Jenna Tonteri

Illustrated Meanings of Climate Change Mitigation's Co-benefits to Human Health in High-income Countries

A literature review and autoethnographic inquiry

Metropolia University of Applied Sciences

Creativity and Arts in Social and Health Fields (CRASH)

Master of Social Services and Health Care

Master's Thesis

the 16th of May 2023

Abstract

Author:	Jenna Tonteri
Title:	Illustrated Meanings of Climate Change Mitigation's Co-benefits to Human Health in High-income Countries – A literature review and autoethnographic inquiry
Number of Pages:	128 pages + 3 appendices
Date:	the 16th of May 2023
Degree:	Creativity and Arts in Social and Health Fields (CRASH)
Degree Programme:	Master of Social Services and Health Care
Specialisation option:	Public Health Nurse
Instructor(s):	Dr. Sanna Kivijärvi

There is an urgent need to act for the planet: the climate crisis will affect the planet's ecosystem and people's lives irreversibly. Human population is also struggling with another massive challenge: burden of non-communicable diseases. There are two kinds of implementations to respond to global warming: adaptation and mitigation. Mitigation aims to curb greenhouse gases and prevent releases to get into the atmosphere. The key assumption of this study is that climate change mitigation measures decelerate global warming and alleviate its impacts and have several co-benefits to public health.

The purpose of this master's thesis is to describe health promotive aspects of climate change mitigation actions and explain in a meaningful way how they are interlinked. Thus, the research question is: "How climate change mitigation implementations intertwine with public health in high-income countries?" This research is a qualitative health research from environmental and cultural perspectives, and it includes an artistic approach. Data on human health was collected and analysed qualitatively through a literature review consisting of 19 peer-reviewed articles. The data was analysed inductively with a qualitative approach. By presenting poetry and aquarelles that evoked during the thesis process, understanding of interconnectedness of human and planetary health is deepened.

According to the findings, climate change mitigation measures have interconnections with human health. By alleviating the greenhouse gas emissions in five different sectors (food industry and nutrition, transportation, energy generation and use, industrial processes, and infrastructure), it is possible to promote public health for example by attaining healthier food intake, improved air quality, increased physical activity and social contacts, and safer and more pleasant environment. These contribute to decreased levels of non-communicable and infectious diseases and improved mental health. It was concluded that the topic of health promotive perspectives of climate change mitigation actions requires further examination, interdisciplinary work, and emphasis on equity and climate justice.

Keywords: artistic approach, climate change mitigation, co-benefits, human and planetary health, interconnections, public health, trade-offs

Contents

1 Introduction

There is an urgent need to act for the planet: for decades, experts have stated that the climate crisis will affect the planet's ecosystem and people's lives irreversibly. Since 1990, the Intergovernmental Panel on Climate Change, IPCC, has published several comprehensive and unequivocal assessment reports, and publications of global warming (e.g., IPCC 1992, 2001, 2007, 2014, 2018, 2022a, 2022b). Nonetheless, people's actions are still inadequate to respond the need for changing habits and procedures towards more sustainable ones.

Human population is also struggling globally with another massive challenge: burden of non-communicable diseases. According to the EAT – Lancet commission report (Willett et al. 2019: 447, 449), the current lifestyle is unhealthy in several countries and increases non-communicable diseases and ill-being among people (Willett et al. 2019: 447, 449). In the report it was highlighted that the challenges would only be exacerbated by the prevailing trends in the food industry together with the growth of population. Report remarked that contemporary food production has left over 820 million people undernourished and in the meanwhile even larger number of people have overconsumed unhealthy food which might have led to micronutrient deficiencies, obesity, and non-communicable diseases, including cardiovascular diseases, and diabetes. Commission reported that "unhealthy diets now pose a greater risk to morbidity and mortality than unsafe sex, alcohol, drug and tobacco use combined" and it is necessary to shift towards plant-based reference diet, for example Planetary Diet. Furthermore, global food production has covered up to 30% of the overall greenhouse gas emissions and has been the main reason for environmental change. (Willett et al. 2019: 449.) Brenndorfer (2020: 23) stated that animal origin food production has emitted higher levels of greenhouse gas emissions than plant-based food production.

In addition to unhealthy food consumption, inactive sedentary lifestyle, and unsustainable travelling with personal vehicles, mainly with cars, threaten both human and planetary health. It was indicated that transportation has covered about 25% of global greenhouse gas emissions, and over two thirds of these emissions have come from road vehicles' engines. The number of car owners is rising, and the amount of motor vehicles is expected to double by 2040. Sustainable options for the personal vehicles could be walking, bicycling, and using public transport alongside shared and rental cars, and taxis. (Arup 2019: 81–83, 85.) Especially, walking and cycling were stated to emit nearly zero greenhouse gases and decrease air pollution. Also, physically more active ways of travelling promote health. (Quam et al. 2017: 11, 14.)

My professional background is in health promotion, and I have been increasingly interested in environmental health aspects. I have been concerned about modern life habits, climate change, environmental degradation, and pollution and the repercussions of different choices for people's health and well-being. Although, the issues seem to be substantial and inextricably interlinked, possibly with the right measures several problems could be alleviated at once. Thus, collective input is needed and in the public health discipline, it is important to bring forward the issues of predominant behaviour (Horton et al. 2014: 847). Brenndorfer (2020: 22–23) highlighted that nurses are on the frontline to perceive the health impacts of climate change, but also to commit people to choices that are sustainable and health-friendly. In the position of public health nurse, I have been able to discuss healthy choices with individuals and groups and highlight some choice's mitigative properties that decelerate global warming. Yet, the aspects of climate change mitigation in discussion of health promotion should be more prominent, therefore wider understanding of climate and environmental issues and their interconnections with health and well-being is needed within social and health fields. Additionally, understanding of public health in climate change discussion is needed.

According to Häikiö and Saikkonen (2010: 38) societal change is central to attain sustainable well-being, since these massive issues are manifold and would not

automatically be solved by low-carbon technological innovations. Far-reaching social and cultural changes require not only an understanding of the information involved but also emotional commitment (Tannock 2021: 10). The master's studies of Creativity and Arts in Social and Health Fields have introduced me to how science and knowledge can be produced with, by and through creativity and arts – and how understanding can be deepened, as well. Therefore, I decided to combine a few of my passions: the interest for public health promotion, willingness to alleviate climate change, and passion for painting and poetry.

Accordingly, the aim of this master's thesis is to encourage people to make changes in their lifestyles by creating evoking information of why alleviating the climate crisis and simultaneously promoting health is important. The purpose is to describe what are the health promotive aspects of climate change mitigation actions and explain in a meaningful way how they interlink. Correspondingly, the research question is: "How climate change mitigation implementations intertwine with public health in high-income countries?". Moreover, I sought to find deeper personal emotional knowledge of the subject. For that reason, I combined rigorous and thorough literature review with rich autoethnographic inquiry that conjoins two art forms.

2 Conceptual premises

In this chapter I describe the most important concepts regarding the research topic: climate change, strategies to respond to it, and human and planetary health. Then, I present presumptions of interconnections between mitigative actions and public health. The idea of how climate change mitigation might benefit both climate and human is visually illustrated. Because this master's thesis is also an autoethnographic inquiry, I specified more of my background to justify why I chose to study with artistic approach how climate change mitigation implementations intertwine with public health.

2.1 Climate change

According to the latest IPCC Sixth Assessment Report summary for policymakers (2022a: 8) the global surface temperature between 2011–2020 had risen to the median value of 1.09°C above pre-industrial levels. It was assessed that even in the scenario of very low emissions there is a significant probability that global warming will reach 1.5°C in a few years. The report highlighted already occurred impacts of climate change, such as weather extremes (e.g., torrential rain, drought, severe heat waves, fire weather, and tropical cyclones) and environmental degradation (irrevocable losses, extinctions, and prominent damages in different ecosystems). (IPCC 2022a: 8–9.) Furthermore, there have been other onset processes, such as retrieving glaciers and thawing permafrost, sea level rise and ocean acidification that are irreversible. It was estimated that 50% of all species have adjusted to climate change by shifting towards poles, or ascending higher on land, and some species have altered their timing of seasonal cycles. The report underlined the concern of ecosystem's limited resilience and capacity to adapt and the entangled consequences to humans. (IPCC 2022a: 9.)

According to IPCC summary for policymakers (2022b: 10), human-induced global net greenhouse gas emissions in 2019 had decreased 12% from the levels of 2010 and 54% from the levels of 1990. The carbon dioxide emissions have elevated the most due to fossil fuel consumption and industry, subsequently methane. In 2019, energy production generated about 34% of overall greenhouse gas emissions, industrial processes 24%, agriculture and other land use including forestry 22%, transportation 15% and residential sector about 6% of the emissions (see Figure 1). However, a great share of the emissions of energy production could be attributed to other sectors: especially industry and residential sectors consume considerably electricity and heat. (IPCC 2022b: 10, 12.)

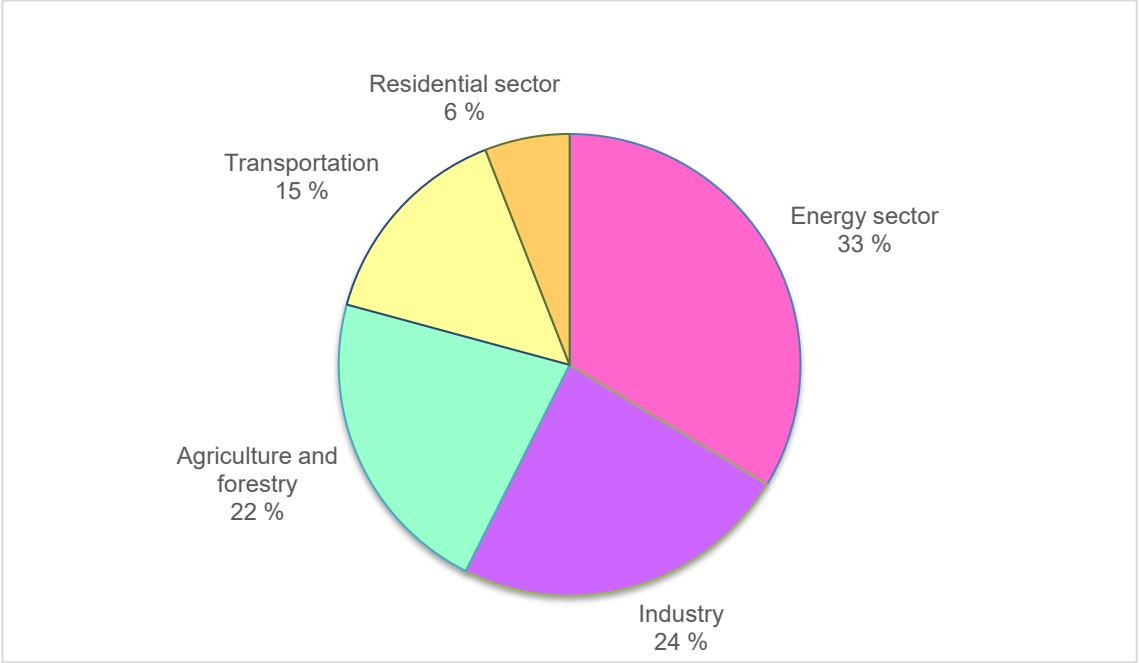

Figure 1 The distribution of greenhouse gas emission sources in 2019 (see IPCC 2022b: 12)

In the column of Klein (2014a), it was stated that climate change started gradually accelerating in the late 1980's – just when the consumerism was born, and "deregulated capitalism" was spread worldwide. Ever since, both marketing and

technology have altered people's daily lives so vigorously that it is difficult to imagine different kind of lifestyle. (Klein 2014a.) Horton et al. (2014: 847) noted that the economic system and the idea of unlimited economic growth was created to serve the needs of a limited group of elites, and the system has only deepened the crises (Horton et al. 2014: 847). In the column of Klein (2014a) the missteps of economic system that have accelerated global warming were described aptly:

> And little wonder: just when we needed to gather, our public sphere was disintegrating; just when we needed to consume less, consumerism took over virtually every aspect of our lives; just when we needed to slow down and notice, we sped up; and just when we needed longer time horizons, we were able to see only the immediate present (Klein 2014a).

The unsustainable and unjust world with disasters such as global warming, require vast cultural and societal changes, that usually happen very slowly and gradually. Renouf (2021: 3) stated that people have not thought about obscure, slow, and long-term events, because of "psychological and cognitive barriers, [and] social, cultural and political impediments". However, Klein (2014a) highlighted that humans have capability to make complicated reasoning and to adjust old habits remarkably fast – but what is needed, is understanding the individual's role and the barriers in the culture that stop from making the required turn.

2.2 Adaptation and mitigation

There are two kinds of implementations to respond to global warming: adaptation and mitigation. Prior et al. (2018: 2–3) stated that adaptation means management of the inevitable consequences of climate change and actions that protect people from the health impacts of climate change, whereas mitigation aims to avoid further unmanageable impacts and reduce health impacts of humans and natural systems.

IPCC (2022a: 24–25) reported that adaptive measures address water-related risks, improvements in agriculture and preserving of biodiversity. In practice, these measures might include for example restoring rivers and wetlands and absorbing soil with less built zones and more upstream forests. Improvements in agriculture means for instance diversification in farms, limited crops, increased urban cultivation and agroforestry, and other ecological and sustainable practices in agriculture. In addition, management of aquatic ecosystems in fisheries and aquaculture is significant. There were also other adaptation strategies suggested, such as control of food security. (IPCC 2022a: 23–25.) According to IPCC summary (2022a: 13), the ecosystem is very vulnerable to climate change, because of unsustainable exploitation of natural resources, habitat fragmentation and pollution that damage the ecosystem, even in the protected areas.

According to World Wildlife Fund (WWF 2023) mitigation of climate change signifies preventing and decreasing releases of heat-trapping gases into the atmosphere thus alleviating extreme increases in temperature. Prior et al. (2018: 2) described that mitigative measures focus on “a deeper understanding of the interconnectedness of human health and well-being, and the health of the natural systems on which we all depend”. In the review of Wheeler and Watts (2018: 177), it was concluded that mitigation of global warming is imperative, because adaptation strategies are limited, and those cannot protect human health from all climate change’s impacts.

IPCC (2022b: 32, 34) summary of climate change mitigation suggested “major transitions” to alleviate global warming, for example by decreasing fossil fuel and material consumption considerably, exchanging for energy sources with low emissions and by improving energy efficiency, and advancing carbon sinks in urban environment. Arup (2019: 97–98) listed effective interventions for climate change, and they were following: alterations considering food consumption, household, infrastructure, transport, aviation, and consuming of clothing, textiles, and electronics.

Tannock (2021: 95–96) emphasised that naive trust towards governmental and industrial shift to avoid climate change and widely promoted symbolic mitigation actions such as avoiding food waste and recycling instead of reducing consuming, have prevented people from making meaningful individual amendments for the climate. Tannock proposed that small actions, such as recycling, are insufficient, they are individualised, consumerist and could prevent from making more comprehensive, collective, political actions that push for institutional reform (Tannock 2021: 95–96). Everyone needs to start somewhere, but these smaller actions should not be used to preserve other harmful habits.

2.3 Human and planetary health

Bardy (2010: 27–28) described that the definitions for human well-being are vast and multidimensional and there remain plenty of open questions what well-being is, how to define it, and measure it. In this study well-being means physical, mental, and social health and well-being. Particularly, when discussing of global well-being, non-communicable diseases and their prevention distinguish. Willett et al. (2019: 450) defined the non-communicable diseases as long-lasting chronic illnesses contributed by genetics and physiology, behaviour, and environment, mainly meaning diabetes, cardiovascular and respiratory diseases, and cancers.

Gonzalez-Holguera et al. (2022: 2) emphasised that human health is dependent on functioning natural and social environments. Gonzalez-Holguera et al. (2022: 2) summarised that “Planetary Health is a new transdisciplinary health paradigm, which aims at recognizing the systemic links between human health, socio-cultural environment, non-human living organisms and Earth’s natural systems”. The principles of Planetary Health meet the Sustainable Development Goals, thus equal health and well-being of all people should be pursued together with other goals within the limits of ecosystem. (Gonzalez-Holguera et al. 2022: 2.)

World Health Organization (WHO) and Finnish Institute of Health and Welfare (THL) have constantly been monitoring impacts of global warming to the health,

planning adaptation, and preparing climate resilient health systems. The rise of global surface temperature has threatened the life on earth, and it is justified to know throughout the complex impacts to human health and be prepared. According to IPCC summary (2022a: 10–11), accelerated rising of global warming is imminent danger to human beings and planet alike. It threatens human systems by increasing shortage of fresh water and endangering food systems by reduced crop yields, health and productivity issues of animals and livestock and decreased fishery stocks. In addition, global warming causes health issues such as infectious diseases, heat- and other weather extremes related morbidity and mortality, malnutrition, and mental health issues. It damages both inland and coastal areas and infrastructure in cities. Consequently, climate change increases human mortality and has detrimental socio-economic impacts, which further affect mental health. (IPCC 2022a: 10–11.) Yet, climate change itself as a threat to human health was not considered in this master's thesis in a deeper level.

Instead, the health impacts of mitigative measures were studied. As Thomas et al. (2014: 274) noted, it is useful to acknowledge how mitigation actions might effect to human health:

> Rather than just viewing poor health outcomes as an inevitable impact of climate change therefore, we can develop understanding of how impacts and measures to alleviate or mitigate these at one scale may influence or disrupt health and well-being [!] outcomes at other scales (Thomas et al. 2014: 274).

