaptation communications into vocational studies in critical fields, it is ensured that competence and risk management related to climate change will become part of professional skills.

Especially in circular economy, there is an increase in work tasks with occupational safety risks, such as harmful exposure to chemical, biological and physical agents, and in occupational accident hazards. Knowledge of workplaces and occupational health care about the risks already known must be increased. More research data and cooperation with various circular economy actors are needed to ensure that products and materials and the related processes are as safe as possible for employees at all stages of their life cycle.

Attention should be paid to the combined effects of heat and chemical exposure and to increasing workplace awareness of these interactions. Replacing personal protective equipment with other solutions is particularly important as the heat load increases as a result of climate change. Workplaces need help and advice on risk management measures in hot work, also taking chemical exposure into account. Research data is needed on the combined effects of thermal and chemical exposure and good practices, to ensure the working capacity of employees.

Knowledge and awareness of the impact of slippery weather on accidents must be increased and prevention developed further. Creating slipping-accident prevention programmes at workplaces and improving risk management are ways to reduce slipping accidents. There are already different systems to alert people about slippery weather (e.g. the Finnish Meteorological Institute's pedestrian weather service). With the increase of slippery weather, these should be further developed, as well as investing in the product development of work footwear that prevents slipping.

7 Emergency supply

In accordance with the government decision on the objectives of emergency supply (1048/2018), emergency supply refers to securing the critical production, services and infrastructure necessary for the population's livelihood, the country's economy and national defence in serious disruptions and emergency conditions, including securing communication and information networks, water and food supply, health care services and logistics. Both national and international impacts of climate change may affect the emergency supply, as it is based on effective international political, economic and technical links and their continuity. Combating climate change and adapting to it will be taken into account in the development of emergency supply and measures.

The Emergency Powers Act (1552/2011) contains provisions on the authorities' preparedness for emergency conditions and the powers of officials during emergency conditions. Section 12 of the Emergency Powers Act contains provisions on general preparedness obligations. The government, state administrative authorities, independent public-law institutions of the state, other state authorities and state enterprises and municipalities, joint municipal authorities and municipal consortiums must ensure, by means of preparedness plans as well as preparation of operations under emergency operations, that their tasks are carried out in emergency conditions as effectively as possible.

According to section 13 of the Emergency Powers Act, preparedness is coordinated and supervised by the government, and by each ministry in its branch. Each ministry coordinates preparedness in its own branch. The obligation of public social welfare and health care units to prepare for disruptions and emergency conditions is based on section 12 of the Emergency Powers Act. It can be considered that, through this obligation, social welfare and health care already have an obligation to take threats such as climate change into account in preparedness. The obligation of preparedness covers both short-term, unexpected events and long-term changes in the operating environment.

Climate change and its knock-on effects can be expected to increase the disturbance sensitivity of society and situations that require the reallocation of resources and/or an increased need for service/care from social welfare and health care. For this reason, preparations for disruptions should be further developed and improved in the social welfare and health care service system.

From the perspective of preparedness, adaptation to climate change requires attention to emergencysupply and social welfare and health care in disruptions and emergency conditions. Emergencysupply refers to securing the country's economic functions and systems necessary for the income of the population, the economic life and national defence in serious disruptions and emergency conditions. The safeguarding of emergencysupply is based on legislation and decrees and the government's decision on the objectives of emergency supply. The aim of the emergencysupply activities is to ensure that the basics that are important to the citizens also work in emergency conditions: there is enough electricity, heat, fuels, food and clean drinking water, social welfare and health care services work, communications networks function and daily logistics and payment traffic work. During the COVID-19 pandemic, which began in 2020, the adequacy of protective equipment, medicines and medical devices has been emphasised in terms of social welfare and health care emergencysupply (The National Emergency Supply Agency2020).

In the future, the emergencysupply of social welfare and health care will be examined particularly on the basis of a national risk assessment. Comprehensive security is a joint operating model for Finnish preparedness, in which vital functions of society are ensured through cooperation between the authorities, business life, organisations and citizens. The general principles of comprehensive security are outlined in the Security Strategy for Society (VN 2017). Climate change can also contribute to the realisation of these threats. Threat models are updated as part of national risk assessments every three years.

The threat models described in the Security Strategy for Society in 2010 are:

- serious disruptions in the power supply
- serious disturbances in the telecommunications and information systems
- serious disturbances in transport logistics
- serious disruptions in public utilities
- serious disturbances in food supply
- serious disturbances in the financial and payment systems
- disruptions in the availability of public funding
- serious disturbances in the health and welfare of the population
- major accidents, extreme natural phenomena and environmental threats
- terrorism and other criminality that endanger social order
- serious disturbances in border security
- political, economic and military pressure and use of military power

8 Cross-sectoral impacts

In the planning of adaptation actions, it is important to take into account not only the direct impacts of climate change, but also indirect impacts transmitted by and accumulated from other sectors. In the implementation and mid-term evaluation of the National Climate Change Adaptation Plan (Mäkinen et al. 2019), social welfare and health care have been identified as a sector with exceptionally high impacts from other sectors. As regards adaptation plans implemented in other sectors, it has been noted that formulating objectives and actions as concretely as possible will promote their implementation and progress monitoring. In addition, it is essential to pay attention to the roles and responsibilities of different actors in the planning of adaptation actions, and to try to identify as well as possible the party responsible and the parties participating.

The administrative branch of social welfare and health care is linked to other ministries' fields of activity in terms of energy production, information systems, water management and road maintenance. National distribution channels for materials and medicines must also be taken into account in the functioning of health care. In the administrative branch of the Ministry of Agriculture and Forestry, intersectoral adaptation actions related to the prevention of threats related to health and well-being are reflected, for example, in agriculture and food production, flood risk management and dam safety, the prevention of invasive alien species, water supply and preparedness for forest fires and various types of forest damage. Actions related to the built environment and the environmental administration sector, which are also linked to the administrative branch of social welfare and health care, are included in the action plan for climate change adaptation in the environmental administration (ME 2017) and in the Ministry of the Environment's guide on taking climate change into account in planning. Climate change is also a cross-cutting theme in the ongoing reform of the Land Use and Building Act.

The WHO's national quality criteria for health care emphasise the coordination of cross-sectoral measures and the coherence of decision-making (WHO 2021). An engaging approach between different fields of activity promotes both the engagement between interest groups and sectors and local effectiveness.

Adaptation actions have been implemented in other sectors by mainstreaming preparedness for climate change and climate risk management into various steering instruments, such as legislation, funding and support instruments and research and development projects, advisory services and other information steering. For example,

the Ministry of Agriculture and Forestry has systematically implemented adaptation in water sector legislation since 2008 (e.g. the Flood Risk Management Act, the Water Services Act). Weather and climate risk management has also been developed as part of preparedness and preparation planning in different sectors, for example in water supply. In the social welfare and health care sector, adaptation measures should be analysed extensively, taking into account the entire adaptation chain, even if the events causing adaptation are in other sectors. This requires cross-sectoral analysis, but if successful, it will provide additional information on the possibilities to strengthen the total societal climate resilience. The administrative branch of the Ministry of Social Affairs and Health should consider how health care (and social welfare) should prepare for, for example, various infrastructure problems and how to adapt to these challenges.

Objectives

The general objective of cross-sectoral adaptation actions is to raise awareness of adaptation needs between administrative branches. The following more detailed objectives guide the recommendations for measures set out in appendix 2:

1. Participate in climate change adaptation at the government level: participate in the implementation, monitoring and evaluation of the National Strategy for Adaptation to Climate Change
2. Participate in the preparation of the EU's adaptation strategy.
3. Examine the impact of climate change developments on cross-sectoral impacts with other administrative branches

9 Knock-on effects

Climate change is the result of overuse of natural resources and disturbing of material circulation and ecological balance. The effects on health and health care are created not only directly but also through the rest of the biophysical environment and social environment. Environmental changes are combated through various measures, which also have health impacts. The least amount of information and forecasts has been on knock-on effects, i.e., the societal changes caused by climate change and its prevention, which are not a direct consequence of global warming.

The quality and magnitude of knock-on effects are difficult to predict because they depend on the reaction of societies and citizens to environmental problems and their mitigation. This has been very pronounced in the case of COVID-19, where major societal impacts have arisen from various prevention and control measures, irrespective of the disease itself. The knock-on effects are created especially from matters taking place outside Finland. The terms are not established (Juhola et al. 2020). Terms such as "indirect effects", "international knock-on effects" (exporting and importing risks, cross-border effects) and "external effects" (e.g., "adaptation to harm") have been used.

However, lack of information is not the same as insignificance of knock-on effects (Nordbo et al. 2019, UK Climate Change Risk Assessment 2017, Stattin et al. 2019, Matschke et al. 2020). Different environmental problems and their prevention are related to each other. Problems and their prevention are visible in health and service needs. The social welfare and health care sector must contribute to remedying the consequences of what is happening. The activities of the social and health care sector depend on the resources and distribution of resources in society as well as the general infrastructure and preparedness measures of society: food production and water supply, waste management, transport routes and means of transport, electricity and other energy, the internet and other digital infrastructure.

The following lists some examples of possible developments that may have significant knock-on effects on health and health care in Finland:

– Climate change shapes ecosystems. Extreme weather phenomena increase drought and floods in some parts of the planet. They increase the volume of non-arable land and problems with access to clean water, and they affect food production, international trade and migration. Extreme weather

phenomena will affect different areas of the Earth, and pressure to seek refuge and immigrate will increase, so even large movements of population will be possible. In Finland, these problems may be reflected in the import and export of food and, more generally, in trade and increased immigration.

- The melting of the continental glaciers in the southern and northern regions raises the sea level, and in lower areas it leads to the loss of farming and residential areas, damage to infrastructure, water pollution and possibly fishing problems. The melting of mountain glaciers weakens the water situation in river basins and makes farming more difficult. In Finland, these may have similar knock-on effects as drought and floods.
- Changes in the biophysical environment increase competition for physical resources, especially land and water. As a result, conflicts, including wars, can become more commonplace, which in turn increases environmental problems and refugees. Even remote conflicts have knock-on effects in Finland and Finland's international operations.
- Changes in the biophysical environment and their prevention measures in different parts of the globe will likely change Finnish livelihoods. Today, a great proportion of Finland's business operations is aimed at foreign exports, and consumer products are imported from abroad. Demand abroad may change, and access to raw materials and products may be reduced, trade may decrease and prices rise. It is possible that the division of labour on a global scale will change and a return to a more local economy will take place. A specific issue is the availability of health care technology, which is currently largely dependent on imports. Changes in business life have an impact on people's work, employment and place of residence. And these are all linked to health, well-being and services.
- Social stability, cohesion and meaningfulness of work are important for the basic safety and mental health of humans. Rapid changes in society and unpredictability can increase insecurity and violence in Finland as well.

Global crises caused by climate change are associated with an increase in refugees, which requires adaptation both in health care through a new demographic structure, morbidity and disease variation as well as in social welfare in order to meet different refugee needs, such as the competence and cultural knowledge and skills in new areas of somatic and psychological medicine. Despite the high uncertainty regarding knock-on effects, these should be taken into account in adaptation plans. It is good to be aware of the uncertainty of the future. When investing (buildings, professional training, infrastructure), it is also important to consider scenarios shaped by the knock-on effects. It is important to increase society's overall resilience and adaptability. Practical preparedness plans in health care are

likely made according to the most likely alternatives made, but it would be a good idea to keep plans in place for larger and more dangerous changes.

The activities could resemble national defence thinking: although war is unlikely in Finland and the nature of the war is unclear, preparations for war are constantly being made. And on the other hand, action is taken to prevent war.

Objectives

The general objective is to have sufficient awareness of the significance of climate change in planning and decision-making for the prevention of knock-on effects. The following more detailed objectives guide the recommendations for measures set out in appendix 2:

1. Environmental problems, including climate change, combating them and taking adaptation into account in the need for services in the social welfare and health care sectors. The operation of the sector depends on the resources and distribution of resources in society and on its general infrastructure and preparedness measures.
2. Considering knock-on effects when making investments. Regardless of the great uncertainty regarding knock-on effects, these should be taken into account. When making investments (buildings, professional training, infrastructure), scenarios shaped by knock-on effects should be considered.
3. Investigate knock-on effects in Finland, and, as part of it, investigate knock-on effects in social welfare and health care. As an example of a knock-on effect study, e.g., Nordbø et al. 2019.

10 Research activities, international cooperation, education, scenarios and communication

In addition to sector-specific measures in social welfare and health care, adaptation is emphasised in the joint actions of the administrative sector, research activities, education and communication. A significant part of the objectives and measures of different sectors are linked in one way or another to other social welfare and health care objectives and activities. In addition to joint actions, research and communications, this requires, for example, coordination of the preparation of the health sector scenarios and international networking.

The knowledge base regarding the health and well-being impacts of climate change and adaptation to them is constantly growing. Research activities produce information, solutions and follow-up questions to achieve the objectives of the national adaptation plan. Research on climate change is carried out in universities, state research institutes and, for example, with the support of foundations. National adaptation research has been carried out, for example, in the FICCA and CLIHE research programmes of the Academy of Finland and in the Strategic Research Council's (SRC) Towards a Sustainable, Healthy and Climate-Neutral Food System (FOOD) and Climate change and humans (CLIMATE) programmes. Although more research funding channels have become available in recent years, and the research field has also focused not only on climate change mitigation but also on adaptation with various research programmes, further research is still needed on factors related to Finland and local conditions and their impacts on adaptation and its implementation at local level.

An analysis of the new range of diseases and the training needs of social welfare brought by climate refugees is necessary, together with information on mitigation. In health education, the impacts of climate change, direct and indirect as well as knock-on effects, should be emphasised more strongly. Adaptation to climate change must also be reflected in the planning and implementation of education for social and health care professionals in both vocational education and higher education degree programmes. The Finnish Nurses' Association, Tehy and SOSTE have arranged training events, but the broader inclusion of climate change in training plans is an important part of increasing awareness of adaptation and implementing adaptation. All social and health care trade unions

and vocational associations that have direct links with the members through member communications and continuing vocational training and private sector service providers must be taken into account as key actors.

The aim of research activities supported and implemented by the administrative branch of the Ministry of Social Affairs and Health is to increase understanding of the impact of climate change on health, and to produce information that helps take the adaptation perspective into account in planning and decision-making. Although the plan is aimed mainly at authorities, it is important that all social welfare and health care actors, organisations and also citizens are involved in the implementation of the plan. NGOs and citizens are not only targets of climate change adaptation but also actors in it. When threats are more diverse, such as from climate change, more comprehensive preparedness is needed, in which case citizens also play an important role (Prime Minister's Office 2017).

In the identification of national adaptation paths, it is essential to monitor the international research field and discussion and to participate actively in it. In adapting to climate change, it is important to visualise different possible scenarios that can be realised in the coming decades. An SSP-RCP framework has been created for scenario work, which can be used in climate change research, providing an opportunity to create a uniform basis for decision-making (O'Neill et al. 2020). Scenarios in the social welfare and health care sector are developed, for example, in the CLIHE research programme.

Information is constantly accumulated on the health and well-being impacts of climate change. One of the greatest challenges of climate change is the shock to people and citizens that things cannot be solved immediately. This further increases the role and responsibility of communication in collecting information and learning a broad-based, sustainable lifestyle. Communication is needed for both professionals and citizens, in terms of impacts, mitigation and adaptation. In addition, the links between impacts, mitigation and adaptation are complex, which also needs to be considered in communications. In communications, cooperation with social and health care and environmental health professionals, professional magazines, municipalities and regional actors and news media helps deploy adaptation directly with the actors. The Ministry of Agriculture and Forestry coordinates the national newsletter on adaptation to climate change. Health impacts and adaptation are communicated in THL's environmental health newsletter and on the website. In addition, adaptation advice targeted at social and health care sector actors is needed. The Ministry of Social Affairs and Health is responsible for communicating climate change adaptation and the adaptation of the ministry's own sectors.

Objectives

The aim of research activities supported by the Ministry of Social Affairs and Health is to increase understanding of the impact of climate change and to produce information to take the adaptation perspective into account in planning and decision-making. The aim of international cooperation is to strengthen Finland's position in the international work of climate change adaptation. The aim of training is to make the adaptation perspective part of the social welfare and health care sector's different education levels. The aim of analysing climate change and socio-economic scenarios in the social and health care sector is to assess what types of development paths will be encountered in Finland in the future, how they will impact and how to adapt to them. The aim of the communication is to raise awareness of the impacts and significance of climate change and to support the consideration of the adaptation perspective. The following more detailed objectives guide the recommendations for measures set out in appendix 2:

1. The Ministry and the research institutes in the administrative branch promote research activities and interaction concerning adaptation and mitigation.
2. Determine the need for training on the health impacts of climate change and adaptation in the social and health care sector, including vocational education and training.
3. Communication in the administrative branch supports adaptation

11 Schedule and monitoring of the adaptation plan

After completion of the climate change adaptation plan of the administrative branch of the Ministry of Social Affairs and Health, the ongoing adaptation work is continued. In addition, more detailed planning of adaptation activities, the planning of sector-specific action programmes and the implementation of various measures will be started. The Ministry of Social Affairs and Health and THL will communicate and implement the adaptation plan for social welfare and health care sector actors in a separate implementation project in 2021–2022.

Information on climate change and its social and health impacts will rapidly become more specific both internationally and in Finland, which is why the adaptation plan should be updated periodically. Review and update of the implementation of the plan should be carried out after five years and at the end of 2025 (figure 1), at which time the new Climate Change Act will be available. In addition, research data on Finland in particular will have accumulated and, among other things, the latest assessments of the health impacts of climate change in Finland produced by the Academy of Finland's Climate Change and Health (CLIHE) programme as well as the results of SRC's FOOD and CLIMATE programmes will be available. On the basis of these, a more comprehensive action plan on climate change adaptation can be built, which would include the entire Ministry of Social Affairs and Health's key themes for climate change adaptation. In particular, adaptation issues related to social welfare and social security should be addressed in more depth in further examinations.