Thomas et al. (2014: 273) suggested that climate change and the required lifestyle and behavioural changes might be the most significant secondary impacts on people's daily health. The impacts can be positive depending which measures are adopted. For example, Marinova and Bogueva (2019: 6, 3–4) found that by increasing fibre-rich plant-based food intake and simultaneously replacing high consumption of red meat, it is possible to decrease cancer risk together with decreased greenhouse gas emissions and environmental footprint.

Amelung et al. (2019: 1, 4, 7) found that it was meaningful for people to know the health impacts of mitigation actions: The households, that were informed about health impacts together with reduced emissions of individual climate change mitigation actions, were more willing to adjust to more sustainable eating and housing behaviour than the ones informed only of reduced emissions. Kotcher et al. (2021: 4) reported that when people had comprehensive knowledge about climate change solutions and health, they were more likely to push policymakers to address climate issues.

2.4 Conceptual framework for the study

This master's thesis utilises the idea, that dual benefit to climate and human health, might encourage people more to mitigate global warming. This research focuses also on the positive, quick-acting outcomes of taking climate and the planet into the consideration. By studying from different perspectives, what are climate change mitigation actions' health promotive interconnections expressed with aquarelles and poems, this study could offer comprehensive ways to see mitigative actions' profits.

My preliminary assumptions when I was starting this master's thesis were that climate change mitigation measures, on the one hand, decelerate global warming and alleviate its impacts, and on the other hand, have several co-benefits to public health. However, in this thesis I excluded the information of how decelerating global warming saves people's lives by decreasing climate change's impacts to humans and concentrated only on the mitigative measures' benefits or trade-offs to the human health. My presumptions of these climate actions that benefit both climate and human health were healthier plant-based diet with lower food production emissions, active ways of traveling with less use of individual motor vehicles and more cycling, walking, and using public transport, and green and blue infrastructure in people's surroundings. Reducing overall consumption might have some co-benefits to public health, by improved air quality for example,

in addition to decelerating global warming. Yet, some negative effects to well-being from mitigation actions were expected to occur, as well.

Four common climate change mitigation measures are presented in figure 2 below, and their possible profits on environment and human health based on theoretical framework. Mitigative measures are placed in the middle, on the left side there are possible pro-environmental effects and on the right side, health promotive aspects.

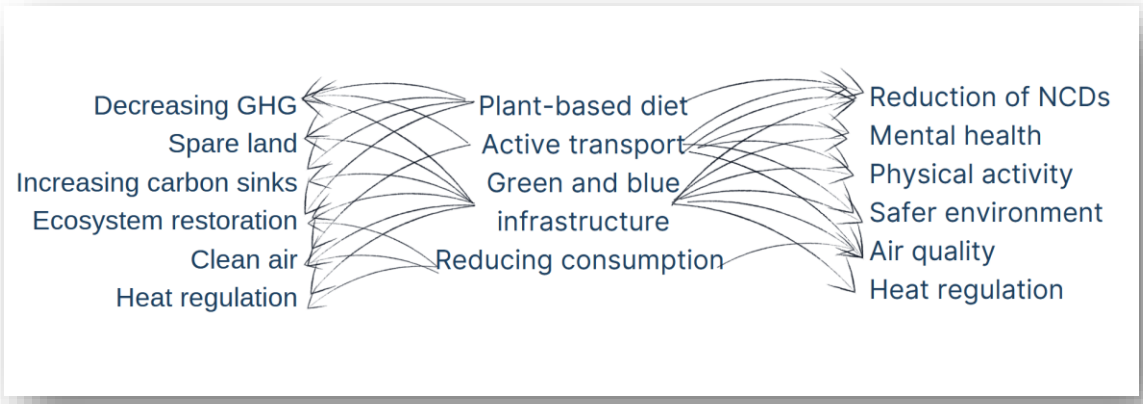

Figure 2 Expected interconnections between environment, climate change mitigation measures and human health

All listed actions are considered to reduce greenhouse gas emissions, and benefit climate and environment. Shift towards plant-based diet, green and blue infrastructure, and reduced consumption are expected to spare land for agricultural use and for restoration of forests and other ecosystems and create natural solutions for climate that increase carbon sinks.

Agriculture and modern food production has exacerbated global warming (Springmann et al. 2018; Sun et al. 2022: 29) and caused changes in terrestrial and aquatic ecosystems by depleting freshwater resources, and by polluting through excess nitrogen and phosphorus (Springmann et al. 2018). Shift to plant-

based diets could simultaneously decrease greenhouse gas emissions and spare cultivated land for other uses, like ecosystem restoration that is regarded as natural climate solution (Sun et al. 2022: 29). According to the IPCC summary for policymakers, “balanced diets contribute to nutrition, health, biodiversity and other environmental benefits” (IPCCa 2022: 25).

Laukkonen et al. (2009: 289) noted that green infrastructure and water bodies in urban environment create carbon sinks, but also regulate increased air temperature and manage stormwater, for example. Moreover, blue and green spaces have co-benefits for health: urban blue and green spaces were reported to have positive health and environmental outcomes, such as “cleaner air, a reduction of the heat-island effect and a reduction in vehicular transport use” which therefore might increase physical activity and enhance social and mental well-being (Thomas et al. 2014: 276).

Active transport could decrease air pollution in addition to decelerating carbon emissions. In Arup’s (2019) report, it was stated that the transportation has covered about 25% of global greenhouse gas emissions, and “over two thirds of these emissions come from the road vehicles’ engines. Electric vehicles have lower operational emissions, but the overall emissions of manufacturing electronic vehicles are 15–68% more compared to similar vehicles with combustion engine. The amount of car owners is growing, and fuel efficiency has in fact, rendered us to travel more with the same expenses, and procure larger vehicles. The number of cars on the road needs to be decreased together with levels of private vehicle’s ownership and sustainable options for owning a personal vehicle are walking, bicycling, and using public transport alongside shared and rental cars, and taxis. However, the case is not very simple because personal vehicles are thought to provide autonomy, freedom, and status. (Arup 2019: 81–83, 85.) Yet, people could be encouraged to active lifestyles by providing walking tracks, bicycle paths and public transport. The incidental exercise, such as walking and bicycling, has potential to decrease rates of noncommunicable diseases and improve mental health. (Prior et al. 2018: 3.) Also, Halonen et al. (2021: 2) highlighted that increased walking, cycling and the

use of public transport reduce both inactivity-related morbidity of non-communicable diseases and air pollution.

Another reasons that might promote people's health and well-being are other kinds of activities, exercise and healthy diet that are not mitigating global warming. Besides, there are numerous factors that affect public health, for example susceptibility to hereditary diseases, use of alcohol, tobacco and other substances, social and cultural reasons for public health and well-being, that are not considered in this study unless those aspects occur in the data. According to Leavy (2017: 67) during research project, it is needed to be conscious of "extraneous variables that are not under investigation but may impact the data."

The need for the compilation of health protective climate change mitigation actions is acknowledged. For example, it was stated that health aspects should be more prominent in decision-making of mitigation strategies, to assess overall benefits of health promotive climate actions and for making green policy more ambitious. (Hess et al. 2020: 1, 9.) There are both positive and negative consequences of mitigative strategies, and people's experiences might vary (Thomas et al. 2014: 276).

2.5 Researcher's sphere

Health promotive aspect has been a significant part of each professional position I have held. I have graduated as a public health nurse, and I have working experience from the health care sector from all stages of prevention in health promotion, disease prevention, medical nursing, and rehabilitation. I also have complemented my knowledge of public health, for instance in the courses of Health Sciences in Helsinki Open University in 2019. I have participated in some courses concerning environmental and planetary health, where I gained general picture of the environmental issues and how they might affect people's health. Ever since, I have obtained more information on environmental issues and

become increasingly conscious of how people are unbeknown to destroying the environment.

The main reason why I chose to study how climate change mitigation implementations intertwine with public health is because there is a need to acknowledge the webbings that affect human lives, environment and health, and people's responsibility in it. I had already learned that meat and dairy products expose to non-communicable diseases through various physiological mechanisms, and I was aware of livestock's contribution to global warming. Apart from that, other reasons why I chose the topic of interconnections between mitigative measures and public health, was based on assumptions that more sustainable options in transportation (e.g., bicycle commuting), and land use (increasing of green areas and conserving forests) would very likely benefit both human and planetary health and I wanted to find out whether the claims were reasonable.

I am currently studying master's degree of Social Services and Health Care in Metropolia University of Applied Sciences. The degree program Creativity and Arts in Social and Health Fields (CRASH) has combined artistic and creative methods in the social and health care sector with the interdisciplinary networks. In the degree program I have been introduced artistic ways of implementing the work in the health field but also conducting research in and through creative practices. Different forms of arts have always interested me: painting, poetry, dancing, singing, and playing the violin have been my ways to express myself especially when I was younger. I have found my creativity again in adulthood after I had children. Since then, I have been able to increase the use of artistic methods also in my working life and noticed its empowering impacts.

Climate change and the vicious problems that interconnect in the Earth's closed system have evoked a lot of emotions and sometimes they have felt very overwhelming and quite impossible to solve. I have not wanted to point the finger at anyone, but I have sometimes been mad at myself for not saying a word when people have justified their normative, unsustainable lifestyles. I have decided that

my task is not to judge, but I would like to be part of changing the narrative about what is truly sustainable, and I have been unaware of how to do it appropriately. Recently, I have thought that expressing these underlying emotions through arts might be the key to changing the status quo. Perhaps there is a need in society to recognise and allow all kinds of feelings because climate change and other environmental issues evoke difficult emotions that might be pushed away – and then the defence mechanisms might step forward and prevent from acting (see Pihkala 2022: 10, 14, 15). Additionally, I needed a channel for the emotions, otherwise the load of this thesis might have gotten too exhausting to carry. That is why the emotions towards inequitable treatment of nature and other people play a significant role in my artwork.

3 Implementation of the study

In this chapter, I elaborate research methodology and explain in more detail about how this master's thesis answered to the research question of "How climate change mitigation implementations intertwine with public health in high-income countries?". In the subchapter of 3.2 "Data construction and analysis", the literature review process is described. Justification for including artwork and description of creative process are reported in the subchapter 3.3 "Arts in the process". Then, in the last subchapter the ethical aspects of this research are discussed.

3.1 Research Methodology

There are various justified ways for conducting thorough research, and qualitative research has achieved a recognised position in the field of science. Bunde-Birouste et al. (2019: 511) noted that "the world of research has greatly evolved since the days when only quantitative research was judged to have merit within the positivist tradition". Salami (2020: 13–14) emphasised that reality cannot be explained only through measurable knowledge – also, sensitivity is needed to understand comprehensively people's complex realities. Salami (2020: 13–14) suggested that the world needs an approach to knowledge that recognises and synthesises emotional intelligence and imagination together with a conventional emphasis on rational intelligence. By combining all these aspects, it could be possible to create awareness that affects the mind, as well as body and soul – interior and exterior. (Salami, 2020: 13–14.)

This master's thesis is a qualitative health research from the environmental and cultural perspective with artistic approach. In this study, more objective data on human health was collected and analysed qualitatively from the literature review findings and understanding was deepened by utilising the poetry and aquarelles

that was expressed during the thesis process. Kylmä and Juvakka (2007: 7–8) stated that qualitative health research produces knowledge of people's individual, communal, and cultural reality that is related to health – besides, the main question for the qualitative health research is, how research can promote public health. This study containes all the aspects: how individual, communal, and cultural health can be promoted via climate change mitigation actions. The aim is to encourage people to make changes in their lifestyles by creating evoking information of why alleviating the climate crisis and promoting health is important.

In qualitative health research it is justified to use literature review in the implementation. Via literature review, the researcher can describe the reality of the studied phenomenon and on top become aware of the assumptions related to the studied subject at both individual and scientific levels. In a thorough literature review, the previous knowledge about the phenomenon is synthesised and a gap in existing knowledge is addressed. (Kylmä & Juvakka 2012: 45–46.) The purpose of this master's thesis is to describe the prevailing state of scientific knowledge of what are the health promotive aspects of climate change mitigation actions and thus the review type is descriptive. In descriptive review it is important to present the findings rigorously according to the data, and not to draw wider conclusions. However, different types of methodologies and suitable elements can be combined to answer the research question in the best possible way. (see Xiao & Watson 2017: 95, 102, 108.) Thus, literature review and autoethnographic inquiry were combined, but in the report, literature review process and data are easily distinguishable from discernible autoethnographic artwork and reflection.

Because the purpose is also to explain in a meaningful way how health promotive aspects of climate change mitigative actions are interlinked, I have wanted to intensify knowledge by illustrating the personal experiences, emotions, and perceptions in addition to more objective data. Autoethnographic approach was stated to bring diverse scientific perspective to the research that might stir people to think differently and drive change – concurrently it enables bringing science intelligible for the public (see Leavy 2017: 144).

Salami (2020: 13) highlighted that “art is a way to understand and change reality just as much as quantifiable information is”. Salami noted that people rarely forget ideas that stimulate the senses, expressed in a poetic, musical or other way through arts. For example, poetry can explain emotions in a manner that no conventional scientific method can. Consequently, it is equally essential what information makes one feel than what it makes one know. (Salami, 2020: 13–14, 22.) Leavy (2017: 191) stated that making art is always individualistic, which makes arts-based research “open to unexpected – to surprises, new insights, and bends in the road”. Leavy stated that the arts-based paradigm can be very versatile in different contexts, depending on the artistic genre or practices, the theoretical framework, and other methodological starting points. (Leavy 2017: 191.) Versatility might be the best word to describe this research combining viewpoints from qualitative health research and arts-based autoethnography.

Bunde-Birouste et al. (2019: 513) defined that autoethnography is a data collection and analysis method, that produces understanding and values of the social contexts under study involving the researcher along all the way. Autoethnographer is expected to fully engage with the research project: to take advantage of the experiences during the data collection and analysis process, combining previously lived experiences as an entity and finally recounting emotions and experiences into a text. Accordingly, it is important to describe what the subject or phenomenon under study means to the researcher, what kind of experiences, expertise, or world views does the researcher have of the topic and how has the phenomena influenced. It all makes the research more diverse. (Bunde-Birouste et al. 2019: 515–516.) Throughout writing the thesis report, I addressed myself to be as open of my background and ideas, as possible. As I reflected thoughts and feelings of aquarelles and poetry, I used my notes I had written down during the process to reflect the autoethnographic data credibly in the discussion chapter.

The autoethnographic inquiry of this master’s thesis can be described as an analytic autoethnography. According to Bunde-Birouste et al. (2019: 513) analytical autoethnography includes “self-observation” and “reflexive

investigation”. While analytic autoethnography enables researcher’s personal engagement, it is possible to increase the theoretical understanding by making deeper interpretations of the available data. Analytic autoethnography analysis tend to build up of manifold layers while inquiring the data with the experiences. Analytic autoethnography was stated to suit very well for the purposes of community-based studies, for instance about health promotion or social work. (Bunde-Birouste et al. 2019: 510, 518–519.)

3.2 Data construction

Literature review was conducted extensively, and the data was analysed inductively with a qualitative approach. Literature review was carried out to summarise, analyse, and synthesise relevant research literature of how climate change mitigation implementations intertwine with public health in high-income countries (see Xiao & Watson 2017: 93). Along the process, starting from the planning until analysing the literature review data, I expressed thoughts through poems and aquarelles, and reflected deeper aspects of the research topic. The artwork is included in the chapter of the findings and the artistic process and ideas were reflected in the discussion part.

During the process, the approved instructions for Responsible Conduct of Research presented by The Finnish Advisory Board on Research Integrity (TENK) was followed. TENK-guidelines emphasized “integrity, meticulousness, and accuracy” in every stage of conducting the research and publishing it (TENK 2012: 30). The methods applied were justified and ethically sustainable and scientific criteria was followed, and accordingly this study was planned, reported, and cited appropriately. (See TENK 2012: 30.)

In the “Guidance on Conducting a Systematic Literature Review” of Xiao and Watson (2017: 93, 108), it was emphasized that the literature review process must be reported point by point to be reliable and repeatable, and in all phases, everything needs to be validated. In this master’s thesis to ensure eligibility,

criteria for inclusion and exclusion were carefully defined, explained, and justified in detail. In addition, the databases, search strategies and data collection process were specified to ensure repeatability, and findings and quality evaluation were elaborated. According to Xiao and Watson (2017: 108), it is very essential that the literature review process is transparent, and the data supports the conclusions.

Literature review is three-phased with planning, conducting, and reporting the review (see Xiao & Watson 2017). In the phases Preferred Reporting Items for Systematic Reviews and Meta-Analyses PRISMA 2020 checklist (Prisma-statement.org) was utilised. In the first phase, I pointed out the need for a literature review by familiarizing myself to the recent research, built a theoretical framework for the study, framed research questions, and outlined the process protocol (see Xiao & Watson 2017; Axelin et al. 2007). For the process protocol I defined inclusion and exclusion criteria, chose the proper databases and the keywords – these definitions are listed in Table 1 below. Kylmä and Juvakka (2012: 46) stated that it is important constantly justify the research topic and define framing of a research question during the literature review process. Research question was revised few times, and eventually it reformed from preparatory research question “What are the health co-benefits of climate change mitigation measures” to “How climate change mitigation implementations intertwine with public health in high-income countries?”

I made several test searches and according to their results, I selected the most useful key words. During the preliminary searches, I read various articles to find the common concepts associated with health promotive aspects of climate change mitigation. I made multiple searches varying the keywords to discover which concepts are the most consistent with the desired search results. The preliminary test searches included concepts, such as “planetary health or health promotion” and “climate impact”; “sustainable lifestyle” and “public health”; “climate change mitigation” and “health co-benefits”; and “human and planetary health”. The term “planetary health” appeared a lot in recent health research concerning climate issues. I also tried alternative expressions for “climate change

mitigation", but the results ended up being more irrelevant, and consequently these words were left out. As a result, I decided to include the keywords "climate change mitig*" with "health promot* or planetary health" to the actual search.

While carrying out the test searches, I saved some of the most relevant papers to compare afterwards if the actual search results included the most valid studies. With these keywords, still some of the relevant papers that I found previously were missing, so I added the expression "health co-benefit/cobenefit" to the keywords, and that way expanded the search results. According to Redvers (2021: 3), use of the word "co-benefit" is increasing in the discussion of health aspects of climate change mitigation. I widened the keywords with alternative expressions "confluences", "interconnections", and "externalities", but I left them out, because there were more extraneous results than with just words health co-benefit/cobenefit.

I used Boolean phrases in the searches, and they are presented in Table 1 below. Only peer-reviewed research and review articles written in English from January 2012 to June 2022, with full text available, were included to limit the results for the most valid ones. The study design of eligible articles was not limited in the inclusion criteria and therefore also secondary research articles, such as literature reviews, were included.

Inclusion and exclusion criteria	• Peer-reviewed research or review articles • Full text available • Articles published in 1/2012–6/2022 • Articles in English • Answers the research question: "How climate change mitigation implementations intertwine with public health in high-income countries?" • Both climate change mitigation measures and their direct health co-benefits are elaborated • Research articles with affiliations that have conflicts of interests are excluded
Databases	• CINAHL Complete (Ebsco) • PubMed • MEDLINE (Ovid) • ProQuest Central • Science Direct
Key words/ Boolean phrases	All fields: Climate change mitigat* AND All fields: Health AND (Promot* OR planetary OR co-benefit OR cobenefit)

Table 1 Literature review search protocol

Then, in the next phase of conducting the literature review, I selected the most purposeful studies, gathered, analysed, and synthesised the reviewed data through subgroups and key themes. The articles were chosen according to the inclusion and exclusion criteria from well-known databases, CINAHL Complete (Ebsco), PubMed, ProQuest Central, and Science Direct (Elsevier).

For CINAHL Complete (Ebsco) database search on 5th July 2022, I entered keywords, delimited the search to peer-reviewed articles in English, with full text

available from January 2012 to June 2022, and received 276 results. ProQuest Central advanced database search was made on 14th September 2022 with similar limitations and key words as previous CINAHL database search, resulting 56 774 articles. Pubmed search was done on 8th August 2022 with same key words and similar limitations except there was no option to choose peer-reviewed articles. 370 results were scored. Science Direct database (Elsevier) was searched on 9th September 2022 and it had more limited opportunities to define search. I used predetermined Boolean phrase, but asterisk for truncation was not permitted to use. For that reason, I broadened key words in Boolean phrase as following: [climate change mitigation] AND [health AND (promotive OR promotion OR promote OR planetary OR co-benefit OR cobenefit)] and limited the results to research and review articles from 2012 to 2022. I received 37 875 results. I ignored the studies that were released starting from July 2022. Overall, some of the results were found from several databases and consequently in these numbers there are duplicates. I also carried out the search in the Cochrane database on 5th July 2022, but none of the studies found was selected according to the inclusion and exclusion criteria.

First, headings, and then abstracts of the possibly noteworthy articles were skimmed through and included if they considered the phenomenon under study and met the inclusion criteria. In total, 1071 articles' titles and abstracts were screened from which 213 full texts were skimmed through and 89 of them were selected as suitable for the literature review. Twelve of these articles appeared twice. Thereafter, the chosen articles were read carefully and twenty of the most eligible studies of good quality that accurately answered the research question, were chosen to the data construction. However, one eligible research article was afterwards left out from these chosen 20 articles, because it came out that the article did not specify enough the mitigation measures, and therefore findings were difficult to categorize with other data. Elaborated flow diagram of the literature search and selection is illustrated below in Table 2.

Identification ⬇	**Cochrane 1/2012 – 6/2022**	**CINAHL 1/2012 – 6/2022**	**PubMed 1/2012 – 6/2022**	**Science Direct (Elsevier) 2012–2022**	**ProQuest Central 1/2012 – 6/2022**
Search result	Search result 18 citations	Search result 276 citations	Search result 370 citations	Search result 37 875 citations	Search result 56 774 citations
Screening ⬇	18 headings/ abstracts were read	276 headings/ abstracts were read	370 headings/ abstracts were read	225 headings/ abstracts were read	200 headings/ abstracts were read
Inclusion and exclusion criteria	Papers did not address climate change mitigation strategies or health aspects. Some considered adaptation.	Excluded papers did not address climate change mitigation, or did not consider health aspects	Excluded papers did not address climate change mitigation or did not consider health aspects.	Excluded papers did not address climate change mitigation or did not consider health aspects.	Excluded papers did not address climate change mitigation or did not consider health aspects.
Eligibility ⬇	None of the papers' full texts was screened	57 of the papers' full texts were screened	96 of the papers' full texts were screened	37 of the papers' full texts were screened	23 of the papers' full texts were screened
Inclusion and exclusion criteria	-	Excluded papers were about adapting strategies or health impacts of climate change, or otherwise did not answer research question	Excluded papers discussed adaptation measures, health impacts of climate change, resilience, or explored middle- and low-income countries. Also, some articles had already chosen from other database.	Excluded papers discussed adaptation measures or explored middle- and low-income countries, or otherwise did not answer research question. Also, some articles had already chosen from other database.	Excluded papers discussed adaptation measures or otherwise did not answer research question.

Inclusion ⬇	-	20 studies were regarded as eligible	50 studies were regarded as eligible	14 studies were regarded as eligible	8 studies were regarded as eligible
Final selection	-	4 papers were selected to the literature review due to their variability	15 papers (2 duplicates) were selected to the literature review due to their variability. Two of these were also selected from the database of Cinahl and ScienceDirect	1 paper were selected to the literature review due to their variability	1 paper were selected to the literature review due to their variability

Table 2 Flow diagram of literature search and selection

Most of the excluded articles mentioned health in general level or summarised only health impacts of climate change and did not involve health perspectives of climate change mitigation actions. There were studies with only adaptation measures and their health benefits, and these were excluded from this literature review. Articles discussing health effects of both mitigative and adaptive measures, were included, though. On the grounds of the theory framework that brough up the problems of industry's lobbying, papers that had clearly affiliations with associations of industry were left out this time. Also, studies with a principle viewpoint of low- and middle-income countries were left out due to the research question. In addition, all non-peer-reviewed articles, and other than research articles e.g., interviews and viewpoint articles were excluded. There were a few studies that were inaccessible because of paywall, and some of them were inaccessible through other databases and search engines, too.

The chosen articles (19) concerned measures that mitigate climate change and their contribution to health promotion with the most versatile findings. I chose variety of research articles that addressed climate change mitigation in different sectors and their health co-benefits or trade-offs. Most of the chosen peer-reviewed articles were reviews (13), and there were also few cohort or other observational studies (3), modelling studies (2) and mixed methods study (1) with both quantitative and qualitative approaches. The Critical Appraisal Skills

Programme CASP tools of review and cohort study (Casp-uk.net) was used to evaluate the quality and correctness of the selected research. The chosen articles followed certain patterns and requirements of scientific research article. Yet, some of the articles focused more on the findings and conclusions and the process or trustworthiness were not discussed much. Some selected review publications were seemingly narrative reviews which did not specify the review process or assess the quality and reliability of the chosen articles. Regardless, they were included in the literature review because in this study I emphasised versatility over extensive and thorough research publications, to give an impression of what has been studied. Some examples of selected articles, their objectives, data collection, and key results are presented in the appendix "Summary of the selected articles for the literature review".

According to Kylmä and Juvakka (2012: 113), the aim of the analysis is to summarise the data of the studied phenomenon in a condensed form. There were both quantitative and qualitative research articles involved in the data set and because the analysis of the literature review was qualitative, quantitative material was analysed as qualitative data.

Extraction and analysis were done inductively, which meant that after receiving a good overview of the data, the dataset was first disjoined into parts and substantially similar parts were combined to construct knowledge. Process advanced from keywords to subcategories to categories to overarching themes. (see Kylmä & Juvakka 2012: 113, 116; Xiao & Watson 2017: 107.) First, sentences, phrases, or short paragraphs of climate change mitigative actions and/or their health co-benefits or trade-offs were attached to a text file from the research articles. I collected and categorised data of present (detrimental) lifestyles or processes' climate impacts, and their health contributions, to lay the groundwork and justify selected measures. I already had an impression of some general categories (e.g., plant-based diet, transportation, green and blue infrastructure, and energy shift) after reading articles through, thus direct citations were copied and pasted under these preparatory categories. Then the key words and subcategories started to form under preliminary categories which later turned

into the overarching themes that formed throughout the literature review data synthesis. Next, the text was summarised into a coherent whole that answered the research question and the purpose of this master's thesis. (see Kylmä & Juvakka 2012: 113, 116–117.)

While going through the literature review data, I thought that it was decisive to define the status quo, specify the contemporary life habits and the actions that warm the climate and harm human health according to the findings. I thought that these findings gave a thorough introduction and verbalised the entangled climate and health issues of the modern world, therefore answering to the research question: "How climate change implementations intertwine with public health in high-income countries?". If this data was excluded, I probably would not have had adequate findings. For example, the data from global economic system would have been so limited and disconnected that all the data should have either excluded or linked to the other findings.

Below, Table 3 demonstrates inductive generalisations of health beneficial mitigation measures in keywords, categories, and themes. The themes, or in another words sectors in which mitigation measures should be implemented, ended up being food industry and nutrition, transportation, green and blue infrastructure, energy reproduction and use, and global economic system. More detailed example of synthesis with climate impacts, health contributions, mitigation measures and their health co-benefits and trade-offs are presented in the Appendix "The synthesis process exemplification".

Keywords of mitigation strategies	Categories	Themes
Increased intake of legumes, nuts, seeds.. etc. Decreased meat and dairy consumption. Community gardening, agroforestry. Restrictions in marketing and infrastructural changes. Health and policy interventions. Changes in behaviour.	Plant-predominant diet, changes in agriculture and food industry	Food industry and nutrition
Electric vehicles, cycling and walking, public transport. Policy interventions: incentives or costs and alterations in infrastructure.	Electrification of vehicles, active travel, public transport	Transportation
Urban parks and gardens, street trees, greenways, green facades and roofs, forests, wetlands, and waterways. Conservation of natural areas, supporting high biodiversity.	Green and blue urban spaces, natural elements, green connectivity	Green and blue infrastructure

Clean and renewable energy, modern technology, energy efficiency, decreasing the energy demand and use	Energy shift, residential alterations	Energy reproduction and use
De-emphasising economic growth and diminishing consumerism. Labour-intensive work, reduced working hours, and employment in green economy. Taxing, incentives, personal emissions trading.	Labour market reforms, green economy, policy reforms	Global economic system

Table 3 Keywords, categories, and themes of mitigation measures that were found to co-benefit public health

In the last phase of the literature review, the review's findings are reported with autoethnographic data: the aquarelles, and poems. The artwork did not necessarily illustrate the findings directly but rather offered some new sights to the topic.

3.3 Arts in the process

Arts can be described as a creative process of artmaking or an outcome by artistic effort, and different forms of arts all contain a feature of expression. Yet, the most important aspect in arts is the ability to awaken emotions. (Stein & Faigin 2015: 70–71.) Rollins (2021: 54) stated that it is possible to create empathy and

compassion through arts. At best, artist might have the sensitivity to understand different feelings and experiences and to express these ideas “through creative emotional expression” so that the artwork wakens curiosity by inviting the viewer to explore the topic and learn (Rollins 2021: 54). Arts might enhance target group’s capacity to understand different aspects, cultures, and causes. Arts can be a tool to inspire and to see new possibilities more creatively. (Rollins 2021: 53–54, 63.)

Rollins (2021: 63) noted that through arts it is possible to inspire target group “cognitively, behavio[u]rally, and/or emotionally”. An example of climate and biodiversity work done with art, is poetry made by forest protection-oriented environmentalist Ida Korhonen. In the Finnish documentary series of Skogens röst – Metsän ääni [Forest’s Voice] released in 2022, Korhonen recited very emotional and evocative self-written poetry, including the information of how Finnish forests’ biodiversity is severely endangered. That poetry touched me profoundly, partly because I have engaged to write climate change-related poetry, but mainly because I did not realise how enormous issue Finnish forestry is, also considering climate change – and I did understand the gravity of the situation through Korhonen’s experiences written in poems. In fact, all the documentary series in question used various artistic and creative ways to make the document more understandable, thought-provoking, and engaging.

Another example of combining knowledge with arts is a project Silentopia which has involved both performing artists and environmental scientists to deal with environmental emotions and find solutions for the enormous climate and environmental crises. Silentopia has started a scientific blog which includes information and poetry, but also produced a dance and music performance of emotions and ritualistic routes towards action and change. (www.silentopia.fi.) These are just a couple of examples that reinforced my idea that arts can make people know and feel simultaneously.

Arts can be intended to evoke hope (Rollins 2021: 63). Hope is an important component of coping while experiencing difficult circumstances (Kelsey 2020: 33;

Rollins 2021: 63) and it is a crucial feature to engage people to participate in collective action for climate and decrease denial towards status quo. Moreover, there has been a misunderstanding that hope only creates misconceptions and rejection, and fear instead should be raised – despite the substantiated harmful impacts of “creating cultures of fear”. (Kelsey 2020: 33.) Tannock (2021) agreed that fear towards the climate crisis can prevent from acting, but also climate hope can have a similar effect if it is based on denial, delusions, or unrealistic optimism. Kelsey (2022: 33) confirmed that hope should not mean walking away from a problem or feeling cheerful instead of disheartened. According to Tannock (2021: 108–110), climate change evokes strong emotions and people experience them differently – and respond to them individually. Consequently, what is a paralysing element for some is a driving force for others, and that is the reason why evoking certain “preferred” emotions should not be the main goal when promoting pro-environmental behaviour. Nevertheless, consideration and recognition of feelings is needed as part of the shift. All emotions that arise from the overwhelming crisis are reasonable and should not be feared. Anxiety about climate change is a normal reaction and there is no need to try to silence it, but to listen what the feeling has to tell, how does it want you to act. The solution for the profound emotions lies within solving the climate change itself. (Tannock 2021: 97–99.)

Yet, arts in scientific context could be problematic for various reasons. For instance, if arts-based research has ideology to make people feel something can the feeling “be adequately captured by scientific description” (Stein & Faigin 2015: 71)? Is the science, or words even, capable of explaining the experiences that arts evoke? Also, does the conceptualised experience of arts in the analysis serve the purpose of certain inquiry? Another problem could be that arts cannot be seen just an instrument or be merited only according to their ability to contribute to a social agenda such as health promotion, but arts own values need to be seen, as well. (Stein & Faigin 2015: 71.)

3.4 Research ethics

Leavy (2017: 25, 31) stated that the whole research process from designing to implementing and disseminating the study, is affected by individual's sense of morality and values based on beliefs, stances, and ideas. For that reason, certain guidelines, and tools, such as TENK, PRISMA 2020 and CASP checklists were important to follow.

According to Leavy (2017: 25), certain major historical events have modified the cultural values and ethical understanding in research community. For example, especially social justice movements in the decades of 1960 and 1970 that raised racial concerns, women's position in society, rights for sexual minorities, and working classes' economic situation, have influenced the ethical values of social research, and made researchers to reconsider why, who, and what to study. (Leavy 2017: 25, 27.) Lately, there have been climate justice movements that emphasise that there is no sustainability without justice. Climate justice means that human rights (of the most vulnerable ones, particularly) are taken into consideration in climate action and in development, the responsible for the climate change are acknowledged, different forms of injustice are tackled, and wider systemic transformation is pursued (UNICEF 2022: 6). I have followed some climate justice movements via social media and those movements have made me seen the significance of social equity in climate change debate and in public health. Therefore, I assessed the literature review data, and this master's thesis report more critically.

In the manifesto by Horton et al. (2014: 847), it was emphasised that in public health field, it is important to create collective, equitable actions that protect and promote health and well-being, prevent and defeat disability and diseases, and enhance resilience. Moreover, Fletcher et al. (2021: 1–2) underlined that it is essential to attain population's health promotion and further health equity by taking into consideration structural racism and by undertaking appropriate measures to tackle long-term health inequities. Fletcher et al. (2021: 2) stated that public health research with antiracist praxis should respect, bring forward,

integrate, and prioritise marginalised populations and their perspectives in every phase of the study process to tackle systemic injustice. It requires “sensitivity to and awareness of the existing frames, and an understanding of how these frames develop and become engrained in society” (Fletcher et al. 2021: 2).

The planetary health was described as an attitude or philosophy, that prioritises the sustainability and social justice over “creation of unjust societies” that harm ecosystems and threaten humans’ existence (Horton et al. 2014: 847). Also, fundamental idea of planetary health is to preserve the diverse globe on which people coexist and depend on (Horton et al. 2014: 847). Thomas et al. (2014: 275) highlighted that to solve the climate crisis it is not only about promoting strategies to mitigate and adapt to global warming, but the impacts of these measures to different social groups should be understood, as well.