Figure 1. Schedule of the Ministry of Social Affairs and Health's climate change adaptation work.

The expert network analysing adaptation to the social and health impacts of climate change plans and monitors the practical implementation of the adaptation plan according to the table template below. The table defines the concrete measures, their schedules and the responsible party for each topic in the plan in more detail by topic area (table 4). During monitoring, information on the implementation of the measures is recorded in the table.

Table 4. Planning and monitoring model for the implementation of the adaptation programme

Adaptation plan measure	Concrete actions	Schedule	Party responsible	Actualisation
1. Priority area				
1. Measure	1. More specific measure 2. More specific measure	1. Time 2. Time	Party responsible	Monitoring details
2. Measure	1. More specific measure 2. More specific measure	1. Time 2. Time	Party responsible	Monitoring details
2. Priority area				
1. Measure	1. More specific measure 2. More specific measure	1. Time 2. Time	Party responsible	Monitoring details

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Appendices

Appendix 1. Needs for adaptation of health and social well-being

1. Health hazards from heat

Climate change directly affects the health risks caused by the ambient temperature, which arise from both cold and hot weather in countries with cool and warm climatic conditions alike (Gasparrini et al. 2015). Cool and cold weather is associated with more health hazards each year than warm and hot weather, because temperatures that are more favourable to health are more common than high temperatures.

However, public health hazards from heat are also significant because, as the temperature rises, the mortality rate of the population increases dramatically. The health hazards of hot weather also manifest very quickly, during the same day or with a delay of a few days. Strong heat waves can thus lead to large, potentially even catastrophic impacts in a relatively short period of time (Anderson 2014, Fouillet et al. 2006, Robine et al. 2008). With climate change, temperatures rise and heat waves become more common and stronger. In other words, the adverse effects associated with cold weather are likely to decrease, and the impacts from hot weather will increase (Gasparrini et al. 2017). Thus, adaptation to climate change primarily requires preventing the adverse effects of heat. In the future, the likelihood of health hazards caused by temperature extremes will be increased not only by climate change but also by the ageing of the population.

Hot weather and heat waves are already causing significant health hazards in Finland. The mortality rate of the population increases considerably when the average daily temperature exceeds approximately 20 degrees (Ruuhela et al. 2017). During heat waves lasting four days or longer, daily mortality increases by an average of 10%. A prolonged heat cycle lasting 3–4 weeks may cause several hundred deaths (Kollanus & Lanki 2014).

The most sensitive to the adverse effects of heat are elderly people, small children and those suffering from long-term illnesses. In particular, the risk of serious harm affects people over 65 years of age, among whom mortality increases in connection with, for example, circulatory and respiratory diseases, kidney diseases, mental and behavioural disorders and nervous system diseases. Mortality increases among both elderly people in

health and social care institutions and those living at home. The impact of hot weather on morbidity has been studied less than the effects on mortality. However, prolonged and strong heat waves have been found to increase at least the need for hospital treatment related to respiratory diseases in Finland (Sohail et al. 2020). In general, the heat waves in Finland also cause milder impacts. Based on a FINRISKI project survey, 80% of the respondents suffered from at least mild adverse reactions from heat waves, and 7% reported that they experienced respiratory symptoms and 6% heart symptoms (Näyhä et al. 2014). The thermal island phenomenon and differences in social vulnerability increase the risk of mortality, and in Helsinki, the risk of mortality associated with heat is higher than in the surrounding area (Ruuhela et al. 2021).

For the time being, the quantitative impacts of climate change on the health harms caused by heat in Finland have not been comprehensively assessed. However, it has been suggested that the mortality associated with heat waves may increase in Finland during the current century by some tens of percent or even more than triple, depending on the progress of climate change and population adaptation (Guo et al. 2018).

The health impacts of hot weather can be combated through both short-term and long-term measures. Short-term measures focus on acute prevention of impacts during heat waves and are implemented especially in social and health care. Long-term prevention measures, on the other hand, include measures aimed at reducing thermal exposure, improving the management of indoor temperatures in buildings and reducing the impacts of the thermal island phenomenon in densely built urban areas. These measures can be implemented in construction and urban planning as well as in the renovation of old buildings. Long-term measures also include developing social preparedness and health impacts or developing the monitoring of preparedness, and increasing the awareness of citizens, authorities and health and social welfare actors regarding health hazards and their prevention.

So far, some measures have been taken in Finland to combat health hazards from heat. The Finnish Meteorological Institute has issued heat warnings since 2011. However, the warnings are mainly aimed at supporting citizens' self-preparedness and do not involve pre-planned measures by the authorities. The most significant legislative measure has been the action thresholds specified by the Ministry of Social Affairs and Health in the Decree of the Ministry of Social Affairs and Health on Health-related Conditions of Housing and Other Residential Buildings and Qualification Requirements for Third-party Experts (Ministry of Social Affairs and Health 545/2015) for the high temperature of room air outside the heating season. Efforts have also been made to influence the temperature conditions of buildings in the Ministry of the Environment decree on the energy efficiency of a new building (ME (1010/2017). In addition, guidelines on the prevention of adverse effects have been published for municipal health protection authorities, health care and

care institutions and the public (Hassi et al. 2011, Kujala et al. 2013, Ministry of Social Affairs and Health 2014, thl.fi/fi/web/ymparistoterveys/ilmasto-ja-saa/helle, kuumainfo.fi). However, there are still many challenges in the prevention of heat hazards and needs. It is also unclear how effective the measures taken so far have been and to what extent municipal authorities, social and health care actors or the population are aware of the adverse effects of heat on public health and their prevention.

The most significant development needs in the prevention of health hazards from heat are related to the preparedness of social welfare and health care units, as these services and care and treatment institutions cover a large number of people who are sensitive to adverse effects.

Based on studies in the 2010s (Ung-Lanki et al. 2017, Rapeli et al. 2016, Regional State Administrative Agency 2019, Siirilä 2018), social welfare and health care units generally take at least some measures to reduce indoor temperatures and to protect the health of residents or patients during heat waves. However, the operational units usually do not have contingency plans for heat. Many units have high temperatures during heat waves, and in many units there is no possibility of cooling indoors. On the other hand, the strong heat waves experienced during this decade have, at least to some extent, increased interest in developing heat preparedness among local social welfare and health care actors. However, there is no up-to-date and comprehensive information on the level of preparation of care institutions.

A key area of development is also a national action plan, which is lacking in Finland, aimed at preventing health hazards from heat, which has been drawn up in many other European countries (Bittner et al. 2014, Casanueva et al. 2019, Martinez et al. 2019). The World Health Organisation (WHO) has published comprehensive guidelines to help prepare the action plan (Matthies et al. 2008, WHO 2011, McGregor et al. 2015, WHO 2021). Issues to be considered include, in particular, management and coordination, a timely warning system, communication and information, reducing indoor thermal exposure, sensitive population groups, preparedness of health and social care, construction and urban planning, and monitoring and evaluation. The action plan should preferably cover both short-term and long-term measures in all relevant operating sectors. Measures aimed at preventing health hazards during heat cycles should also be tied to the heat warning system.

2. Mental health effects

Climate change leads to mental health impacts not only indirectly but also directly. Climate change directly increases anxiety, probably depression and possibly suicides (Berry et al. 2018, Burke et al. 2018, Gammans 2020). Little research has been carried out

as of yet with Finnish data. The challenges arise from solar radiation changing in different ways during different seasons because of climate change (Ruuhela et al. 2012). These impacts are likely to appear indirectly as a result of the increase in extreme weather phenomena. The physical and psychological morbidity of people with mental health problems will also increase during heat waves (Zander et al. 2015, Parks et al. 2020). The stress on the respiratory and cardiovascular systems increases, sleep deficit increases and recovery is slower if the body cannot cool down at night. In addition to temperature, the amount of light is also important.

In Finland, climate change reduces the brightness of the outdoor environment due to increasing cloudiness and shorter snow coverage periods during the winter months. The darkness of the winters can lead to more widespread symptoms of seasonal affective disorder. Indoor lighting conditions also affect the manifestation of seasonal affective disorder symptoms (Grimaldi et al. 2009). According to population-level health studies, 25 percent of adults perceive seasonal affective disorder symptoms as a problem, one in ten suffering not only from seasonal affective disorder symptoms but also from depressive symptoms during the winter, and nine people out of a thousand suffer from seasonal affective depression every winter (Partonen 2019). The seasonal affective disorder and depression symptoms have a number of direct effects on well-being. Darkness affects the regulation of the internal human clock. The dark season is known to be associated with the so-called winter darkness strain, which includes, for example, appetite for sweet food, weight gain, fatigue and sleep disorders occurring during winter months. In a small number of people, the dark period provokes clear depressive symptoms (Terveyskirjasto 2018). In addition, repeated weight gain in particular every winter may, in a few years, result in significant adverse health effects, which are indirectly reflected in work ability and the national economy as a whole. Seasonal affective disorder accounts for about one tenth of all mood disorders, which can lead to an impact in the magnitude of up to €800 million annually (Laine et al. 2018). The scarce light of winter months may also be a factor that makes people more susceptible to suicides, because the less solar radiation there is outdoors, the more suicides there are in winter months (Ruuhela et al. 2009).