Despite this study do not explore the viewpoints of the most vulnerable groups or highlight who are the responsible for the global warming, nor emphasise climate justice, the idea behind is that the changes need to be done for the sake of all people and the planet. As it was noted in the Lancet (2021: 71) article, the most disadvantaged groups of society, who have had the least part in causing climate change in general, will likely suffer the consequences the most. It is evident that majority of people in wealthy countries have enabled the global warming and need to be committed in the required implementations: by curbing the greenhouse gas emissions in local scale, the effects can be felt globally (Laukkonen et al. 2009: 289). It seems that affluent people with emissions-intensive lifestyle need more reasons for making the required transformations. My intention is to encourage people to think differently: that to act for the climate, it is not desisting from the modern conveniences and getting back to the medieval times – it is about making some effective changes for the sake of the planet and gaining something more: safer and healthier life supporting well-being. By bringing forward how climate change mitigation implementations intertwine with public health in high-income countries and illustrating some viewpoints with arts, I have wanted to provide more reasons to act for the planet and make people to see better the overall benefits of the mitigative actions now and in the future.

I intentionally left no space to industrial lobbying in this study which seemed to have had enough room at least in policy and marketing, already. Therefore, I excluded the research articles that had clearly affiliations with associations of industry, and therefore provided more space to unbribable science. Also, because of the standpoint of public health and accordingly determined research question, the constructed knowledge emphasised health over economy that has been central in justification of decision-making. It is good to remind that the reported findings do not take thoroughly into account the possibilities of making change from the economy's vantage point, although they are discussed a little. Because of my background in public health promotion, I might have misunderstood some concepts, and I am unaware of paradigms and conformity biases of different scientific fields that might have appeared in the data.

Because this master's thesis is targeted to people in high-income countries, it would be important to disseminate and present the findings as broadly as possible. When considering availability, it could be both advantage and disadvantage that the report is written in English. The language can be a bit difficult to read for those who are not familiar with the English vocabulary of health and environmental sciences. Yet, because the report is written in English it could reach a larger audience, if only it was known and discoverable. One research article would be published in Finnish in the trade magazine of The Finnish Association of Public Health Nurse which hopefully would evoke some thoughts and discussion among public health nurses of how climate change mitigation can be included in the health promotion. I will also survey further possibilities of publishing another research article to share the research findings after finishing the thesis report. Furthermore, if the findings can be additionally presented exquisitely and accessibly with poems and aquarelles in rather well-known platform, for example in social media, the knowledge produced in this master's thesis will possibly reach wider audiences. When disseminating the findings, it is important to provide only truthful knowledge and keep in mind the positive forward-looking health promotive prospects to prevent evoking very strong negative emotions, such as despair or apathy that might even hinder from making the changes.

4 Findings

Human-caused greenhouse gas emissions have emerged mainly from food industry, transport, energy reproduction and use. Consequently, reforms were suggested to be done especially in these sectors and in their economic processes, but also in forestry and waste treatment. (Gao et al 2018: 685–686.)

Figure 3 The web of life

In this chapter, I synthesised how climate change mitigation implementations intertwine with public health in high-income countries. I described jointly with aquarelles and poems what are the health aspects of climate change mitigation actions and how they interlink. First, I reported the findings concerning transformations in food industry and nutrition, and then different transportation reforms including electrification of vehicles, active travel, and public transport. Next, I elaborated measures regarding green and blue infrastructure, then shifts

in energy reproduction and use, and finally, some suggestions for global economic system.

4.1 Food industry and nutrition

Based on the literature review, there was some variation of how much agricultural sector was estimated to generate greenhouse gases of the entire emissions caused by humans, but estimations alternated between 11–35% (see Barrett 2022: 2–3; Gao et al 2018: 688; Lowe 2014: 20; Pathak & McKinney 2021: 544; Vineis et al. 2021: 766). Gao et al. (2018: 688) highlighted that the emissions of agriculture have been anticipated to grow 50% by 2030. Meat production was reported to generate majority of the greenhouse gas emissions of agriculture (Barrett 2022: 2–3; González et al 2020: 132; Laine et al 2021: 790; Pathak & & McKinney 2021: 544; Vineis et al. 2021: 765–766), subsequently the next greatest emitter being dairy production (González et al 2020: 132; Laine et al 2021: 790; Pathak & McKinney 2021: 544). The lowest greenhouse gas emissions were found to come from vegan and vegetarian foods (González et al 2020: 132; Pathak & McKinney 2021: 544).

Several papers suggested that by altering food production and consumption, especially from dominant animal sources towards more prevalent plant-based diets, it is possible to ameliorate the climate impact and gain human health advantages by reducing the incidence of chronic diseases, such as obesity and diabetes related disorders (Barrett 2022: 5; Gao et al 2018: 689; Pathak & McKinney 2021: 544).

4.1.1 Agriculture and farming

According to the literature review, livestock production, including meat and dairy production, has comprised 75–80 % of the overall greenhouse gas emissions

from agriculture sector (Gao et al 2018: 688; Lowe 2014: 20; Vineis et al. 2021: 766). It was found that emissions from the livestock production have consisted of nitrous oxide from fertilisers used in pasture and cultivated land, energy use while raising animal feed and farming animals, enteric methane formed in the ruminant's digestive processes, carbon dioxide emissions from land use changes and deforestation, and transportation (Gao et al 2018: 688). Ruminant livestock has caused approximately half of all agriculture's emissions in the global level, ruminant's enteric methane being the largest source (Lonnie & Johnstone 2020: 282), which has caused 44% of all emissions in the agricultural sector (Vineis et al. 2021: 766). Methane was described as one of the so-called short-lived climate pollutants with about 8–10 years atmospheric residence time, and as an ozone precursor affecting ozone formation, which has harmful consequences both to human health and crop yields. Therefore, by decreasing methane emission levels, local near-term benefits can be achieved. (Gao et al 2018: 691.)

Animal products have had manifold consequences on the environment compared to plant-based foods (Barrett 2022: 3; Küçükgöz & Trzaskowska 2022: 1, 5; Lonnie & Johnstone 2020: 283; Vineis et al. 2021: 765–766). For instance, livestock production has required significant amounts of water, expanded agricultural land, and intensified agricultural practices which has caused deforestation, land degradation and biodiversity loss (Barrett 2022: 3; Küçükgöz & Trzaskowska 2022: 1, 5; Vineis et al. 2021: 765–766). Gao et al (2018: 688–689) reported that some of these "agriculturally-induced changes", especially land use changes and deforestation, has amplified the greenhouse gas emissions. Lonnie and Johnston (2020: 283) discovered scientific consensus that principally even the lowest-impact animal-based products exceed the environmental impact of plant alternatives.

In addition to the adverse health impacts of current unhealthy diet, Vineis et al. (2021: 766) emphasized that agricultural industry has provoked health impacts that are not entirely known. At least, agricultural practices have caused occupational exposure to chemicals, heavy metals, and pesticides (Vineis et al. 2021: 766). Ammonia emissions from agriculture has resulted substantially

secondary inorganic particulate matter which causes health risks, as well (Williams et al. 2018: 204). It was indicated that there is growing evidence of agricultural drivers' associations with increased risk of infectious diseases, including different zoonoses and parasites, some of which are possibly carcinogenic. Gao et al. (2018: 689) advocated additive measures to make food production more sustainable, for example by improving optimal land use, amplifying carbon capture and sequestration, and intensifying efficiency of practices. Accordingly, Bikomeye et al. (2021: 13) recommended agroforestry, diversified farming and water saving irrigation to decrease greenhouse gas emissions and environmental impact. Yet, none of the health co-benefits for these measures were brought forward.

Figure 4 Goodbye monoculture

Nevertheless, Prior et al. (2018: 3) summed up that agricultural and social shift towards plant-based diet might improve food security and enhance social

stability. Local food production and allotment gardening might decrease greenhouse gas emissions because of reduced need for food transportation, subsequent sale, and packaging. Especially, allotment gardening might increase the intake of fruits and vegetables, which can reduce obesity rates, provided that the consumption of produced fruits and vegetables decrease the intake of energy-dense food. It was remarked that allotments in the most deprived areas might enhance access to healthy nourishment and decrease obesity inequities. Regional farming and gardening have also engaged people towards sustainable lifestyles and learning of local ecosystems (Demuzere et al. 2014: 111). Furthermore, agricultural land near urban areas prioritised only for agricultural use, is likely to halt suburban sprawl. (Lowe 2014: 22.) Accordingly, in the review of Gao et al. (2018: 689), it was suggested to favour locally produced food to decrease emissions from transportation, yet all locally produced seasonal or sustainable food choices have not proved to be consistently mitigative. Barrett (2022: 4–5) noted that, for example, locally produced vegetables in northern climate are not environmental-friendly during the winter season.

4.1.2 Plant-based diets

Animal products and ultra-processed foods were described to be the most “emissions-intensive” (Lowe 2014: 20) and diets with poorer nutritional quality were associated with higher climate impact (Vineis et al. 2021: 766). Respectively, the most emitting foods were reported to be beef and cheese, followed by pork, and then chicken (Pathak & McKinney 2021: 544). In the Spanish EPIC cohort study, it was found that “red and processed meat consumption” has covered over 41% of greenhouse gas emissions from diets, while plant foods including vegetables, legumes, grains, and fruits has covered only 11% of the dietary emissions. Approximately 19% of the emissions were described to have derived from dairy products and around 9% from fish and molluscs. (González et al 2020: 134.) In the review of Barrett (2022: 3) it was stated that the meat products account for twice as much of the greenhouse gas

emissions than the whole amount of plant foods combined – although meats cover a fraction of the nutrition. According to the research of González et al. (2020: 134), high meat consumers with over 140g daily intake of red meat had 4,7 times more greenhouse gas emissions than low meat eaters less than 140g daily intake of red meat. Present semi-vegetarian and vegetarian diets were found to have emitted 22–29% less greenhouse gas emissions and with the help of a plant-based dietary change, the dietary greenhouse gas emissions globally could be reduced 29–70% by 2050, appeared in the review of Barrett (2022: 2).

Prevailing dietary patterns were described to contain high amounts of animal protein, saturated and trans fatty acids, added salt, and sugar (Barrett 2022: 2; Gao et al 2018: 689; González et al 2020: 133; Laine et al 2021: 793; Lowe 2014: 19–20; Pathak & McKinney 2021: 543; Vineis et al. 2021: 766–767), and lower levels of micronutrients and fibre (Vineis et al. 2021: 766–767), which was discovered to cause increased morbidity in obesity, type 2 diabetes, cardiovascular diseases (Barrett 2022: 2; Gao et al 2018: 689; González et al 2020: 133; Laine et al 2021: 793; Lowe 2014: 19–20; Pathak & McKinney 2021: 543–454), certain cancers (Barrett 2022: 2; Gao et al 2018: 689; González et al 2020: 133; Laine et al 2021: 793; Pathak & McKinney 2021: 543–454), and dyslipidaemia (Barrett 2022: 2). Meat eating at least three times a week was associated with increased diabetes, and cardiovascular disease mortality and total mortality rates (Barrett 2022: 2). Also, highly processed food was linked with increased mortality (Pathak & McKinney 2021: 543), especially concerning processed meat (Barrett 2022: 2). Increased ultra-processed food consumption was found to contribute to global epidemy of obesity (Pathak & McKinney 2021: 543; Vineis et al. 2021: 767), cardiometabolic diseases (Vineis et al. 2021: 767), and micronutrient deficiency, such as iodine, vitamin A, zinc, and iron, resulting immune system and cognitive effects, for example (Pathak & McKinney 2021: 543). Ultra-processed foods might increase cancer risk, as well, but evidence was reported to be limited (Vineis et al. 2021: 767). Dairy products with high contents of fats and cholesterol, but also allergens and lactose, might cause health problems (Küçükgöz & Trzaskowska 2022: 7).

High levels of dietary greenhouse gas emissions were associated with increased overall mortality (Barrett 2022: 2; Gonzáles et al. 2020: 132–134; Laine et al 2021: 793). An EPIC-Spain cohort research indicated that there was nearly 10% higher mortality among people having the highest dietary emissions than the ones with lowest (Gonzáles et al. 2020: 132–134). There was significant association between dietary greenhouse gas emissions and type 2 diabetes and coronary heart disease risk (González et al 2020: 133–134; Laine et al 2021: 790–791, 793). Moreover, there were greater rates for cancer mortality linked with higher dietary emissions (Barrett 2022: 2; Laine et al 2021: 791). Incidence of “cancers of the bladder, renal pelvis, ureter and other urinary organs, breast, colorectum, oesophagus, kidney, larynx, lung, skin melanoma, stomach, and thyroid” associated with dietary emissions (Laine et al 2021: 791).

It was emphasised that there is an evident need for diets that consider both environmental and human health aspects (Laine et al 2021: 793), and one easy solution could be revising national dietary guidelines according to recent evidence (Lonnie & Johnstone 2020: 284). According to the findings, sustainable diet could diminish the environmental impact, but also enhance all elements of health and well-being (Lonnie & Johnstone 2020: 282; Vineis et al. 2021: 767), at the same time being safe and equitable, acceptable, and accessible for all (Lonnie & Johnstone 2020: 282). Sustainable diet, that is, plant-based diet, was described to comprise versatile selection of minimally or unprocessed cereals, legumes, vegetables, fruits, seeds and nuts and significantly smaller proportions of animal-based products, especially limiting the amount of ruminant meat (Laine et al 2021: 792; Lonnie & Johnston 2020: 282; Pathak & McKinney 2021: 544).

There were found several compatible dietary patterns decreasing dietary emissions and promoting health, such as UK Eatwell Guide, Reset the Table, Menus of Change, Mediterranean Diet, and EAT-Lancet recommendations of Planetary Health Diet (see González et al. 2020: 131, 134; Lonnie & Johnstone 2020: 282, 284–285; Pathak & McKinney 2021: 544; Vineis et al. 2021: 765–766). For example, EAT-Lancet recommendation included consuming pulses (peas, different beans, and lentils) 75 grams daily and limiting weekly consumption of

meat and eggs to 392 grams, and average daily dairy product consumption to 250 grams (Lonnie & Johnstone 2020: 282). Eatwell Guide had suggested that protein could be obtained also from nuts, tofu, mycoprotein or bean curd (Lonnie & Johnstone 2020: 285). The concept of "flexitarianism" (combination of the words flexible and vegetarian) was defined to refer to a person who follows predominantly vegetarian diet but occasionally might eat fish or meat enabling flexibility and it mirrors the growing amount of people who are reducing meat for the environmental reasons. Instead, vegetarian, and vegan diet are counted among plant-based diets, but they are not synonymous. Vegetarians avoid all meat consumption including fish and vegans avoid all animal products, also dairy products, and eggs, for example. (Lonnie & Johnstone 2020: 282, 285.) In the review of Lonnie and Johnston (2020: 283–284), one dietary approach appeared on the data indicated that “2/3 vegan diet” including one animal-based meal a day (otherwise vegan), seemed to be less emissions-intensive than vegetarian diet with dairy and eggs. Thus, there might be multiple ways to reduce dietary greenhouse gas emissions, still emphasis on reducing animal-based products from contemporary levels. Connective factors of these different diet patterns are their associations to declining greenhouse gas emissions and reducing the incidence of non-communicable diseases (Pathak & McKinney 2021: 544).

There was convincing evidence that plant predominant diet decreases overall morbidity and mortality (see Barrett 2022: 2; Lonnie & Johnstone 2020: 284; Pathak & McKinney 2021: 543–544; Vineis et al. 2021: 765–766). It was estimated that the shift towards plant-based diet might decrease mortality rates globally 6–24% (Barrett 2022: 2; Laine et al 2021: 792; Vineis et al. 2021: 765–766). According to Pathak and McKinney (2021: 544), transitioning towards plant-based diet could prevent up to 11 million deaths annually in the global scale by decreasing chronic diseases, and

Figure 5 Shift towards sustainability?

“flexitarian diet” about 5.9 million deaths. Yet, in the review of Barrett (2022: 2), it was found that one previous study had suggested that sustainable and healthy eating “was associated with lower mortality for women, but not for men” but Barrett also stated that the amplitude and consistency of published studies support the perception that plant-based diets have significant health benefits for all.

Vegetarian diets were confirmed to lower the incidence and mortality of cardiovascular diseases (Barrett 2022: 2; Lonnie & Johnstone 2020: 284), and cancers (Barrett 2022: 2; González et al 2020: 133; Laine et al 2021: 792), including colorectal cancer (Gao et al 2018: 689), and they were linked with reduced obesity rates and associated diseases (Barrett 2022: 2; Lonnie & Johnstone 2020: 284; Lowe 2014: 22), and the prevention of type 2 diabetes (Lonnie & Johnstone 2020: 284). Plant-based diets were associated with lower body mass index, reduced LDL cholesterol levels, lower blood pressure, and reduced blood sugar levels (e.g., Barrett 2022: 2). Plant-based diet including decent amount of fruits, vegetables, pulses, nuts, whole grains, and seeds, was found to reduce the risk of non-communicable diseases and depression, but also treat them (Pathak & McKinney 2021: 543), mainly because plant-based diets contain fibre, unsaturated fats, micronutrients, antioxidants, and different phenolic compounds (Lonnie & Johnstone 2020: 284, 287–288). Thus, the versatility of the diet seemed to decrease overall mortality and colorectal cancer risk, as well (Vineis et al. 2021: 767).