In part of the population, climate change causes environmental or climate anxiety (Pihkala 2019). Environmental anxiety is usually caused by the feeling of hopelessness that society is not doing enough to improve things, and this must be taken into account especially among children and young people. Climate anxiety, symptoms related to darkness and, for example, reduction in the opportunities for physical winter activity because of lack of snow may have a significant impact on the working and functional capacity of Finns. Taking mental health into account and ensuring that society and individuals are resilient is also associated with many other phenomena, such as post-traumatic stress reactions involving refugees.

Taking into account the scale of the national economic impact of mental health problems and seasonal affective disorders, it would be justified to include indicators for mental health in the national climate change adaptation indicator framework, which can be used to monitor the effectiveness of adaptation measures.

The aim is to prevent the mental health hazards from heat and frost periods and the period of winter darkness. In social welfare and health care, the measures include increasing the capacity to act in the event of traumatic psychological crises and stress disorders due to extreme weather phenomena, improving the efficiency of treatment to prevent the increased disease burden caused by summer heat cycles, and increasing the use of timed light to prevent adverse effects due to increasingly dark winter days. Construction, land use and housing measures include increasing and introducing systems to enhance cooling (heat cycles), heating (frost periods) and lighting (winter darkness).

The realisation of the measures is monitored using the quality registers of health care, the number of patients discharged from a hospital per disorder group starting to use outpatient services within 7 days of discharge, and the number of patients whose treatment involves daylight therapy. Use the care registers for health care to monitor the quantity and manner of attempted suicides in different population groups and regions. The number and manner of suicides in different population groups and regions is monitored in real time with the forensic medicine information system. Combine this information with the Finnish Meteorological Institute's open data on weather conditions in different areas in Finland.

3. Waterborne diseases

In international comparison, Finland's water supply is of a high standard, and Finland is well equipped to adapt to the additional risks posed by climate change in water supply. Advanced water supply and safe domestic water are crucial in countries with high hygiene. It is worth remembering that the ability to consume sufficient water has contributed significantly to public health on the planet over the past 150 years, reducing water-borne epidemics.

Climate change can increase the risk of waterborne epidemics, because increasing rainfall and rising temperature will reduce the microbiological quality of water systems. Extreme weather phenomena (storms, drought, etc.) and flood risk will also affect the threat of aquatic epidemics and the operation of water facilities as a result of climate change. Water facilities must guarantee safe water supply, which means that attention has been paid for a long time in legislation to the management of water risks. In their investments, water utilities already must take into account changes in the quality of raw water and potential

problems in the availability of water (Meriläinen et al. 2019) and the ageing of the water distribution network (Miettinen et al. 2019). In Finland, water utilities feel able to respond adequately to the problems caused by weather fluctuations. Preparations have been made particularly well for power outages. However, only some utilities have contingency plans, and climate change has rarely been taken into account in the plans. Up to one third of the utilities have failed to investigate weather and climate risks at all (Meriläinen et al. 2019).

Risk management measures relevant to adaptation to climate change include monitoring the microbial removal efficiency of water treatment processes and optimising processes as the quality of raw water changes, to minimise the risk of infection (Meriläinen et al. 2019). A Water Safety Plan (WSP), based on the model recommended by the WHO for the comprehensive risk assessment of water utilities, is used in promoting water safety and preventing water epidemics (WHO 2009). Finland's WSP is a standards-compliant risk management method, and the risk assessment of a plant supplying domestic water can be carried out using an online WSP tool (https://wspssp.fi). Water-borne epidemics are monitored in Finland through a municipal investigation team as epidemics occur. Domestic and bathing water epidemics are reported to the notification system for food-borne and water-borne epidemics, the RyMy system.

In Finland, flood preparedness and adaptation are guided by the Act on Flood Risk Management (620/2010). In addition to water and seawater floods, special attention is paid to heavy rainfall and the resultant stormwater flooding in densely built areas, because they can contribute to the contamination of raw water and increase the risk of water-borne epidemics. Preparations for floods are made with regional flood maps and flood risk management plans (Parjanne et al. 2018). In addition, floods are warned about on the Flood Centre's website (Flood Centre 2013), which also contains forecasts of different types of floods for use by water plants.

The Centres for Economic Development, Transport and the Environment ensure that significant flood risk areas, flood hazard maps, flood risk maps and flood risk management plans are reviewed every six years as necessary in accordance with the Flood Risk Management Act. In addition, the ELY centre also manages other planning to prevent and reduce flood risks (e.g. flood risk mapping) in other flood risk areas. Municipalities may also prepare flood hazard maps for building and land use pressure areas as necessary. Flood risks are taken into account in land use planning and environmental permit matters. In addition, municipalities carry out a risk assessment of stormwater floods every six years, but because it focuses on critical infrastructure, it excludes the so-called ordinary risks of properties, small waste water treatment plants and wells owned by older people. The risks and vulnerabilities of agricultural and rural actors are also excluded, which also increases the vulnerability of sparsely populated areas in terms of water supply.

Climate change has a significant impact on water resources and water quality, which may have direct and indirect impacts on health, as well as on many other sectors of society that are directly dependent on water. Climate change also increases the regional risk of water scarcity and drought in Finland. From a health point of view, the risk of deterioration in (drinking) water quality is more significant, due to rising temperatures, increased rainfall and leaching, changes in seasonal weather patterns and the increasing prevalence of extreme weather phenomena. Increased storms and floods may cause contaminants from sewers and water purification plants to leak into surface water or groundwater used as raw water. Many of the predicted changes in the weather can therefore cause problems in the quality of raw water used in the production of domestic water or in the distribution of water, thereby increasing the microbiological health risks associated with drinking water. These changes bring additional pressure to water treatment processes (e.g. sand filtration, activated carbon filtration or UV disinfection), especially in surface water plants. Groundwater treatment plants must prepare for possible problems by maintaining the capacity to disinfect water. Wastewater treatment plants should also take into account the increasing precipitation in their own processes, especially with regard to the stormwater system. In preparing for these changes, consideration should be given to preventive adaptation measures, such as infrastructure solutions aimed at preventing pollution of water bodies.

Analysing the vulnerability of water supply is an important part of adaptation. In wastewater management, location-specific wastewater systems are the most vulnerable and may pose a health risk to water bodies and groundwater resources in connection with floods and heavy rainfall. On the domestic water side, the most vulnerable are small water abstraction plants and private wells. Drought also threatens water resources as climate change progresses, and prolonged spring drought without a heat cycle is entirely possible. Shortage or lack of water can cause problems, for example, for older citizens who rely on their own wells or for farm livestock units, also affecting food safety.

In adapting the water supply, training is important on the impacts, risks and vulnerabilities of climate change. It is necessary to increase competence both in the degree programmes in the social and health care sector and in the additional training of older personnel. In addition, construction supervision and technical students and staff can be trained to take into account the reduction of risks and vulnerabilities in the social health sector, for example by taking vulnerable groups of citizens into account and increasing communality.

Climate change also increases the risk of waterborne epidemics on beaches. With the increase in recreational use of water due to increasing temperatures, the number of swimmers on beaches will increase, which will increase the number of water contamination cases, especially with regard to noroviruses. In addition, the increase in water temperature may contribute to the spread of new microbial species and enable the

growth of some pathogen microbes. In connection with the summer 2014 heat wave, the illness of about 1,500 people in Finland was linked to the contamination of bathing water. Climate change also increases the risk of intestinal infection caused by campylobacter in the Nordic countries (Kuhn et al. 2020). An example of a more recent threat involving bathing water is the increase of infections caused by the Vibrio cholerae bacteria in marine areas due to global warming. The health risk increases on beaches, especially in shallow warm waters with low salinity, as in Finland in the Bay of Bothnia. Cyanobacteria in bathing waters may also increase, and health hazards caused by cyanobacterium toxins may increase. The health risk is caused by recreational use of water and the use of water in recreational dwellings, for example, as sauna water.

The aim of the adaptation measures is to prevent waterborne infections and to ensure access to good-quality and safe domestic water. Adaptation to changing weather conditions and the effectiveness of domestic water action plans are regularly assessed in the WSP process, for example by monitoring changes in water quality. In addition, adaptation related to changes in water quality and the prevention of water epidemics can be monitored by examining the number of water epidemics/change in morbidity before and after the measures (WSP, investments in cleaning technology) have been implemented. The network debt related to water supply also has a significant impact on pipeline failures and contributes to the generation of water epidemics, and the situation must also be monitored from the perspective of adaptation to climate change, because extreme weather phenomena, for example, can put an additional strain on a network that is in poor condition.

The adaptation of Finnish water supply to climate change would be helped by a national action plan on preparing for climate change and the related instructions on implementing the action plan. The level of preparedness of water facilities can be monitored, for example, by the prevalence of WSP plans, the number of investments in the plants and networks (network debt), the prevalence of disinfection preparedness and the prevalence of flood surveys. In addition, the preparedness/adaptation of water utilities to climate change can be assessed by means of targeted data collection, as was the case with the climate panel's "Climate change and water supply" project, which carried out a survey on preparing for climate change in water services (Meriläinen et al. 2019). In addition to monitoring water epidemics, adaptation is strengthened by monitoring the contamination of domestic water. Although contamination situations rarely lead to an epidemic, they indicate the prevalence of threats. It is justified to investigate the impact of stormwaters on the quality of economic and recreational waters, as the increase in heavy rainfall and intensification also affects stormwater loading.