The most significant reductions in the mortality risk were recognised when plant-based proteins displaced red meat and eggs (Lonnie & Johnstone 2020: 284). González et al (2020: 132, 134) noted that it is essential to decrease meat consumption and replace it with plant foods, especially among the ones consuming high amounts of meat. Lonnie & Johnstone (2020: 284) found that specifically processed and red meat consumption should be limited to a maximum of 350–500 g of cooked weight per week due to the increased cancer risk. Lowe suggested that substantial health co-benefits might occur even by reducing daily meat consumption from 250 g to 90 g cooked weight. (Lowe 2014: 22.) In total, 10-39% of cancers incidence, and 63% of cancer mortality could be prevented

within 20 years with plant-based diet, such as EAT-Lancet diet (Laine et al 2021: 792–793). Processed meat is carcinogenic and red meat possibly carcinogenic (Vineis et al. 2021: 765, 767), conceivably due to their high amounts of heme iron, heat processing induced heterocyclic amines and polycyclic aromatic hydrocarbons, and N-nitroso compounds in processed meat (Lonnie & Johnstone 2020: 284, 287–288). However, Lonnie and Johnston (2020: 282) discussed that the healthiness of plant-based diets have been questioned, especially concerning reduction of unprocessed red meat. One of the studies included in their review, claimed that by reducing the energy intake of omnivore diet to the levels of plant-based reference diet, it was possible to reduce mortality rate reductions without shifting to plant-based diet. Still, there seemed to be consensus that specifically high red meat consumption effects to total mortality, cancer, and cardiovascular health. (Lonnie & Johnstone 2020: 283–284.)

According to the review of Lonnie and Johnston (2020: 285–287), there occurred concerns of plant-based diet's nutrients. Especially, among consumers protein appeared to be one of the most sought-after nutrients, and there remain confusions and debate whether plant-based foods' protein content and its quality are enough. There were misconceptions of the sufficient quantity of protein, as many people considered that they should increase their current protein intake. Nonetheless, in the review it was found that the average protein intakes in the United Kingdom (87 g for male adults and 67 g for female adults per day) were adequate for most people. In the UK the nutritional recommendations have set daily protein intake for adults under 65 years at 0,75 g per kg of bodyweight. Despite plant-based foods were found to consist of less protein than the animal-based foods, daily protein requirements can be covered with vegetarian or vegan diets. For example, 100 g of whole grains contain almost 15 g of protein, and 100 g of legumes and beans contain approximately 20–40 g per 100 g, while the amount of protein is 30 g for 100 g of poultry, meat, or cheese. A cohort study that was included in this review, found that in Switzerland vegetarian and vegan adults under 50 years had less protein intakes than omnivores, but the protein intake was enough (vegetarians' average daily amount was 64 g and vegans' 65 g). Instead, sufficient protein intake might be an issue for older population,

because healthy adults over 65 years have been suggested to increase daily amount of protein up to 1,2 g per bodyweight kg, and the ones having acute or chronic conditions to increase amount up to 1,5 g per weight kg to decelerate muscle loss and consequently prevent sarcopenia. (Lonnie & Johnston 2020: 285–286.)

In the review of Lonnie and Johnston (2020: 286–288) it was emphasised that plant-based protein quality, regarding amino acid content, digestibility, and bioavailability, needs consideration. There are nine different essential amino acids that must be contained in the diet. It was reported that foods from animal origin mainly provide complete proteins, which means that all amino acids are in the optimal proportion for requirements of human nutrition, while proteins from plant sources are usually incomplete, because single plant food sources have fewer essential amino acids in quantity. It was stated that by combining variety of plant foods, such as whole grain products with legumes, it is possible to supplement the essential amino acids, and accomplish amino acid score by consuming solely plant foods. (Lonnie & Johnstone 2020: 286–288.)

It was found that plant sourced proteins have lower bioavailability than animal sourced proteins because of plant's natural compounds, such as tannins, lectins, saponins, and phytates, that "can impair the digestion and absorption of protein" (Lonnie & Johnstone 2020: 287). In part, these anti-nutritional factors can be eliminated by cooking, roasting, steeping, and fermenting, and the bioavailability can be improved especially concerning legumes (Lonnie & Johnstone 2020: 286–288). Also, it was considered that probiotic supplements might promote plant protein's bioavailability (Küçükgöz & Trzaskowska 2022: 4; Lonnie & Johnstone 2020: 287), and probiotics can function in symbiosis with plant components increasing their health benefits (Küçükgöz & Trzaskowska 2022: 4).

It was discovered that some other nutrients, such as iron and zinc, were found in lower quantities and in less bioavailable form in foods from plant sources than from animal sources. Additionally, plant-based foods do not provide all essential nutrients, such as vitamin B12, and DHA and EPA omega-3 fatty acids. (Lonnie

& Johnstone 2020: 286–288). Instead, it was discovered that animal products do not cover, or they contain only limited amounts of certain essential nutritional components that are provided by plant sources, such as dietary fibres e.g., inulin, b-glucan, and pectin, and phytochemicals e.g., flavonoids, carotenoids, and phenolic acids (Küçükgöz & Trzaskowska 2022: 3–4; Lonnie & Johnstone 2020: 288), which contribute to protecting cells, enhancing lipid metabolism, and weight management (Küçükgöz & Trzaskowska 2022: 3). Lonnie & Johnstone (2020: 287–288) remarked that consuming high amounts of food from plant sources had fewer health risks compared to consuming excessive amounts of animal-based food that often contain saturated fats and carcinogenic chemicals as well.

Still, Lowe (2014: 22) noted that it is quite unrealistic to assume that everyone would make the dietary change towards plant-based foods (Lowe 2014: 22). Nonetheless, all meat reduction especially among those consuming higher amounts of meat, could enhance human and planetary health (e.g., González et al 2020: 134; Laine et al 2021: 793). Lonnie & Johnstone (2020: 282) discovered that to reach Paris Agreement's ambitious goals, and to transform global food industry into a net carbon sink, the intake of plant-based foods needs to be doubled and the intake of red meat and added sugars reduced by half (Lonnie & Johnstone 2020: 282).

Is it a matter of deciding to be an omnivore?
Or is it about letting someone else to direct what you eat
and not to decide?

4.1.3 Food industry transitioning and economic processes

Ultra-processed and ready prepared foods are unnecessarily emissions-intensive due to processing and packaging (Lowe 2014: 20; Pathak & McKinney 2021: 544), providing only "empty calories" (Pathak & McKinney 2021: 544). According to the review article of Vineis et al. (2021: 766) the volume of ultra-processed foods in the market has exploded since it's early years in 1970. Industrialised food processing has aimed to offer tempting products with significant profits from

low-cost ingredients, and ultra-processed foods are often branded, preservable, ready to eat, and hyper-palatable being “designed to displace all other food groups” (Vineis et al. 2021: 766). It was stated in the review that in the United Kingdom 55% of the total calories consumed consisted of ultra-processed foods, and in the United States share was 60% – consumption still growing globally. (Vineis et al. 2021: 766–767.) Highly processed foods were found to risk human health in multiple ways (see Barrett 2022: 2; Pathak & McKinney 2021: 543; Vineis et al. 2021: 767), as discussed previously. It was also reported that ultra-processed foods’ packages possibly contain carcinogens and endocrine disruptors (Vineis et al. 2021: 767). Pathak and McKinney (2021: 545) found that by selecting plant-based foods instead of foods from animal origin, the body burden of “polybrominated diphenyl ethers—a class of endocrine-disrupting flame retardant” can be decreased 27% in a year. Food production and retailing, especially concerning animal-based foods, has increased risks of foodborne infectious diseases. For example, Clostridium, Salmonella, Listeria, Campylobacter, were linked more often with foods from animal sources (poultry, especially) than plant sources. (Vineis et al. 2021: 765–766.)

Food transportation has increased embodied greenhouse gas emissions of food (Lowe 2014: 20). Approximately 10% of total emissions from food production has derived from transportation. There were variations of climate impact between different food transportations: for example, ships and trains were found to have relatively low impact, while air cargo, refrigeration and small volumes contributed to higher impacts. (Barrett 2022: 4–5.)

According to the literature review findings, it appeared that the reform towards plant-based diets needs to be done in food industry, as well. Lonnie and Johnstone (2020: 288–289) suggested that industry could offer new ways to replace foods of animal sources with plant sources. Thus, there were mentioned some obstacles, such as perceived distastefulness, lack of trust in plant-based products’ healthiness and ethicality concerns. Also, meat substitutes were reported to have more added salt than meat products. (Lonnie & Johnstone 2020: 288–289.) Nevertheless, ongoing growing awareness of environmental concerns

and health aspects of nutrition have already led consumers to seek for plant-based alternatives, and it was highlighted that markets need to meet the increasing demand. Ethical concerns of studies regarding alternative food's health evaluation can be avoided with artificial digestion systems in experiments. (Küçükgöz & Trzaskowska 2022: 1, 3, 5, 7.) It was noted in Küçükgöz and Trzaskowska's (2022: 5, 6) review that sensory acceptability of dairy alternatives was enhanced when they were fermented with probiotics. Besides, probiotics preserved nutrients and colours and improved nutritional quality with countless health benefits (see Küçükgöz & Trzaskowska 2022: 2). Yet, Küçükgöz & Trzaskowska (2022: 3, 5) discussed in their review that there have been only a few different plant-based probiotic products available, while dairy-based probiotics have dominated the markets (Küçükgöz & Trzaskowska 2022: 3, 5).

Lonnie and Johnston (2020: 289) reported that vegetarian consumers seemed to have positive mindset towards healthy eating. Furthermore, it was noted that increasing knowledge of the nutritional quality and health benefits of plant-based diets might urge consumers to decrease animal-based foods. However, clear nutritional guidance was missing and there remained knowledge gaps, especially concerning plant protein intake recommendations. Hence, both encouraging for the healthiness and distributing the information of plant-based diet's health co-benefits are needed. Concerning nutritional values, public health initiatives could coordinate public health messages that highlight the recommendations and nutritional factors of both animal and plant sources and their desired health outcomes. (Lonnie & Johnstone 2020: 286, 288–289).

The environment, and its prevailing values and ideas, was found to affect individual's choices remarkably. Pathak and McKinney (2021: 543) pointed out that lifestyle is barely chosen by individuals, but rather resulted from an interplay between environmental, political, social, and psychological elements. Barrett's (2022: 3) review emphasised that "culture, social norms, geographic region, socioeconomic status, and family traditions all importantly influence what foods are eaten". For instance, shortage of affordable and sustainable options might lead to excessive intake of unhealthy processed foods that are emissions-

intensive (Pathak & McKinney 2021: 544). Large proportion of supermarkets and most restaurants' food selection were found to be energy-dense and highly processed. Mostly, plant-based foods have been more affordable than the ones containing large amounts of dairy or meat. Nonetheless, some products have been more expensive, for example, fruits, nuts, seeds, and high nutrient grains, and consequently unaffordable for people with lower income. (Barrett 2022: 5.) Groceries and other outlets should offer wide selection of suitable plant-based alternatives, for example meat substitutes for the meat reducers (Lonnie & Johnstone 2020: 289).

Marketing has likely influenced people's impressions of nutrition and food. For example, vast and extensive marketing of high-protein products may have influenced on people's impressions that protein intake should be increased. (Lonnie & Johnstone 2020: 285–286). When regarding probiotic products, dairy-based products has covered up to 80% of the supply, while there are only few plant-based options, such as alternative yoghurts and probiotic beverages, and barely any probiotic products of vegetables and fruits ((Küçükgöz & Trzaskowska 2022: 3). Food marketing is hardly regulated, and especially energy-rich "junk food" is advertised a lot, several of these advertisements are targeted at children. (Lowe 2014: 20–21.)

Our domestic
loved cattle
fed barley and grass
producing the most
pure, superior quality food

Or could it be
polished images
food waste
deforestation and climate change
Unwholesomeness?

Figure 6 Inseparables

Lonnie & Johnstone (2020: 282) reported that to respond to the challenge, variety of policy actions and economic responses are needed to raise awareness of people, improve agricultural and post-harvest practices, such as food transport and processing, and enhancing collaboration between supply chain operators. Lowe (2014: 22) suggested policy proposals of restricting the advertising of highly processed and unhealthy emissions-intensive foods and beverages. Also, limiting the number of fast-food restaurants while attracting healthy food businesses with incentives particularly in low-income areas, might be effective to make the dietary shift towards more healthy and sustainable diet (Lowe 2014: 22). Taxation, subsidies and labels on products might guide and enable individuals to make healthier and more sustainable food choices (Barrett 2022: 4; Lowe 2014: 22), and few countries, including Finland, had reported successive impact of fiscal incentives (Barrett 2022: 4). However, Barrett (2022: 4) remarked that there were barriers restraining policy interventions: food system's complexity, pressurising of industry, stakeholders' conflicts of interests, isolated departments, and lack of willingness towards decision-making. To enable functioning policy intervention, representatives were recommended to build relationships with stakeholders from different fields and sectors. (Barrett 2022: 4.)

4.2 Transportation

Almost 60% of total oil demand and 30% of the global energy delivered has been attributed to the transport sector, and transportation was considered to expend the second most energy in the world, right after industry (Gao et al. 2018: 688). Carbon dioxide releases from transportation have grown significantly since 1990. According to Bikomeye et al. (2021: 1), in 2007 transportation's emissions had increased 45% and by 2030 they were estimated to increase an additional 40%. Gao et al. (2018: 688) described that the emissions from transport might grow even 80% between 2007 and 2030. Motorised vehicles (cars, trucks, and buses) has accounted for about 74% of the transportation's emissions (Gao et al. 2018: 688). Additively, oil industry, car manufacturing and road construction has discharged greenhouse gases (Lowe 2014: 20).

Figure 7 Gas flares

How about my emissions
beyond the borders
of Finland

Flares of gas
invisible, hidden
in Global South
For pure petrol
done for us

Transportation sector was reported to be responsible about 60% of the total concentrations of fine particles, of which trucks accounted for 69%, buses 23%, motorbikes 5% and cars 3% (Gao et al. 2018: 688). Motor vehicles has emitted numerous toxic air pollutants, such as particulate matter, sulphur dioxide, nitrogen oxides, volatile organic compounds some of which are agents accelerating global warming (Gao et al. 2018: 688).

There were proposed two ways to decline greenhouse gas emissions of transportation: decreasing the travelled distance by light duty passenger vehicles, “vehicle miles travelled” and electrification of vehicles (Maizlish et al. 2022: 426). In addition to reduced use of private cars and fleet electrification, Gao et al. (2018: 688) proposed energy efficient vehicles with lower emissions. These mitigative measures had substantial health effects, for example by reducing pollution or by promoting physical activity (Gao et al. 2018: 688–689; Maizlish et al. 2022: 426). Consequently, both electrification and reducing motor vehicle use is needed (Gao et al. 2018: 688, Maizlish et al. 2022: 430).

4.2.1 Fleet electrification

The volumes of motor vehicle traffic worldwide were stated to be tremendous. Therefore, it is apparent that transportation system associated with high concentrations of greenhouse gas emissions and air pollution needs conversion (Gao et al. 2018: 688). Especially, electrification of transportation and vehicle’s

gas burners were considered as “an economically viable venue” to decrease greenhouse gas emissions and de-emphasise the reliance of carbon (Bikomeye et al. 2021: 7). Nonetheless, Sabel et al. (2016: 10, 11, 17) highlighted that in some locations, electricity can be produced with fossil fuels, in which case the cuts in carbon dioxide emissions due to electric vehicles are annulled and possibly moved elsewhere. Therefore, it is important to examine whether the local power generation mix produces less greenhouse gas emissions than diesel and petrol used for vehicles (Sabel et al. 2016: 5).

Pollutants released by traffic, especially particulate matter, and nitrogen oxides, have had tremendous and direct health consequences in both high- and low-income countries (Gao et al. 2018: 688). Car use was associated with pollution, but also obesity (Lowe 2014: 20). Especially, the most underprivileged people in society, was remarked to live near highly trafficked roads, and airports, which are sources of pollution and noise. Noise nuisance might disrupt the restorative sleep that is essential for health, preventing and curing chronic diseases. Inadequate sleep was mentioned to be associated with diabetes, cardiovascular diseases, mental health disorders and “suboptimal immune function”, for instance. (Pathak & McKinney 2021: 546.)

Sutcliffe et al. (2016: 710) stated, that practically the use of electric vehicles does not emit greenhouse gases on site apart from minor emissions of tyre and brake wear. It was found that electric light-duty vehicles have the potential to decrease fine particle pollution (Gao et al. 2018: 688–689; Maizlish et al. 2022: 429), and urban nitrous dioxide levels (Williams et al. 2018: 207), and therefore achieve health gains and avoid premature deaths (Gao 688–689; Maizlish et al. 2022: 429). Yet, it was argued that predicted significant increases in transportation, by both private vehicle use and road freight demand, might lead to amplified non-exhaust emissions of fine particles PM2.5, and coarse particles PM10, from abrasion of tyres and brakes (see Maizlish et al. 2022: 430; Williams et al. 2018: 208). Therefore, fleet electrification does not prevent all health risks, and electric cars were linked with modest decreases in morbidity and mortality rates (Maizlish et al. 2022: 430).

To enable vehicle electrification sufficient funds are needed, e.g., for investments in battery charging infrastructure, car range development, incentives to decrease price of electric car purchases, and phasing down fossil fuel vehicle sales. Besides, electrification was regarded to be built on private ownership. (Maizlish et al. 2022: 431.)

Nevertheless, solely electrification displacing fossil fuels does not respond to the issues related to car-centricity, such as sedentary way of travelling, noise nuisance, suburban sprawl, transport infrastructure's barriers limiting people's active travel, and traffic accidents (Maizlish et al. 2022: 430). Every additional hour a day of driving increases obesity risk by 6%. Car traffic also raises children's risk of becoming overweight due to the parental concern of safety and therefore avoidance of outdoor play and mobility. (Lowe 2014: 20.)

Figure 8 Stop before the stop line

In the review of Lowe (2014: 20) it was stated that in Australia car-centricity has been advanced for decades by policies concerning taxation, infrastructure, and transport planning. For example, in infrastructure planning car use has been prioritised over other forms of mobility. Residents, workplaces, and services were found to be often too far from each other to walk or cycle easily, and public transport connections too time-consuming to use. The lack of safe pedestrian and bicycle ways has not encouraged walking and bicycling, either, especially in some suburban and rural areas. The review found that in Australia, 4 times more public funds had been directed to the construction of roads than railways, and for both automotive and fuel industry and car owners were provided with subsidies or tax reductions. (Lowe 2014: 20.) According to Maizlish et al. (2022: 431), recent

measures towards carbon neutrality have given precedence to vehicle electrification and have undervalued the role of active transportation. Driving a car is sedentary behaviour and it displaces more active ways to travel, such as bicycling, walking and using transport, that mainly includes walking or other physical activity, as well (Lowe 2014: 20).

4.2.2 Active travel

Sedentary lifestyle has caused increased morbidity and mortality. According to Pathak & McKinney (2021: 544), physical inactivity was associated with 3.2 million deaths annually, and various non-communicable diseases. According to Gao et al. (2018: 688) active travelling, also including public transport that usually involves physical activity, is regarded as nearly zero pollutant and the best measure to decrease greenhouse gas emissions.

By decreasing the use of private vehicle and replacing it with active transport, with walking and cycling for example, it is possible to decline carbon emissions, and have health outcomes of increased physical activity and decreased air pollution (see Gao et al. 2018: 688; Lowe 2014: 21; Prior et al. 2018: 3; Sabel et al. 2016: 5, 13, 18; Vineis et al. 2021: 766). Active means of transport were found to prevent non-communicable diseases, such as obesity, type 2 diabetes (Prior et al. 2018: 3; Vineis et al. 2021: 766), cardiovascular diseases, some cancers (Gao et al. 2018: 688; Pathak & McKinney 2021: 544–545; Vineis et al. 2021: 766), and depression (Gao et al. 2018: 688); thus decline morbidity and mortality rates (see Maizlish et al. 2022: 426, 429; Pathak & McKinney 2021: 544). In the review of Lowe (2014: 21) it was stated that if all short trips would be made by foot or by bicycle instead of car, it could nearly eliminate obesity without any change in diet.

Active travel might promote mental health and increase happiness (Prior et al. 2018: 3). Furthermore, active transportation might increase social interaction and possibility to encounter natural environments (Gao et al. 2018: 688) and promote resilience to the COVID-19 pandemic (Bikomeye et al. 2021: 13). Moreover, Bikomeye et al. (2021: 12) considered that both active and public transport could

advance “sustainable and resilient urbanization” together with decreasing greenhouse gas emissions and promoting public health.

Figure 9 True freedom

In urban areas active travel exposes to air pollution (Maizlish et al. 2022: 431; Sabel et al. 2016: 13; Salmond et al. 2016: 101), because of increases in ventilation, proximity to heavily trafficked streets (Maizlish et al. 2022: 431), and the lack of shield against ambient air (Salmond et al. 2016: 101). However, the harm caused by breathing fine particles was found to be decidedly offset by the benefits of increased physical activity (Maizlish et al. 2022: 431; Sabel et al. 2016: 13).

Maizlish et al. (2022) screened the health benefits of different mitigation measures in transportation. Two of the scenarios involved active travel, in which at least half of the US adults increased physical exercise from cycling and walking and achieved either 150 minutes or about 37 minutes per week. Another two scenarios were electrification of vehicles in which 50% and 100% of the vehicles

were electrified. Vehicle electrification decreased more greenhouse gases and fine particle concentration than increases in active travel. Although, intriguing was that in US, the health benefits of a less ambitious active travel scenario significantly exceeded the health benefits of scenario representing a full transition to electric cars (100% car electrification scenario), because physical activity seemed to promote health more than greater reduction of fine particle pollution. Ambitious active travel scenario decreased morbidity and mortality rates significantly and decreased 24% of the carbon emissions compared to the baseline by 2050 in the United States. (Maizlish et al. 2022: 426, 427, 429–430.) Yet, health benefits of active travel were moderated by possible traffic injuries of vehicle collisions decreasing full health years (disability-adjusted life years) and causing deaths (Maizlish et al. 2022: 429). Findings of the review of Gao et al. (2018: 688) confirmed that active transportation promotes physical activity and enhances air quality, while the health co-benefits were restrained on some occasions by the increased risks of injuries. However, better infrastructure for pedestrians and cyclists, could essentially decrease the active travellers' traffic accidents (Maizlish et al. 2022: 431).

Maizlish et al. (2022: 430–431) discovered that the less ambitious scenario of active travel, achieving around 25% of the physical activity goals, has been exceeded in many countries already, for example in the Netherlands and in Switzerland, which indicates that even more ambitious active travel might be achievable. Pathak and McKinney (2021: 544) noted that the greatest health gains of active travel are possibly achieved in the countries where active transport is not very common, for example in the United States. Nonetheless, Maizlish et al. (2022: 429) pointed out that it is not attainable to switch solely to active transport if the trips are mainly longer, as in the United States where the distances exceed 8 kilometers in most of the cases.

Lowe (2014: 22) remarked that the Netherlands and Denmark have invested in cycling and had "achieved cycling rates more than 10 times higher than Australia." In many research articles, it was stated that there is a need for policy contribution and public investment for proper active travel infrastructure, such as

walkways and cycle lanes (see Bikomeye et al. 2021: 12; Gao et al. 2018: 688; Lowe 2014: 22; Maizlish et al. 2022: 431; Prior et al. 2018: 3), secure crosswalks and bike parking (Lowe 2014: 22). Infrastructure was suggested to be planned to support active travelling by providing accessibility and short distances to workplaces and essential services (Maizlish et al. 2022: 429). For instance, greater residential density might shorten distances between daily trips (Lowe 2014: 22). Furthermore, tax concessions and office showers might encourage people to bicycle commute to work (Lowe 2014: 22).

4.2.3 Public transport

The use of public service vehicles was reported to reduce greenhouse gases in transportation sector (Bikomeye et al. 2021: 12–13; Lowe 2014: 21; Prior et al. 2018: 3). Bikomeye et al. (2021: 13) stated that reduced emissions could be accomplished by improving the infrastructure of public transport and decreasing private vehicle use as a result. Correspondingly, Lowe (2014: 21) reported that with optimal customer base, public transportation was noted to consume “only a small fraction of the fossil-fuel energy” compared to private vehicles moving people.

Public transport usually involves physical activity of walking and cycling to and from the stops and stations (see Bikomeye et al. 2021: 12–13; Lowe 2014: 21; Maizlish et al. 2022: 426), and it was reported to decrease obesity (Lowe 2014: 21; Prior et al. 2018: 3), cardiovascular diseases, and diabetes (Prior et al. 2018: 3). In the review of Lowe (2014: 21) it was reported that convenient access to public transit amplified the human energy expenditure on walking and reduced the powered energy expenditure. By advancing public transportation and thus increasing physical activity, public transit was reported to decrease 3.2 million annual inactivity-related deaths globally (Bikomeye et al. 2021: 13). For instance, the review of Lowe (2014: 21) found that in eight months light rail transit introduction in Charlotte, in the US state of North Carolina, led to 18% decrease

in body mass index and declined the risk of obesity among the light rail commuters.

Public transportation decreasing the amount of private transport vehicle use was suggested to enhance air quality and decrease illnesses related to air pollutants, reduce traffic congestion, road accidents, and noise impact (Bikomeye et al. 2021: 13). For example, Sabel et al. (2016: 13) found that metro declined mortality locally due to decreased air pollution in Greek city Thessaloniki and declined noise levels considerably. The noise was louder in the most deprived areas; however, the noise level reductions did not enhance well-being significantly in those areas. (Sabel et al. 2016: 5,13–14.) Nevertheless, public transport was found to foster health equity by enhancing the possibilities of mobility among people with limited access to private vehicles. For instance, women and children, elderly, disabled, or impoverished people, benefit from public transit as it enables management of social and economic necessities. (Bikomeye et al. 2021: 13.)

Consequently, it was suggested that public transport should be advanced with government subsidies to provide inexpensive, accessible (Lowe 2014: 21; Maizlish et al. 2022: 426), and efficient transit with less emissions (Lowe 2014: 21; Prior et al. 2018: 3) which also enables larger customer volumes of transportation and enhanced equity of accessibility (Lowe 2014: 22). Frequency, speed, and network of public transport services need to be increased together with improved infrastructure for pedestrians and cyclists. Also compact-sized cities promote the use of public transportation. Additionally, public transport use could be increased by making the private car use less appealing option, for example, by raising the costs of car use (fuel, parking, and congestion charge) and infrastructural changes (lower speed restrictions, limited parking spaces, and car-free pedestrian streets). (Lowe 2014: 21–22.)

Maizlish et al. (2022: 432) stated that although active and public transportation and electrification of vehicles are presented “as contrasting visions”, jointly they maximize reductions of greenhouse gas emissions and health co-benefits. Focal is that there need to be equal possibilities to choose between these means of transportation in a way that they all are “comparably time-efficient, affordable, and convenient” (Maizlish et al. 2022: 432).

Figure 10 Passages

4.3 Green and blue infrastructure

Green infrastructure in urban areas was regarded as an efficient measure to mitigate climate change and adapt to it (Bikomeye et al. 2021: 11–12; Demuzere et al. 2014: 108, 113; Gao et al. 2018: 692; Prior et al. 2018: 3; Salmond et al. 2016: 95–96). Forests and other green areas with trees was reported to play an important role in capturing and storing carbon (Bikomeye et al. 2021: 7; Gao et al. 2018: 692; Pathak & McKinney 2021: 546; Prior et al. 2018: 3) due to biomass’s ability to sequester carbon from the atmosphere through the photosynthesis process (Bikomeye et al. 2021: 11–12; Demuzere et al. 2014: 108–109; Prior et al. 2018: 3). Urban waterways mitigate global warming, as well, (Lõhmus & Balbus 2015: 5; Tieges et al 2020: 2) by sequestering carbon and promoting biodiversity in urban areas (Lõhmus & Balbus 2015: 5). For instance,

conservation, sustainable forest management, afforestation, and reforestation were attributed to climate change mitigation measures (see Bikomeye et al. 2021: 7; Gao et al. 2018: 692). Green and blue urban infrastructure was defined to comprise of green spaces or natural elements of urban areas, such as parks and gardens, street trees, greenways, green facades and roofs, forests, wetlands, and conservation areas, and they can include blue spaces such as waterways (see Bikomeye et al. 2021: 11; Demuzere et al. 2014: 107; Lõhmus & Balbus 2015: 7; Prior et al. 2018: 3).

In the United States, woodlands and trees were projected to "store a total of 643.2 million tons of carbon and sequester about 25.6 million tons of carbon" annually (Bikomeye et al. 2021: 7). Green infrastructure might also reduce the sources that produce greenhouse gas emissions, for example by promoting active travel (Bikomeye et al. 2021: 11–13; Demuzere et al. 2014: 110; Gao et al. 2018: 692). Yet, Demuzere et al. (2014: 113) noted that vast green areas in most cases decrease population density which quite the contrary might increase the need for transportation possibly causing fossil fuel consumption increases (Demuzere et al. 2014: 113).

Demuzere et al. (2014: 107) reported that green and blue areas effect to ecosystem's resilience and provide services for humans. There were plenty of health co-benefits that reduce the negative health impacts of climate change, such as green and blue spaces' ability to prevent floods and heat island effects in urban areas (see Demuzere et al. 2014: 110; Gao et al. 2018: 692; Lõhmus & Balbus 2015: 1, 5; Salmond et al. 2016: 98; Tieges et al 2020: 2), which may decrease for example heat-related stress and mortality (Prior et al. 2018: 3). These can be attributed as climate change adaptation's co-benefits (Bikomeye et al. 2021: 9) which have not been further examined in this master's thesis.

According to Gao et al. (2018: 692–693) further inquiry is needed to indicate the associations between greenhouse gas reductions from green environment interventions and health improvement. Yet, in addition to the climate change mitigation possibilities, urban green infrastructure was stated to advantage

human health (e.g., Bikomeye et al. 2021: 12; Gao et al. 2018: 692; Lõhmus & Balbus 2015: 1; Salmond et al. 2016: 96, 104) and increase people's quality of life (Bikomeye et al. 2021: 12; Salmond et al. 2016: 96) by improving physical, social, and mental well-being and health (e.g., Bikomeye et al. 2021: 12, Pathak & McKinney 2021: 544). Some papers suggested that residential proximity to green spaces was associated with enhanced overall health (Lõhmus & Balbus 2015: 1; Demuzere et al. 2014: 110;), and lower morbidity rates of certain diseases, especially anxiety and depression (Demuzere et al. 2014: 110). Urban green areas are likely to enhance air quality, increase physical activity, (Gao et al. 2018: 692; Lõhmus & Balbus 2015: 1) and provide aesthetic and cultural values and experiences that promote mental well-being, as well (Gao et al. 2018: 692). Moreover, green spaces was found to increase life expectancy, reduce blood pressure, decrease noise irritation, and stress levels, and have positive effects to birth weight (e.g., Lõhmus & Balbus 2015: 1). However, Salmond et al. (2016: 105) emphasised that generalizations that apply to all social and income groups should be avoided.

Green environments encourage and create opportunities for physical activity (Bikomeye: et al. 2021: 12; Demuzere et al. 2014: 110; Gao et al. 2018: 692; Lõhmus & Balbus 2015: 1) decreasing diseases attributed to sedentary behaviour (Bikomeye et al. 2021: 12). Green spaces in urban environment were linked to decreased obesity risks and therefore declined obesity-related diseases (see Bikomeye et al. 2021: 12; Gao et al. 2018: 692) and lower morbidity and mortality rates of non-communicable diseases such as cardiovascular diseases, type 2 diabetes, and cancers (Bikomeye et al. 2021: 12). Pathak and McKinney (2021: 546) found that larger coverage of urban trees was associated with smaller rates of cardiovascular diseases and mental disorders. In the review of Salmond et al. (2016: 105), it was reported that "loss of trees in the neighbourhood resulted in increased mortality related to cardiovascular and lower-respiratory-tract illness, but no mechanism was suggested".

Green environment and increased physical activity are likely to have synergistic effects (Pathak & McKinney 2021: 544). By improving physical health, green environments were reported to enhance general subjective health and quality of life (Bikomeye et al. 2021: 12) but also relieve mental health conditions (Pathak & McKinney 2021: 544). Besides encouraging physical exercise, natural environments provide restorative experiences and increase social interaction (e.g., Demuzere et al. 2014: 110–111; Gao et al. 2018: 692; Pathak & McKinney 2021: 541, 544). Thus, greenness promote mental health, relieve stress, fatigue (Bikomeye et al. 2021: 12; Gao et al. 2018: 692), depression, and anxiety (Pathak & McKinney 2021: 546), and increase happiness (Bikomeye et al. 2021: 12).

Figure 11 Covering with green

Correspondingly, green spaces in neighbourhoods were regarded to alleviate stressors during the social and environmental disturbances (Demuzere et al. 2014: 110) and to increase safety by decreasing the levels of aggression, violence, including domestic violence, and reducing property crimes (Bikomeye et al. 2021: 12). Gao et al. (2018: 692) reported that compared to more artificial environment, the exposure to green urban areas significantly decreased the levels of experienced anger and sadness, among other negative emotions. Salmond et al. (2016: 103–104) described that tree density and greenness in streets were associated with improved mental health and lower rates of antidepressant prescribing.

Green elements in urban environment may mask the urban noise, from busy road for example, and enhance the experience of soundscape. Generally, people

value the natural sounds, e.g., from water features, trees, and birds, more than sounds from human sources. In urban environment, noise pollution is linked with high blood pressure, sound annoyance, and declined subjective sleep quality (Salmond et al. 2016: 102, 104). According to Pathak and McKinney's (2021: 546) review, greater green space coverage was linked with greater amount of sleep among adolescents.

Green spaces were found to provide favourable circumstances to socialise (Demuzere et al. 2014: 111) which might promote social contact, bonding, and cohesiveness (Bikomeye et al. 2021: 12; Demuzere et al. 2014: 111; Gao et al. 2018: 692; Pathak & McKinney 2021: 546). Demuzere et al. (2014: 110) discovered that urban green environments increase social and leisure activities "leading to relaxation, comfort and satisfaction". Especially, natural environments seemed to benefit people with more limited social networks, such as the elderly, families with small children and individuals with weaker health (Demuzere et al. 2014: 111). Also, Pathak and McKinney (2021: 546) stated that elderly benefit from social contacts that green spaces might offer.