4. Vector-transmitted diseases

Vector-borne diseases are bacterial, viral and parasitic diseases that infect humans through vectors such as mosquito or tick bites or stings (WHO 2020). The most significant vector-borne diseases in Finland are Lyme borreliosis and tick-borne encephalitis (TBE) spread through ticks. Mosquito-borne diseases of public health significance in Finland are Pogosta disease and tularaemia.

At the global level, vector-borne communicable diseases account for up to 17% of all communicable diseases, and around 700,000 people die of them each year (WHO 2020). Changes in the epidemiology of vector-borne diseases are difficult to predict, as they are significantly affected not only by climate change but also by changes in land use, health care, urbanisation, socio-demographic factors, population fluctuations in animals serving as reserves, and human behaviour (Rocklöv & Dubrow 2020, Bardosh et al. 2017, Brummer-Korvenkontio et al. 2002). The change in the occurrence of diseases affects human, animal and natural entities in complex ways that are not sufficiently known in all respects (Bardosh 2017). Continuous, up-to-date monitoring and research data is needed to assess the impacts of climate change and to provide a basis for adaptation measures.

The spread of vector-borne diseases is an equation that consists primarily of three factors: the pathogen, the vector and the carrier of the disease. Each of these factors has a different climate dependency. In fact, the most important vector species in Finland are very widespread and, for example, an ordinary tick occurs from Northern Finland to North Africa and Turkey (Estrada-Peña et al. 2017). The most common mosquito species also have a wide range of distribution, many even from the Arctic Ocean to Mediterranean countries (Lundström et al. 2013, Utrio 1979).

It has been predicted that Finland's winters will become warmer and rainfall in the winters will increase (Ruosteenoja 2013). Rainy and snowless winter during freezing periods is fatal to insects wintering in organic debris. On the other hand, their wintering can be very successful if the temperature does not go far below zero or if the winterer is protected by a thick snow cover (Turnock & Fields 2005, Nordman 1952).

For example, the population of ordinary ticks and taiga ticks will increase as a result of climate change (Laaksonen et al. 2018, Estrada-Peña et al. 2017). Tick populations depend on large mammals, and a clear link has been found between the density of roe populations and the incidence of tick-borne encephalitis (Dub et al. 2020, Jaenson 2018, Jaenson 2012, Pakanen et al. 2010). Forest management and game management measures, such as winter feeding and managing the size of carnivores (Miettinen 2019, Vajavaara 2007), have favoured the large populations of elk, roe deer and white-tailed deer. Warmer winters, on the other hand, particularly favour roe deer populations, and the populations are likely to increase (Jaenson 2018).

The incidence of the tick-spread Lyme borreliosis and tick-borne encephalitis (TBE) has increased in Finland over the past ten years (Finnish Institute for Health and Welfare). However, the prevalence of antibodies to Lyme borreliosis was significantly higher in the late 1960s and early 1970s than in 2011 (Cuellar et al. 2020, van Beek et al. 2018). This change is probably due to a change in the livelihoods, because Finland was a highly agricultural society as recently as the 1960s. New species of ticks can also arrive in Finland; for example, the Central European species of Dermacentiy reticularis can already be found in Belarus and Latvia (Estrada-Peña et al. 2017).

The potential long-term changes in mosquito populations in Finland are not yet known. A warmer climate can bring new mosquito species to Finland, but the situation is unlikely to change for the most common species. The most harmful species, for example, the Asian tiger mosquito, which also acts as the vector of the dengue virus, has already spread from southern Europe to southern Germany (Pluskota et al. 2008, Scholte & Schaffner 2007). However, modelling indicates it is unlikely to proliferate in Finnish nature (Caminade et al. 2012).

Mosquitoes of the genus Aedes are the most important tularaemia vectors in Finland, but variations in mole populations also affect the prevalence of tularaemia (Rossow et al. 2015). The diseases spread by mosquitoes can travel long distances also with migratory birds. One example of this is the Sinbis virus that causes Pogosta disease and is common in several African countries, Sweden, Russian Karelia and Eastern Finland (Lwande et al. 2015, Brummer-Korvenkontio et al. 2002). New viruses are also expected to arrive with migratory birds. For example, the West Nile virus was first discovered in Europe in 1996 and has since moved further north (Napp et al. 2018). The Usutu virus has arrived in Europe several times and was found in Sweden for the first time in 2019 (SVA 2019, Ashraf et al. 2015). The vector species used by both viruses are common in Finland.

In addition to vector-borne communicable diseases occurring in Finland, the health of Finnish tourists is also affected by tropical communicable diseases in other parts of the world, the incidence of which has changed greatly in recent years, both geographically and quantitatively. Such viral diseases include dengue, Zika and chikungunya. Shortcomings in the awareness of and protection from these diseases have been observed among Finnish tourists (Mäkelä et al. 2020). Although diseases cannot spread through Finnish vectors, they have a public health impact, and tourists should be provided with up-to-date information on regional risks and ways to protect themselves against infections when travelling to high-incidence areas.

One of the key objectives of adaptation measures is to produce up-to-date monitoring and risk assessment data for different actors to reduce health risks. The Finnish Institute for Health and Welfare monitors the occurrence of vector-borne diseases both nationally

and internationally using various monitoring systems and produces situation and risk assessment reports to support adaptation measures. Risk assessment data is also part of the evaluation process of the national vaccination programme and other vaccination recommendation areas related to vaccination for tick-borne encephalitis.

Cooperation between different research institutes and the sharing of research data are also relevant for actions aimed at reducing health risks, because new research data on vector-borne diseases and pathogen-spreading animals is continuously available. An example of a large-scale research project is the academy-funded research project Vector-borne diseases and climate change in Finland: mapping, modelling, mitigation (VECLIMIT), which involves several key research institutes from different parts of Finland. The study is being carried out in 2020–2023.

An important part of reducing the health risks of vector-borne diseases is human behaviour and its change, which also play a key role in adaptation to the impacts of climate change (WHO 2020). For this reason, key objectives and measures include increasing information and risk communication for both citizens and key actors.

5. Nutrition and health

Climate change will change both food production and trade. Because food production is an important factor in climate change and, on the other hand, food production has a lot of opportunities to mitigate climate change, food should be studied as a combination of the perspectives of health and climate. Nutrition and health are thus examples of a theme where climate change mitigation measures and adaptation cannot be separated from each other, but rather they go hand in hand.

5.1 Food production and consumption

Climate change will change the entire food environment, including food production, trade and the composition of the diet. Weather fluctuations caused by climate change make global food production more difficult and may also affect food security, food availability and nutrition and health in Finland. Dietary changes also provide an opportunity to mitigate climate change because the environmental impacts of the diet vary depending on the foods chosen. A lot more nature resources, such as soil, water and energy, are needed to produce animal products, and their production causes 80% of the greenhouse gas emissions from food production (Sabate and Soret 2014) and 30% of all greenhouse gas emissions. In Finland, the chain of food production and consumption from field to table causes about a third of the environmental impacts of all production and consumption. A vegetarian diet based on nutrition recommendations reduces

the climate impact and other environmental burden from food and promotes health. However, the average Finnish diet is relatively far from the diet that the national nutrition recommendations advise. In particular, the consumption of vegetables is too low and the consumption of red meat and meat products is too high. Changing the diet of Finns to comply with the guidelines would reduce the environmental burden from food as such. In addition to consumption choices, food loss and production methods affect the warming climate, consumption of water, land use, eutrophication and acidification of the environment, and the loss of biodiversity. Our consumption choices are integrally connected with the current food system, and changes in it should be implemented in a sustainable, acceptable and fair manner. Otherwise, there is a risk that social or health inequalities, for example, will increase.

The environmental impacts of food production can be reduced, but unlike with transport and housing, there are no new technological solutions to be implemented quickly. The climate impacts of food consumption can be reduced by favouring foods with a minimum load and by minimising food waste. In households, food waste can be reduced by good planning and by increasing consumers' knowledge of labelling, food storage and cooking. In professional kitchens, food waste can be reduced by influencing planning, procurement, purchasing, storage, cooking, transport and serving. The realisation of good nutrition must be ensured particularly for vulnerable groups that suffer most from extreme climate change phenomena (monitoring of nutrition status, home services).

5.2 Health-promoting nutrition

The government has set an ambitious target for Finland to be carbon neutral by 2035. One of the objectives of the government programme is a climate-friendly and environmentally friendly food system in which, among other things, the share of domestic plant products and fish is increased in accordance with nutrition recommendations and low-carbon targets. Not all measures have been decided on to achieve this goal, but the VTT report anticipates major changes to the Finnish diet (VTT 2020). The report Carbon neutral Finland 2035. https://doi.org/10.32040/2242-122X.2020.T366). The report examined several scenarios, and reaching the target required, for example, a 15%–25% reduction in meat consumption and otherwise a plant-based diet.

In the EU too, mitigation measures are starting to change food production, as the aim is to reduce emissions by 55% by 2030 (https://ym.fi/euroopan-unionin-ilmastopolitiikka). Indeed, the communication published by the Commission in January 2020 suggests that up to 40% of the agricultural budget is directed to climate measures (https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/651922/EPRS_BRI(2020)651922_EN.pdf).

Therefore, the impact of these expected changes on the Finnish diet and food security should be assessed and possible adaptation needs considered. As a whole, the situation is favourable from a health point of view, because in general a vegetarian diet based on nutrition recommendations reduces the climate impacts and other environmental burdens of food and promotes health. A vegetarian diet enriches microbiota beneficial to health in the body. Versatile microbiota are particularly important in childhood, when the immune defence develops, and early contact with diverse nature and a diet rich in vegetables enrich microbiota that are beneficial to health in the body. A vegetarian diet is linked to better weight management and reduced prevalence of several non-communicable diseases, such as type 2 diabetes, cardiovascular diseases and some types of cancer. Better weight management promotes both health and endurance. On the other hand, we must also be prepared for the possibility of individual-nutrient intake being reduced, so that it is necessary to supplement the diet to ensure sufficient nutrition. This is necessary if the composition of the diet becomes unbalanced or if the quality of the food deteriorates. A health-promoting diet contains a sufficient number of nutrients and an appropriate amount of energy for humans.

Adding vegetables, root vegetables, potatoes, berries and fruit and cereal products to the diet in accordance with the season improves food safety by reducing food waste and, at the same time, guides consumption to the time when the food items are at their best. Consumption of fish and chicken meat has a lower climate impact than red meat (National Nutrition Committee 2014), which is why increasing them is likely to be the subject of mitigation measures. In particular, Finnish fish is an underconsumed food, the increased use of which would simultaneously improve health and food security and reduce eutrophication of water systems. and climate emissions. The maximum recommended amount of red meat and meat products is 500 g per week, which is the case for women of working age, while the consumption by men of working age is almost 900 g (Kaartinen et al. 2021; Valsta et al. 2017). On average, Finnish men of working age consume one third less vegetables and fruit, and women one fifth less per day compared to the nutrition recommendation, which is at least 500 g per day. Based on a previous study, emission reductions that can be achieved by consumers' food choices are estimated to be 25%–50% (van Dooren et al. 2014, Roininen and Katajajuuri 2014).

The consumption habits of the population are not only based on individual choices, but are likely to be subject to significant political measures. In collective meals, different nudge methods are known to be functional in making doses healthier and more plant-based. Similarly, the food industry has done successful health-promoting nudge measures, for example by reducing the fat content of semi-skimmed milk from 2.9% in the 1980s to 1.5% today without consumer resistance or self-activity. For example, with the help of nudging, the supply of meat from shops can be kept unchanged if the effects of climate

policy on meat production are directed towards reducing the meat content of ready-made meals and restaurant foods.

Sustainable and healthy diets can be promoted by influencing agricultural policy, utilising fiscal means, food services and public procurement, education and information, research and product development, and by influencing the food environment. The change in the food system towards a sustainable and healthy diet requires a wide range of cross-administrative measures. In addition to the government, municipalities must be included because they have responsibility for many practical solutions related to, for example, the food environment, the provision of public food services and the organisation of teaching. Municipalities can significantly support the promotion of residents' health, local economy and positive climate impacts (such as food waste and the quality of meals offered) by taking these factors into account in public food services.

The potential of public food services in the development of health and environmentally responsible activities is based not only on supply and waste prevention, but also on the food education aspect. Offering healthy and environmentally friendly food and, for example, the order of the food along the canteen line will inspire better choices among customers, and the habits will extend in the best case to the individual's other food choices. Early childhood education and care and schools practise responsibility related to eating, saving energy and reducing food waste as part of environmental education and sustainable lifestyle growth. Children can be included in the monitoring of the food waste as part of the environmental education of food education, in which the children learn to assess the impacts of their own activities.

Municipalities and joint municipal authorities must take responsibility and sustainable development into account in the municipal strategy and outline how the strategy is visible in food service and food procurement. In addition to nutritional quality factors, it is advisable to require a description of sustainable properties related to society and social factors in the tendering process for food services. These may include the seasonal use of raw materials, the degree of self-manufacturing, ecology and waste management.

In the environmentally friendly supply of food services, Finnish crop vegetables, root vegetables, leguminous plants, mushrooms and berries are favoured in a versatile manner, and potatoes or cereals instead of rice. The supply of red meat and meat products will shift to the supply of legumes, fish, in particular domestic freshwater fish, and poultry.

Monitoring food consumption and food waste (kitchen, distribution and uneaten portions) is a key part of managing environmental loading and reducing the amount of bio-waste. In catering services, food waste can be reduced by influencing planning, procurement, purchasing, storage, cooking, transport and serving. The leftover

lunch concept provides the opportunity to sell excess food, i.e. food once offered for consumption may be sold to staff and customers at the end of the serving period.

Ensuring food safety is essential for health. Climate change increases extreme weather phenomena and crop damage. This is why versatile primary production is also important for health. Versatility is also supported by serious experiences of the spread of swine fever in China, where the disease brought the production of pig meat to a collapse and even shook global markets. Therefore, for example, sufficient plant protein production would be important to ensure that the different production sectors are as independent as possible when crises strike. In connection with plant protein production, it must be ensured that the product development of foodstuffs takes into account the composition of foodstuffs, for example in terms of saturated fat and salt.

6. Occupational health and well-being

Climate change affects Finnish working life and the working-age population in many ways. The impacts of climate change on working life can be divided into direct impacts, preparedness impacts and knock-on effects. In the short term, the direct impacts of climate change on work and occupational health can be predicted to be lower than the impacts of preparedness for climate change. The following paragraphs discuss these impacts in more detail. More extensive information on this topic can be found in the Finnish Institute of Occupational Health's report Hyvinvointia työstä 2030-luvulla: skenaarioita suomalaisen työelämän kehityksestä (Well-being from work in the 2030s, scenarios of the development of Finnish working life), whose content has also been used in this plan for adaptation (Finnish Institute of Occupational Health 2020b).

6.1 Heat load at work

The prevailing environmental condition (e.g. temperature, humidity and wind speed) is a significant factor affecting physical work ability. Prolonged thermal load reduces the employee's thermal comfort, functional capacity, well-being at work and productivity. In addition to loading, recovery is weaker. The magnitude of the impacts depends on the work tasks and the employee's personal characteristics, such as health, fitness, age and ability to adapt to heat.

As a result of climate change, work done in hot and extreme conditions in outdoor and unventilated indoor spaces will increase. Already in the 2030s, work will be done in Finland to an average extent at temperatures 0.5°C–1°C higher compared to the previous decade (IPCC 2014; Ruosteenoja et al. 2016). In Finland, the greatest exposure to heat load caused

by climate change will occur in physically heavy outdoor work during the early summer heat wave, before adapting to higher temperatures.

The body's thermal regulation mechanisms and temperature adaptation (acclimatisation) determine human heat tolerance and physiological responses to an increased thermal load. As the average temperature rises and warm days become more common, the population will adapt to some extent, depending on the amount of exposure to new temperature conditions (Hanna & Tait 2015).

Adaptation takes place on a continuum, with minimal and high temperature exposures at opposing ends. In cool areas, such as Finland, people with minimal exposure and slower adaptation to higher temperatures are overrepresented. The impacts of climate change on working capacity in countries in the temperate climate zone, where the population has generally adapted to the cold climate, may be more significant than expected (Adam-Poupart et al. 2013).

Preparations have been made for the prevalence of high temperatures and heat waves in summer by providing guidelines and recommendations (e.g. the Occupational Safety and Health Administration 2020; the Finnish Institute of Occupational Health 2020; ISO 7243:2003) to prevent adverse effects caused by temperature conditions and by assessing temperature conditions on a case-by-case basis at workplaces. Exposure to heat has been found to be a particular risk factor for illness at work, and written instructions on health examination practices and other measures in hot work have been issued to occupational health care workers (Karvala et al. 2019). Training and operating guides have been prepared for occupational health care personnel in connection with hot work.

Occupational heat exposure, both outdoors and indoors, will increase as a result of global warming. For this reason, various measures for temperature management must be taken to reduce risks and ensure a safe working environment. Preventive measures to prevent adverse effects caused by thermal conditions include identifying persons at risk, programmes that support active adaptation to ambient temperature, planning work and rest periods as well as breaks at work, maintaining fluid balance and managing temperature conditions with active air conditioning.

Research is still needed on the impacts of thermal load and extreme conditions on work ability and recovery. It is essential to study the effectiveness of proactive preparedness and prevention. Better information on the possibilities and use of developing monitoring technology in risk management is also needed. There is an international standard approved in Finland for assessing and managing the risks of cold work (SFS ISO 15743). Corresponding standardisation is needed to assess and manage the risks of hot work.