Green environments could enhance people's experiences of resilience and coping. Activities related to green urban areas, for example, allotment gardening or restoration of green areas, can help experience self-efficacy and responsibility of climate change mitigation, learn about ecosystems, and become devoted to places fostering climate-positive behaviour. (Demuzere et al. 2014: 110 – 111.) Natural environments can play a role as sacred places for some people, as well (Pathak & McKinney 2021: 546). Moreover, during the COVID-19 pandemic, green urban infrastructure has played a significant role to decrease the infection risk, but also promote physical health and mental well-being by providing opportunities for different kind of activity while enabling both safe social interactions and distancing. Consequently, the use of green spaces (especially remote trails) for physical exercise grew due to the social and physical distancing of COVID-19. (Bikomeye et al. 2021: 12–13.) Furthermore, greenery in the school yard was associated with reduced stress, enhanced cognitive performance and socioemotional health, and increased childhood exercise which may prevent

various illnesses in adulthood, for instance certain non-communicable diseases, and mental disorders (Bikomeye et al. 2021: 13).

Bodies of water provide aesthetic environment (Lõhmus & Balbus 2015: 5, Tieges et al. 2020: 2), and spaces for recreation, physical activity, and social encounters (Tieges et al. 2020: 2). Moreover, water bodies might inspire to invest in business and tourism (Tieges et al. 2020: 2). The 17-year longitudinal observational research by Tieges et al. (2020), studied the health impacts of canal regeneration in Glasgow in areas with significant socioeconomic health disparities and found that blue infrastructure has the possibility to both benefit health and decrease health inequalities. In the regenerated canal region, the mortality rates decreased evidently, especially in the high deprived areas nearby the waterway (a maximum of 500 metres distance from the canal), where the mortality rates declined the most rapidly. (Tieges et al 2020: 1, 3, 6, 8.) Tieges et al. (2020: 8) elaborated that mortality rates in Scotland's most deprived areas have increased 1% annually from 2012, but the regeneration of canal decreased the rate up to 3% achieving substantial physical and mental health gains. Tieges et al. (2020: 2, 9) described that urban waterways tend to locate equally in different socio-economic areas – more evenly than green areas – therefore their regeneration might have important role enhancing overall health, well-being, and health equality. Yet, it was highlighted that there remains need for further examination of confounding variables and causal link of regenerated waterways and health gains (Tieges et al. 2020: 9, 10).

Trees might regulate air quality and decrease the air pollution exposure (Bikomeye et al. 2021: 12; Pathak & McKinney 2021: 546; Salmond et al. 2016: 99) by filtering the air and decreasing air impurities (Bikomeye et al. 2021: 12; Demuzere et al. 2014: 110; Salmond et al. 2016: 99). Depending on the vegetation, trees and forests may absorb nitrogen dioxide, sulphur dioxide, particulates (Demuzere et al. 2014: 110; Salmond et al. 2016: 100), and ozone (Salmond et al. 2016: 100). In few research, the evidence of trees and other green areas impact on air quality was mentioned to be limited and conclusions complicated to validate (see Demuzere et al. 2014: 110, 112; Gao et al. 2018:

692; Salmond et al. 2016: 100). Vegetation's effects on air quality depend on multiple factors, such as species under consideration, the size of trees and leaves, vegetation density, location, and surroundings (Salmond et al. 2016: 100).

Nonetheless, sometimes in urban areas there are limited possibilities to build new natural spaces, and therefore trees are planted generally in the kerbside locations (Salmond et al. 2016: 95–96). Lõhmus and Balbus (2015: 4, 7) mentioned that lately green walls, roofs, ornaments, and constructed and restored water bodies have become more popular among the city planners. Kerbside trees planting and preserving are often justified by trees' climate change mitigation properties together with certain health co-benefits (see Bikomeye et al. 2021: 7, 10; Salmond et al. 2016: 95–96). Kerbside trees are considered as an important element of liveable milieu promoting environmental justice. However, trees signify different things to people: they may represent connectedness with natural environment or annoyance, they can be an element to support walkability, or prevent it by provoking fear because of reduced visibility. (Salmond et al. 2016: 97, 103, 105.)

According to Salmond et al. (2016: 96, 105), sometimes growing the vegetation density raises complex issues in urban settings (Salmond et al. 2016: 96, 105). Trees in the sides of streets are under pressure due to the light intensity, higher temperatures, drought, and radiative loads to which they are generally unaccustomed (Salmond et al. 2016: 99, 101). Consequently, harsh urban environment might induce trees to emit increasingly volatile organic compounds which contains precursors of ozone further leading to air pollution (Lõhmus & Balbus 2015: 1; Salmond et al. 2016: 99–101). Different tree species emit different levels of biogenic volatile compounds, and by choosing species that have low emissions, the risk of ozone increases could be reduced (Salmond et al. 2016: 101–102). Tightly planted large trees in the opposite kerbsides could reduce wind currents therefore preventing dispersal of air pollutants (Demuzere et al. 2014: 110, 113; Lõhmus & Balbus 2015: 7). Thus, street trees might even increase local air pollution levels (Lõhmus & Balbus 2015: 1; Demuzere et al.

2014: 113; Salmond et al. 2016: 101). Salmond et al. (2016: 101) mentioned that there were mixed results of street trees' contribution to air quality between different research focuses, for example between dispersion led research and research concerning deposition processes.

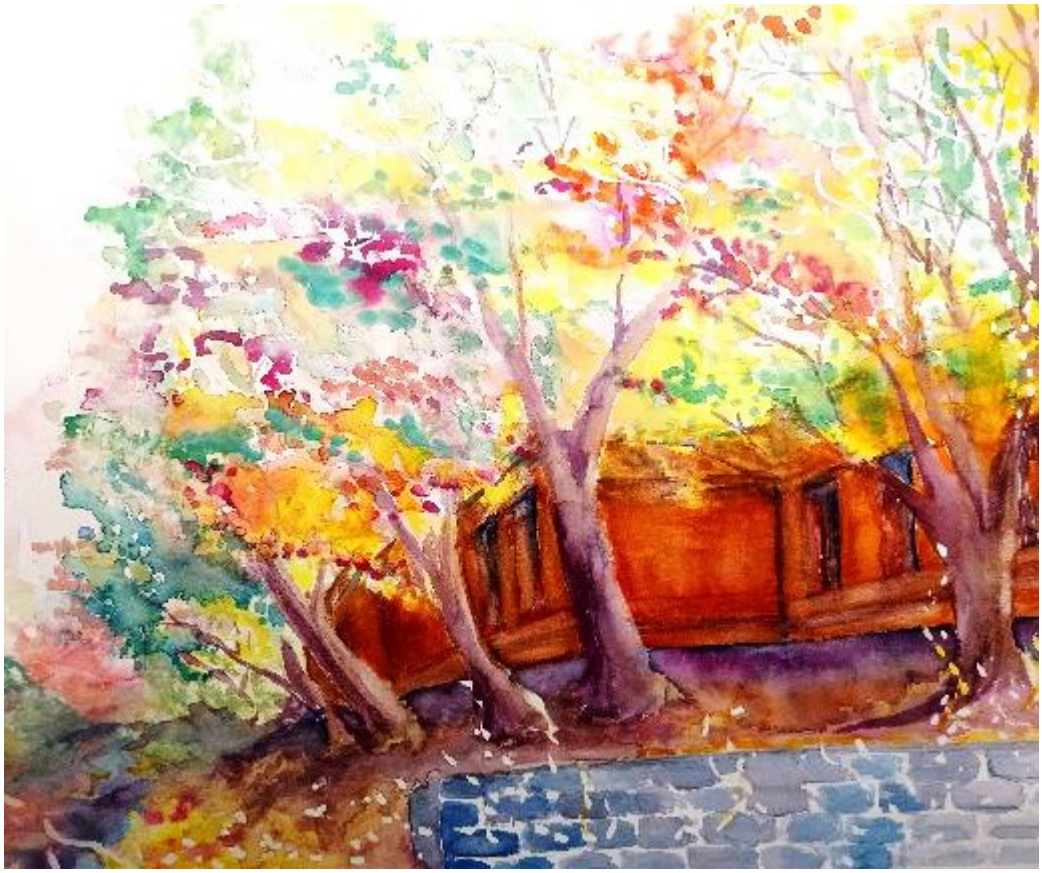

Figure 12 Whispering trees

These street trees react
to the intensive light
day and night
Scarce water
and temperatures high

In kerbsides under strain
they are emitting too
biogenic volatile compounds
Enabling ozone formation
and pollution

Also, there were stated to remain other complicated aspects of trees properties, such as litter from seeds and fruits, and pollen. Increasing of male trees have been thought to reduce litter, but it could lead to amplified levels of aeroallergens, instead (Salmond et al. 2016: 96). Allergenic tree pollen in urban areas was linked with allergic responses and exacerbated asthma. For example, birches and cypresses that have been used widely in Europe are highly allergenic. (see Lõhmus & Balbus 2015: 7; Salmond et al. 2016: 102–103.) According to Lõhmus and Balbus (2015: 7), respiratory pollen allergies' occurrence and severity have grown causing decreased work ability. Additionally, high levels of aeroallergens might influence on physical and mental well-being of allergic people (Lõhmus & Balbus 2015: 7). Salmond et al. (2016: 102–103) reported that high levels of vehicle exhausts seemed to coincide with respiratory pollen allergies and exacerbate the symptoms. Lõhmus and Balbus (2015: 7) confirmed that air pollutants have "toxic effects on respiratory tract and an adjuvant effect on respiratory hypersensitivity and asthma" which could explain why pollen allergy symptoms are 20% more common in urban areas than in rural areas. However, preferring insect-pollinated trees might decrease the pollen levels (Lõhmus & Balbus 2015: 7).

Green spaces and natural elements require maintenance to survive in harsh conditions in urban environment, which might lead to higher costs (Salmond et al. 2016: 96, 104–105) and possibly carbon dioxide emissions due to the construction activities and transport (Demuzere et al. 2014: 113). Severe urban environment could lead to amplified evaporative demand, and without additional irrigation, the trees are incapable of cooling down the urban environment (Salmond et al. 2016: 99). Moreover, some built green spaces, such as green roofs, demand persistent fertilization which can deteriorate rainwater runoff (Demuzere et al. 2014: 113).

Pathak and McKinney (2021: 542) described that land use changes and deforestation among other factors have caused biodiversity loss. In the review of Pathak and McKinney (2021: 547), it was stated that low biodiversity together with decreased contact with elements of natural environment might detract

healthy gut microbiome that is “a key component of immune and central nervous system development and function”. Imbalanced microbiome was associated with infectious diseases but also autoimmune and inflammatory diseases. (Pathak & McKinney 2021: 547.) Nevertheless, physiological health benefits linked with biodiversity cannot be achieved by simply growing the number of species in the environment, but rather by a certain combination of species in biodiversity (Lõhmus & Balbus 2015: 2). According to Lõhmus and Balbus (2015: 2), it is rare that urban environment could support high biodiversity, because of fragmentation and habitat destruction. Also, wild species that live in urban green areas are regardless likely the ones adapting easily to human-induced changes (Lõhmus & Balbus 2015: 2). Furthermore, Demuzere et al. (2014: 107) noted that urban green areas are not able to replace natural areas, although they are considered as valuable for ecosystems.

Figure 13 Taking flight

However, promoting biodiversity in urban areas has challenges. Lõhmus and Balbus (2015: 6) found that there is a great concern of toxic blooms in the urban water bodies, that endanger humans, pets, and the aquatic organisms. Low rates of water flow, shallowness and eutrophication may lead eventually to algae blooms, some of which may produce neurotoxins or hepatotoxins. Therefore, developed algal mats may affect health and possibly prevent activities such as fishing and swimming but also cause unpleasant odours that degrade the pleasantness of the environment. (Lõhmus & Balbus 2015: 6.)

Lõhmus and Balbus (2015: 2, 4) and Demuzere et al. (2014: 113) highlighted concerns of the urban green and blue areas and connectivity between natural urban environments which might support the pest populations and consequently zoonoses. For instance, rats gain advantage from dense vegetation with broad-leave trees, ruderal species, and seasonal fruits. Rats act as a host for multifarious zoonotic pathogens and people may expose to rat allergen. Green connectivity is found to enable rat dispersal, but it is likely to increase rodent predators, e.g., foxes and predatory birds, as well. However. it was also noted that rats may colonize through residential areas, sewers, railways, or waterways. (Lõhmus & Balbus 2015: 4.) Instead, tick populations are dependent on the movements of their hosts, for example, deer, hares, small rodents, and insectivores, and there are several studies suggesting that tick-borne zoonoses occur in urban green areas (Lõhmus & Balbus 2015: 2–3). Waterways with dense vegetation, might attract bird species, and especially constructed ponds without natural predators, might promote mosquito reproduction, which both could increase the possibility of vector-borne disease transmission to humans (Lõhmus & Balbus 2015: 5–6).

Lõhmus and Balbus (2015: 2) raised the possibility that high biodiversity could prevent the spread of zoonoses for example through the hypotheses of dilution effect and zooprophylaxis. Briefly, they mean that by increasing the number of animals, the insect bites can divert towards hosts that are less likely to further transmit the disease, and therefore decrease the possibility of transmission to humans. But because the ecosystem is complex, the diversity of species does

not necessarily always have a protective effect against zoonotic diseases, but sometimes composition of certain species is more vital. (Lõhmus & Balbus 2015: 2–3.)

To reduce risks that urban green areas pose, it is important to increase understanding of the complex interplay between disease agents and vectors and improve the ecosystem interventions in urban settings (Lõhmus & Balbus 2015: 8). It was emphasised that population in urban areas has increased rapidly which demands functional infrastructure design (Bikomeye et al. 2021: 11). Simultaneously, people have noticed the values of green environment and pushed for increasing green infrastructure through reforestation and conservation, for instance (Salmond et al. 2016: 96).

Figure 14 Recovering forest

Earth and its nature
will survive
It adapts to new climate
heat, floods, and storms

But Earth and its nature
will never be the same
It will grief the lost ones
The ones extinguished forever

4.4 Energy reproduction and use

In 2012, energy sector accounted for about two thirds of global human-induced carbon dioxide emissions, and even three quarters when considering only industrialised Annex I countries. Consequently, major changes are critically needed. (Gao et al 2018: 686.)

Yet, according to the research describing findings from Urban Reduction in Greenhouse Gas Emissions in China and Europe (URGENCHE), the recently adopted mitigation strategies in few European and Chinese cities, concerning fuel mix alterations in local power generation, renovating building stock, and encouragement to replace car use with other transportation options, was insufficient to limit local air pollution enough (Sabel et al. 2016: 11). According to the research, there is a risk that by reducing local emissions, the emissions elsewhere rise. Therefore, suitable and less carbon-intensive energy mix needs to be introduced, if possible. (Sabel et al. 2016: 11.)

In global scale, residence buildings are estimated to cause up to 18% of the carbon dioxide emissions. 11% of the global emissions result from grid electricity and municipal district heating, and the rest 7% from cooking and heating by fossil fuels in household level, mainly in developing societies. In high-income nations residential emissions consist mainly of intensive use of electricity, heating, and air conditioning. In high-income countries households' carbon dioxide releases are larger. As an example, the citizens of the United States covers only 4,3% of the world's population, but the share of entire global emissions of the households in the United States was about 20%. When considering national level, for

instance, in the United Kingdom the residential emissions were approximately 26% of the country's carbon dioxide releases. Biomass or wood burning, which was not included in these numbers, has accounted for approximately 7% of the households' energy use globally and additionally has been responsible of unsustainable forest felling in some areas causing deforestation and loss of carbon sinks. (Gao et al. 2018: 689–690.)

Energy sector causes "more environment-mediated morbidity and mortality worldwide than any other sector" mainly due to greenhouse gas emissions, air pollution, occupational health hazards, and occasional accidents (Gao et al 2018: 686). Air pollution is one of the top 10 reasons of disease burden and it was estimated to be responsible for about 3.2 million deaths annually (Gao et al. 2018: 686). Air pollution was linked with cardiovascular diseases, and respiratory diseases (Vineis et al. 766; Williams et al. 2018: 203), such as coronary heart disease, stroke, chronic obstructive lung disease (COPD), asthma, and infections and carcinomas in the respiratory tract (Williams et al. 2018: 203). Air pollution is carcinogenic, especially regarding ambient particulate pollution (Vineis et al. 2021: 766).

Air pollution and greenhouse gases are interlinked because they have largely the same sources, they evolve inseparably in the atmosphere, and have effects on both humans and ecosystems (Gao et al 2018: 685, 692). Especially, fossil fuel energy combustion causes air pollution of particulate matter, nitrogen oxides, and sulphur dioxide, contributing to mortality and morbidity (Gao et al. 2018: 686). Also, some of the greenhouse gases have health consequences (Vineis et al. 2021: 768). Black carbon and ozone are both severe climate-warming agents and ground-level pollutants (Gao et al. 2018: 685, 691). Therefore, by reducing greenhouse gases, it is possible to slow down global warming, but also significantly enhance air quality and public health – if the policies are meticulously designed and implemented (see Gao et al 2018: 691; Williams et al. 2018: 209–211).

According to the review of Bikomeye et al. (2021: 14), declines in greenhouse gas emissions, and consequently improvements in air quality are likely to result health co-benefits, such as decreased premature mortality, heart attacks, and decreased incidence and exacerbations of respiratory diseases (e.g., chronic bronchitis, and asthma). Besides, considerable number of workdays lost can be avoided. (Bikomeye et al. 2021: 14). By reducing greenhouse gases 50% in energy generation by 2030 compared to the business-as-usual scenario, health gains in European Union were estimated to correspond about 100 additional life-years per every million people (Gao et al. 2018: 687–688). In Pathak's and McKinney's (2021: 545) review it was found that if greenhouse gas emissions were reduced according to Paris agreement and Sustainable Development Goals (SDG), up to 1.8 million deaths could be avoided solely due to decreased ambient particulate pollution.