6.2 Interactions: Heat load, accidents at work, chemical exposure

Working at hot temperatures has interactions with occupational safety and chemical exposure, which should be taken into account in the risk assessment. An increased thermal load may increase the risk of occupational accidents, for example due to dizziness or reduced brain activity caused by sweating hands or fogging of protective goggles (Schulte et al. 2016, NIOSH 2016). Increased respiration through heat load can increase exposure to harmful substances through the respiratory tract, and increased sweating and increased surface blood circulation promote the absorption of these substances through the skin (Gatto et al. 2016, Schulte et al. 2016, NIOSH 2016). Chemical exposure may also affect the human heat-regulation system, which in turn reduces the capacity to adapt to the heat load (Gatto et al. 2016). In hot conditions, the use of protective equipment can be perceived as unpleasant, which may lead to inadequate or incorrect use of protective equipment (Gatto et al. 2016, Schulte et al. 2016). Protective equipment can also contribute to the worker's thermal load.

6.3 Occupational safety in the circular economy and energy production

With climate change, the operating models and structures of organisations will change increasingly towards circular economy (Simons et al. 2018; COM (2020)98). The aim for a carbon-neutral society will likely have an impact on work and occupational health. For example, sectors related to fossil energy production may disappear, and new ones may emerge in relation to renewable energy. There are also occupational safety risks associated with both perspectives. In circular economy processes, attention has been paid to harmful exposures, especially biological exposure agents such as mould and bacteria, and chemical (e.g. solvents) and physical (e.g. noise) exposure agents (Laitinen et al. 2017, Kauppi et al. 2019). Sectoral studies on different exposure agents and recommendations on safe methods have already been done, such as the safety risks of circular economy facilities (Ervasti et al. 2018), sustainable and safe circular economy (Kauppi et al. 2019) and occupational exposure risks of circular economy (Laitinen et al. 2017). The frequency of occupational accidents has been shown to be higher in jobs related to recycling than in traditional waste management (Graham et al. 2015). Accident hazards related to circular economy tasks include working at high elevations, using and moving machines and equipment, and the risks of fire and explosion (Laitinen et al. 2017, Ervasti et al. 2018).

6.4 Climate change and outdoor work

As a result of climate change, winters in Finland are becoming increasingly mild. Due to slippery weather and other weather changes affecting road conditions, various road accidents have been estimated to increase by as much as 20% (Tuomenvirta et al. 2018). This phenomenon affects professional drivers and, in particular, commuter traffic.

As zero-temperature weather become more common, the number of slipping accidents and the related incapacity to work and costs will increase. At the moment, slipping accidents are already quite common in Finland, causing considerable costs. According to a study conducted by Liikenneturva in 2014, approximately 40% of Finns had fallen during the year due to slippery weather conditions. One in two of them got hurt. Most of the slipping accidents requiring medical visits occur among the working-age population (Rantala et al. 2015, Tuomenvirta et al. 2018). Serious injuries requiring hospitalisation or medical attention cause direct costs and loss of working time. In addition, slipping accidents cause a significant number of milder contusions and sprains etc., which do not necessarily leave a mark on the statistics, but which may reduce work ability and productivity. From the viewpoint of the working-age population, the increased risk of slipping applies especially to outdoor workers, mail carriers and property managers, but also to all commuting workers, because a significant number of slipping accidents occur on the way to work to persons working indoors.

Work tasks related to the prevention of slipperiness will increase, and this will also involve occupational safety perspectives. For example, increasing sanding increases the amount of street dust and the concentrations of particles that will be inhaled (Tervahattu et al. 2005). Both outdoor workers and the entire population are exposed to street dust, especially in spring, and street dust has been shown to have negative health effects (Lanki 2013).

Extreme weather conditions, such as storms, floods, earthquakes, landslides and drought, are increasing as a result of climate change, causing risks primarily to those working outdoors and those participating in rescue and repair work (Schulte et al. 2016). Drought increases the probability of forest fires, and the associated fine-particle problems affect not only those who carry out rescue and clearing work, but also the rest of the population working in the affected area. The health impacts of and deaths from warming are more common in cold weather than in warm weather (Gasparrini et al. 2015). Although climate change, as a rule, reduces the occurrence of periods of extreme cold, in certain limited areas, periods of extreme cold may even increase at times as a result of climate change (Mori et al. 2019). During periods of extreme cold, special groups, such as people with respiratory symptoms, cardiac illnesses and (type 2) diabetes patients, will be increasingly exposed to extreme temperatures and temperature fluctuations. This may weaken their ability to work. In addition to physical and mental loads, various extreme weather phenomena may also affect working hours.

Climate change can increase the disease burden because the living conditions of vector animals in Finland become more favourable for them. This may affect the occupational health and safety of outdoor workers, and these risks must be identified in occupational health care and at workplaces.

As a result of climate change, air humidity and precipitation as well as storms and floods will increase. This may increase moisture damage in buildings, the growth of harmful moulds and microbes, and the exposure of those working in the premises (Tuomenvirta et al. 2018).

6.5 Effects of dark on work ability

Climate change has been predicted to affect the weather in Finland during the winter season so that the annual snow-covered period in southern and central Finland will decrease (Räisänen 2016), the amount of rainfall and clouds will increase and the sunlight will decrease (Ruosteenoja et al. 2016). Therefore, during the winter season, darkness is stronger than at present.

Mental health disorders are currently the leading cause of disability in Finland (ETK 2019, KELA 2020), and the human and economic impacts caused by mental health disorders are quite significant. As mentioned in section 3.1.4, climate change directly increases anxiety, probably depression and possibly suicides (Berry et al. 2018, Burke et al. 2018, Gammans 2020). Preparations must be made at workplaces and in occupational health care for mental health disorders that increase as a result of climate change, and methods for reducing these disorders must be actively developed.

Kirjallisuus

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Appendix 2. Recommended actions for the promotion of adaptation to the health impacts of climate change

Priority area	Adaptation actions	Key actors
Health hazards from heat	1. National action plan to prevent health hazards	MSAH NIHW FIOH
	2. Connecting heat warnings with pre-planned procedures	MSAH FMI NIHW FIOH AVIs municipalities hospital districts SOTE operating units National Emergency Supply Agency
	3. New and updated guidelines for different actors (e.g. municipalities, social welfare and health care, schools and day care centres)	MSAH MEC NIHW FIOH
	4. Improving the cooling possibilities of social welfare and health care institutions	MSAH hospital districts municipalities SOTE operating units
	5. In the Decree of the Ministry of Social Affairs and Health on Health-related Conditions of Housing and Other Residential Buildings and Qualification Requirements for Third-party Experts (Ministry of Social Affairs and Health 545/2015), a health-based examination of the action limits given for high indoor room temperatures outside the heating season	MSAH NIHW

Priority area	Adaptation actions	Key actors
	6. Recommendations for measures to combat heat hazards in urban planning and zoning	ME
	7. Taking the prevention of overheating of buildings into account in construction	ME
Slipping	8. Determine the impact of climate change on slippery conditions and slipping accidents in Finland	NIHW MSAH
	9. Continue communication campaigns to prevent slipping accidents	Non-governmental organisations NIHW
	10. Improving road maintenance to prevent slipping accidents, including promoting more ecological and less dusty ways to prevent slipperiness	NIHW MSAH Non-governmental organisations
Indoor air problems	11. Determine the links between climate change and indoor air quality in Finland	NIHW MSAH
	12. Determine the possibilities for adaptation to climate change in Finland in regard to indoor air	NIHW MSAH
Mental health problems	13. Determine the impact of climate change on mental health in Finland	MSAH NIHW
	14. Taking climate change into account in current reporting	MSAH NIHW
	15. Increasing capacity for traumatic psychological crises caused by extreme weather phenomena.	MSAH MI Specific catchment areas
	16. Improving the efficiency of treatment to prevent the disease burden added by the summer heat cycles.	MSAH SOTE centres
	17. Adding the use of timed light as part of treatment and other customer visits to prevent adverse effects caused by the darkness of winter days.	MSAH SOTE centres

Priority area	Adaptation actions	Key actors
	18. Instructions on adding systems used in construction, land use and housing to enhance cooling (heat cycles), heating (freezing periods) and lighting (winter darkness).	MSAH ME AVI
	19. Mental health promotion campaigns for climate anxiety	MSAH NIHW Non-governmental organisations
Waterborne diseases	20. Develop a national action plan on preparedness for the impacts of climate change in water management and its inclusion in the WSP	MSAH MAF NIHW Valvira
	21. Develop guidelines for water utilities (and water cooperatives) on the implementation of a climate change action plan	MSAH
	22. Take into account additional risks caused by climate change in the assessment of network deficit (surveying and repairing the condition of the domestic and sewage pipeline systems)	MAF MSAH water utilities
	23. Develop the monitoring of contamination situations in addition to the monitoring of water epidemics	MSAH NIHW
	24. Report on the health risks of storm water and climate change (impacts on the quality of domestic and bathing water)	MSAH ME NIHW SYKE
	25. Developing operational weather and climate services targeted at the health sector in cooperation with the Finnish Meteorological Institute and SYKE	MSAH ME NIHW SYKE FMI

Priority area	Adaptation actions	Key actors
Vector-transmitted diseases	26. Monitor the occurrence of vector-borne communicable diseases with the help of the communicable diseases register of the Finnish Institute for Health and Welfare (THL) and other national registers. Monitoring will be enhanced by producing risk assessment data, which is developed especially with respect to tick-borne encephalitis	NIHW
	27. Enhance international cooperation and monitoring of the disease situation	NIHW MSAH
	28. Enhance research on the impacts of climate change on vector-borne diseases.	Research institutes In Finland, e.g., NIHW and universities
	29. Enhance cooperation between different authorities. Survey a national network of actors for vector-borne diseases, and aim to establish an expert network.	NIHW
	30. Develop risk communication on protection against vector-borne disease	NIHW Regional actors
	31. Increase and produce information on vector-borne communicable diseases for both citizens and key actors	NIHW
	32. Increase and produce information on tropical vector-borne communicable diseases among tourists	NIHW
	33. Tick-borne encephalitis vaccine, national vaccination programme and recommendations for vaccination in areas outside the vaccination programme	MSAH NIHW
	34. Implementation of vaccinations	Municipalities
	35. Monitoring the development of a potential borreliosis vaccine and assessing cost-effectiveness	NIHW
Health hazards of UV radiation	36. Study on the impact of climate change on exposure to UV radiation and its health hazards	RNSA FMI NIHW

Priority area	Adaptation actions	Key actors
	37. National action plan to prevent health hazards from UV radiation	RNSA NIHW
	38. Information on the UV index and protection against UV radiation	RNSA FMI Non-governmental organisations
	39. Adding shady locations to outdoor areas	Municipalities ME
Nutrition and health	40. A strong perspective on research-based nutrition recommendations related to climate change adaptation and environmental sustainability	EK-FJLS Food and specialist group National Nutrition Council (VRN)
	41. Implementation of nutrition recommendations in public procurement based on combining environmental responsibility and nutrition	MAF Cooperation between different authorities VRN MAF NIHW Ekocentria
	42. Support for nutrition guidance in social welfare and health care (PALKO recommendation)	Health care service system
	43. Research on the link between a sustainable diet and health and disease risk	Research institutions in Finland, e.g., universities Luke NIHW

Priority area	Adaptation actions	Key actors
Occupational health care	44. Increasing awareness and competence in occupational health care. More tools for occupational health care to support workplaces.	FIOH Universities of applied sciences universities Centre for Occupational Safety private education providers
	45. Identify health, safety and work ability risks related to climate change (incl. risks related to circular economy) by increasing education related to the topic, especially in sectors critical to safety.	FIOH Universities of applied sciences universities Centre for Occupational Safety private education providers
	46. In the occupational safety and health administration, raising awareness and taking climate change into account in practical supervision tasks.	MSAH AVIs
	47. Increasing awareness and competence at workplaces.	Centre for Occupational Safety FIOH Labour market organisations entrepreneurial organisations Vocational schools and universities of applied sciences universities

Priority area	Adaptation actions	Key actors
	48. Preparing for exceptional situations, such as floods, storms and power outages from the viewpoint of occupational safety	FIOH occupational health care services occupational health and safety
	49. Supplementing and updating the website related to occupational safety in circular economy and guidelines based on research.	FIOH
	50. Increasing safety awareness in tasks related to new forms of energy.	FIOH Centre for Occupational Safety
	51. Preparing for and adapting to work in high temperatures and developing tools for assessing and managing risks of working in high temperatures.	FIOH VTT Finnish Standards Association SFS FIOH FMI VTT universities universities of applied sciences UKK Institute Finnish Defence Forces Likes/KIHU FIOH VTT
	52. Other adaptation activities related to work in high temperatures (e.g. wearable smart technology).	FIOH Centre for Occupational Safety

Priority area	Adaptation actions	Key actors
	53. Increasing awareness of and competence on UV radiation protection at workplaces. The means include training, information counselling and information campaigns.	FIOH and Centre for Occupational Safety
	54. Creation of slipping accident prevention programmes at workplaces (risk branches in particular)	FIOH Centre for Occupational Safety FMI workplaces occupational health and safety
	55. Taking into account the psychological impacts of climate change, instructions at workplaces and occupational health care	FIOH
Social impacts	56. Implement an assessment of welfare economy impacts in connection with significant investments at national level in order to overcome inequalities caused by climate change	MSAH research institutes
Health impacts of climate change mitigation measures and adaptation to them	57. Nutrition advice identifies people's climate motives, and communication relies on both climate and health perspectives.	VRN health care NIHW
	58. In municipal transport planning, prepare for an increase in muscle-powered and electrically assisted traffic, ensure a smooth flow of lightweight traffic and secure adequate opportunities for people with impaired mobility and functionality.	Municipalities MTC FTA
	59. Take health and recreational values into account when planning and implementing urban green areas and forest carbon sinks.	Municipalities ME Luke Metsähallitus
	60. In guidelines for small-scale burning of wood, take into account both the health and climate perspectives. In both cases, the citizens have an erroneously positive view.	ME MSAH NIHW
	61. Analyse the service needs of social welfare and health care changing due to climate change	MSAH NIHW
	62. Analyse the information needs of health care workers related to the health impacts of climate change	MSAH NIHW

Priority area	Adaptation actions	Key actors
	63. Training for health workers related to the health impacts of climate change	MEC universities of applied sciences universities
	64. Determine whether health care is adequately prepared for disruptions caused by extreme weather phenomena in contingency plans	MSAH NIHW
	65. Analyse the sensitivity of vulnerable population groups to the impacts of climate change, including those within the scope of home care	MSAH NIHW
	66. Promote adaptation measures for vulnerable population groups to the impacts of climate change	MSAH NIHW
	67. Based on climate scenarios, survey the impact scenarios related to health care and health	MSAH NIHW
	68. Cost-effectiveness assessment of adaptation measures in health care: assessing the benefits and costs of the measures and assessing the related information needs	MSAH NIHW
	69. Creating good practices and plans for social welfare and health care units on adaptation to and mitigation of climate change, including the introduction of policies that support sustainable development and mitigate climate change	MSAH NIHW Association of Finnish Local and Regional Authorities
Social welfare services	70. Analyse the information needs related to the health and well-being impacts of social welfare workers	MSAH NIHW
	71. Training related to the health and welfare impacts of climate change for social welfare workers	MEC universities of applied sciences universities
Knock-on effects	72. The state government will investigate knock-on effects in Finland.	MSAH
Research activities and international cooperation	73. Participate in the preparation of the EU's adaptation strategy	MSAH

Priority area	Adaptation actions	Key actors
	74. Increase dialogue between the preparation and implementation of adaptation policies and research	MSAH NIHW
	75. Assess the impacts of climate change on health and welfare	NIHW
	76. Research institutes and their partners actively seek European R&D&I funding to mitigate climate change, assess impacts, and research and develop adaptation measures.	NIHW FIOH
	77. Actively invest in the work of the IPCC by influencing its activities and conducting research relevant to the IPCC to analyse and support the adaptation of health and welfare	NIHW
	78. Strengthen cooperation with the Finnish Meteorological Institute, other sectoral research institutes and universities	NIHW
	79. Participate in climate change adaptation at the government level (participate in the implementation, monitoring and evaluation of the National Strategy for Adaptation to Climate Change)	NIHW MSAH
	80. Participate in the preparation of the EU's adaptation strategy	NIHW MSAH
	81. Focus research on topics that support adaptation to climate change	NIHW
	82. Continue the work of NIHW on phenomena and the development of its climate change programme	NIHW
Education and training	83. Participate in developing awareness of climate change, its mitigation, adaptation and impacts at all levels of study in social welfare and health care	NIHW MSAH National Board of Education comprehensive schools general upper secondary schools vocational schools higher education institutions

Priority area	Adaptation actions	Key actors
	84. Increase education and awareness of a sustainable adaptable society in social welfare and health care workplaces	NIHW MSAH FIOH workplaces
Communication	85. Communicate about climate change and adaptation to it in the environmental health newsletter	NIHW
	86. Participate in communication on climate change adaptation in the national monitoring group	NIHW MSAH
	87. Compile and update climate change websites (e.g. NIHW, MSAH, Climate Guide)	NIHW MSAH
	88. Direct clients to material on climate change through communications, including social media applications.	NIHW MSAH
	89. Communicate the progress of measures related to adaptation	NIHW MSAH
	90. Present the adaptation plan at events aimed at different sectors	NIHW MSAH
	91. Suggest opportunities for cooperation in communication with other actors	all
Monitoring	92. Arrange the monitoring of the implementation of the MSAH climate change adaptation/action plan	NIHW MSAH

Abbreviations Ministry of Social Affairs and Health (MSAH), Finnish Institute for Health and Welfare (NIHW), Finnish Institute of Occupational Health (FIOH), Finnish Meteorological Institute (FMI), regional state administrative agency (AVI), Ministry of Education and Culture (MEC), Ministry of Environment (ME), National Supervisory Authority for Welfare and Health (Valvira), Ministry of Agriculture and Forestry (MAF), National Nutrition Council (VRN), Finnish Environment Institute (SYKE), Natural Resources Institute Finland (Luke), Technical Research Centre of Finland (VTT)

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