Fine particles, PM2.5, consist of black carbon, carbon monoxide, organic carbon, nitrogen oxides, and sulphur dioxides (Gao et al. 2018: 691). Particulates emitted from fossil fuel combustion was found to affect all organs destructively. From the lungs, fine particles may get into the bloodstream, and harm organs directly or systemically via inflammation and free radicals (Pathak & McKinney 2021: 545). Simultaneously, fine particle pollution causes non-communicable diseases. For instance, about 3.2 million diabetes incident cases were linked with particulate pollution. (Pathak & McKinney 2021: 545.) In the modelling study of Williams et al. (2018), it was noted that specifically fine particulate matter together with nitrogen dioxide and ozone, caused the most severe health effects (Williams et al. 2018: 203). In the review of Pathak and McKinney (2021: 545), it was reported that pollution of fine particles was associated with approximately 4.2 million deaths annually. Consequently, by decreasing greenhouse gas emissions, premature deaths could be prevented due to decreases in the levels of fine particles and ozone (see Bikomeye et al. 2021: 14; Gao et al. 2018: 691).

Black carbon, which is one of the components of particulates, was found to have deteriorating effects on public health, because it enters deep into the lungs through inhalation. Lifetime of black carbon in the atmosphere is rather short,

from days to weeks, thus, decreasing the levels of black carbon would have instant and direct effects on climate change mitigation and health. Furthermore, by reducing the emissions of black carbon, also particulate levels, and other pollutants from combustion, such as nitrogen oxides and carbon monoxide decline. Therefore, the health co-benefits and prevention of premature deaths might be amplified. (Gao et al. 2018: 691–692.) It was found that scenarios of methane curbing in energy, industry, and agricultural sectors, were projected to decrease premature deaths (Gao et al. 2018: 692).

Burning of fossil fuels might also pollute water and soil by various toxic substances, such as heavy metals (24 Pathak & McKinney 2021: 545). According to Pathak and McKinney (2021: 545), when taking different kinds of pollution into account, pollutants caused “21% of cardiovascular deaths, 26% of coronary artery disease deaths, 23% of stroke deaths, 51% of chronic obstructive pulmonary disease deaths, and 43% of lung cancer deaths”. Pollutants could cause epigenetic changes and endocrine disruption in addition to non-communicable diseases. (Pathak & McKinney 2021: 545.)

To mitigate climate change and gain health co-benefits by decreased ground-level pollution, it is important to shift towards clean energy away from fossil fuels and to enhance energy efficiency in industry and energy sectors. The measures include for example enhancing structures of energy and industry, low carbon technology development and introduction, and promotion of renewable energy. (Gao et al. 2018: 690–691.) Gao et al. (2018: 688) noted based on the review, that global warming could be limited to around 2.3 Celsius degrees by decreasing consumption of fossil fuels, increasing forest cover, together with biofuels and technology of carbon capture and storage (CCS) consequently preventing an average of 2.2 million premature deaths due to declined concentrations of fine particles and ozone.

Apart from the health benefits, decentralised and efficient energy production with renewable alternatives would improve social stability and enhance power supply dependability (Prior et al. 2018: 3). Also, the shift to 100% clean energy could

save up to 21 billion US dollars due to health outcomes and creation of new jobs (Bikomeye et al. 2021: 14). Reductions in residential energy use and energy efficiency advancement were found to be among the top priorities in policy because they were regarded as cost effective and effortlessly available measures to curb emissions from energy sector and decrease air pollution levels (Gao et al. 2018: 687, 690).

Energy generated from the resources of wind, solar, and geothermal has been regarded as renewable energy, and these energy alternatives were found to mitigate climate change and improve air quality and human health. For example, wind energy production was reported to emit 97,48% less carbon dioxide, 80,38% less sulphur dioxide, 57,31% less nitrogen oxides, and 30,91% less coarse particle emissions than coal power system for the same extent of energy. Windmills have rather low installation and production costs and low water demand, as well. Yet, there remain challenges. Wind energy is likely to impact wild species in air and ground, because of decreased and fragmented natural habitat, for example. (Gao et al. 2018: 687.) Also, geothermal energy reduces energy consumption, but the electricity needed reduces its profitability (Sabel et al. 2016: 10).

Alternative low emission fuels, such as bioethanol and biodiesel emit less carbon dioxide than fossil fuels (Sutcliffe et al. 2016: 709). However, cultivation of biomass and forestry are likely to cause biodiversity loss and degrade the soil and water and there remain risk of chemical exposure (Sutcliffe et al. 2016: 709). Accordingly, in the research of Sabel et al. (2016: 10) it was emphasised that biomass production possibly produces greenhouse gas emissions because of deforestation, transportation, and the use of fertilisers.

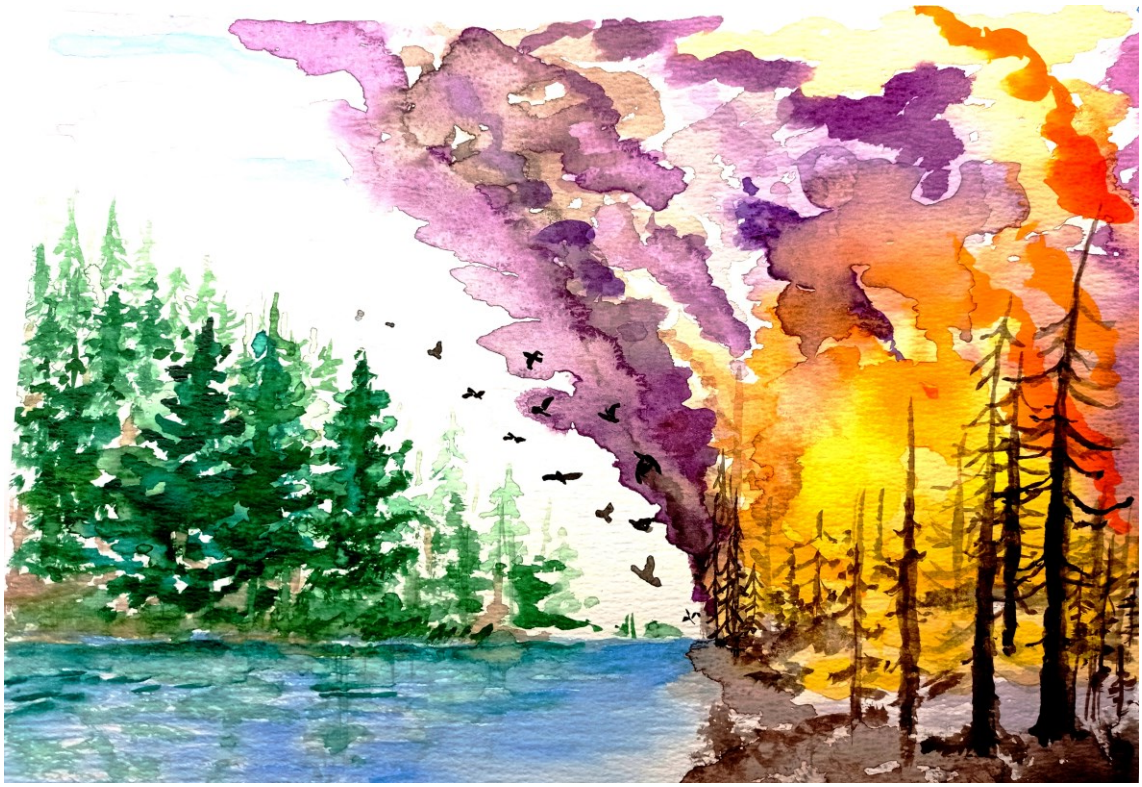

Figure 15 Depletable forests

It was claimed that forests are
national property
a stable, long-term holding
resource of
clean energy

But after logging them down
are they just another source of
carbon and pollution
and instead of forests
there remain only tree plantations

Heating systems with biomass burning were considered to decrease greenhouse gas, especially carbon dioxide emissions (Sutcliffe et al. 2016: 709). Therefore, biomass and biofuels have been regarded as low carbon energy alternatives to displace fossil fuels (Williams et al. 2018: 204) and it was found that cities were interested in it as an energy source (Sabel et al. (2016: 17). Nonetheless, Sabel et al. (2016: 17) mentioned that conclusion of reducing carbon dioxide emissions

through biomass burning “is dependent on assumptions on carbon neutrality which are less and less supported”. According to Sabel et al. (2016: 11), carbon neutrality in this context means the plant’s capability of absorbing the carbon, which combustion releases to be absorbed again by plants.

However, burning of biomass was found to cause harm for human health (see Sabel et al. 2016: 17; Sutcliffe et al. 2016: 709), and these health impacts were found to exceed the benefits from reduced carbon dioxide emissions, at least in terms of societal costs (Sabel et al. 2016: 5, 17). Wood burning causes air pollutant emissions (Sabel et al. 2016: 11–12), such as significant fine particle increases indoors and urban outdoors (Sutcliffe et al. 2016: 709). Fine particulate matter has negative impacts on respiratory and possibly cardiovascular health (Sutcliffe et al. 2016: 709). Also, polycyclic aromatic hydrocarbons developed in wood burning are carcinogenic and harmful for health (Williams et al. 2018: 211). Biomass burning was reported to increase the rates of mortality (Sabel et al. 2016: 12, 14; Williams et al. 2018: 208) and morbidity (Sabel et al. 2016: 12, 14). Alternative low emission fuels in domestic heating and controlled industrial biomass burning were found to be safer (Sabel et al. 2016: 12, 17).

A modelling study of Williams et al. (2018) found that the low-emission energy production scenarios with and without nuclear power constraint, significantly declined the levels of nitrogen dioxide, and attained saved life-years nearly from the start throughout the analysis period. Yet, domestic burning of biomass and biofuels increased in these scenarios, and therefore the concentrations of fine particles and aerosols amplified significantly, which consequently affected public health and increased premature mortality compared to the baseline scenario. Also, long- and short-term ozone metrics were a bit higher in the two low-emission scenarios causing slightly more premature deaths. The combined effects on life years from fine particulate matter and nitrogen dioxide were not presented in the research, because of possible and insufficiently understood overlaps. (Williams et al. 2018: 204, 208.)

Energy-efficiency should be emphasised more in all countries (Gao et al. 2018: 687). Efficiency in residential energy use can be improved for example, by informing people of appropriate ventilation, by renovating and installing energy efficient heating systems in the old buildings, fuel switching, or by developing and constructing low-energy or zero-energy buildings with environmentally friendly, climate neutral materials guided by regulations of construction standards (see Bikomeye et al. 2021: 7; Gao et al. 2018: 690; Prior et al. 2018: 3, Sutcliffe et al. 2016: 710). Yet, Sabel et al. (2016: 10) found that lately projected improvements in housing efficiency and decreased need for heating were planned to be achieved mainly by constructing new buildings, consequently offsetting the decreased emissions. Also, Sabel et al. (2016: 5) discovered in their research, that declines in carbon dioxide emissions are potentially minor. Gao et al. (2018: 690) stated that challenges to decrease residential energy use are complex and therefore all implementations are needed. Especially, energy consumption should be decreased, therefore behavioural changes are required (Gao et al. 2018: 690, 694).

It was found that the implementations in the residential sector curb greenhouse gases, improve air quality both in indoors and outdoors, and have positive health outcomes (Bikomeye et al. 2021: 13; Gao et al. 2018: 691; Sutcliffe et al. 2016: 710). Comprehensive strategy implemented with all residential measures could decrease carbon dioxide levels and narrow down 850 disability-adjusted life years (loss of full health years) per million people annually compared to the levels of 2010 (Gao et al. 2018: 690).

According to the review of Bikomeye et al. (2021: 13), positive health outcomes of mitigating greenhouse gas emissions in the residential sector include decreased incidence of asthma and COPD because of reduced air pollution. In addition, investing in climate friendly low-energy buildings equipped with safe and efficient heating and other devices, might substantially decrease infectious diseases, and prevent chronic diseases, such as cardiopulmonary diseases. For instance, through advanced insulation measures, and improved natural ventilation, the exposure to outdoor pollution and dampness might decrease, and

consequently prevent mould development. (See Bikomeye et al. 2021: 13; Sutcliffe et al. 2016: 709–710.) Also, proper insulation enhances thermal comfort (Bikomeye et al. 2021: 13; Sabel et al. 2016: 13) and reduces illnesses due to extreme temperature, e.g., hypothermia, especially among older adults and small children (Bikomeye et al. 2021: 13). Additionally, measures to provide safe and energy efficient housing might inhibit pests, home injuries, and the use of hazardous or poisonous building materials, for instance (Bikomeye et al. 2021: 13). However, it was stated that building's increased insulation and air tightness with the intention to improve energy efficiency, might even worsen air quality indoors (Gao et al. 2018: 690; Sabel et al. 2016: 13) and drive biological contamination (Gao et al. 2018: 690). Also, wood burning in insulated houses can lead to significantly increased indoor air pollution (Sabel et al. 2016: 12). According to Sabel et al. (2016: 5), health co-benefits rely upon appropriate air exchange. Therefore, it was suggested that sufficient ventilation is essential to arrange in residences, for example a heat recovery ventilation (Gao et al. 2018: 690).

In the research of Sabel et al. (2016:13), it was pointed out that "poor indoor air was associated with poorer well-being". People with lower socioeconomic status, are more likely to experience substantially lower well-being due to housing conditions, such as poor indoor air quality. Also, energy efficiency interventions, such as thermal insulation without sufficient ventilation might increase inequalities because more affluent groups have the possibility to install air conditioning if necessary. (Sabel et al. 2016: 14.)

In the data, there were elaborated some mitigation technologies to decrease the releases in energy production and industry, for instance (e.g., Gao et al. 2018: 687, 691–692; Vineis et al. 2021: 768). One suggested option to decrease carbon dioxide emissions was through the process of carbon capture and storage, CCS (Gao et al. 2018: 687). According to Gao et al. (2018: 687) the technology of carbon capture and storage regulate the carbon dioxide emissions from electricity production, industry, and transport either via pre- or post-combustion. However, in the review of Vineis et al. (2021: 768), it was pointed out that in mitigation

policies, not solely carbon dioxide emissions' reduction can be centred, because then the health co-benefits of broader measures would be lost. By simply applying the technology of carbon capture and storage, the fossil fuel combustion would still discharge certain pollutants, such as heavy metals, polycyclic aromatic hydrocarbons, and particulates (Vineis et al. 2021: 768). In the review of Gao et al. (2018: 687), it was reported that the use of carbon capture and storage might result in poor air quality by increasing the levels of particulate matter, nitrogen oxides, and ammonia from the smokestacks, further endangering the health of people and offsetting the benefits for climate. There have been concerns whether carbon capture and storage technology has detrimental consequences on people, ecosystem, and environment, for example by causing multiple impact of toxics on the freshwater ecosystems. (Gao et al. 2018: 687). Gao et al. (2018: 687) noted that carbon capture and storage has rather been described as "a bridging technology" towards more efficient and carbon neutral energy production still allowing fossil fuel use in the medium term.

Gao et al. (2018: 691–692) found that if all existent control technologies reducing the emissions were enforced, the emissions of black carbon could be declined 50% by 2030. The number of decreased emissions of black carbon could compensate the carbon dioxide released during past one to two decades. Also, the co-emitted pollutants with cooling effect would be declined, though. Therefore, climate benefits would be more moderate. (Gao et al. 2018: 691–692).

Vineis et al. (2021: 768) highlighted that interconnections between mitigation measures and human health need to be recognised in mitigation policy. Yet, there remain challenges to address both climate change mitigation and equitable health promotion "for the most vulnerable groups in our societies" (Williams et al. 2018: 211). In the modelling study of Williams et al. (2018: 209), it was reported that the levels of fine particles and nitrogen dioxide were considerably higher in deprived areas, even after the concentrations decreased. However, the inequality gap regarding air pollution narrowed by 2050 in all mitigation action scenarios. Thus, to maximise public health promotion in the long run, it should be pivotal in mitigation policies to acknowledge the incessant socioeconomic differentials.

(Williams et al. 2018: 209, 211.) Furthermore, it is important to reduce emissions in global scale to prevent transferring the emissions elsewhere (Sabel et al. 2016: 10).

4.5 Global economic system

According to Lowe (2014: 20) with the help of technology, daily life has been made more effortless. For example, cars, household appliances, television and computers have made people's time use more passive and fossil fuel consumption has displaced human energy expenditure (Lowe 2014: 20). Consequently, energy for electricity, industry, and transportation produced with fossil fuels have become the most enormous pollution source besides their massive greenhouse gas emissions (Pathak & McKinney 2021: 545). Gao et al. (2018: 690) stated that industry is the most energy-consuming sector. The greenhouse gas emissions of industry and economic processes was said to be as much as emissions from global agriculture and more than emissions from transportation systems. (Gao et al. 2018: 690.)

Continuous economic development requires constant expansion of manufacture and inventing ways how to make people spend more money. Increases in production and connected overconsumption, but also emissions-intensive technologies increase GHG emissions and accelerate climate change. (Lowe 2014: 21.) Urbanisation, which is an essential part of economic growth, has encouraged consumerism (including throw-away culture), and has increased demand of energy, releases of pollutants and greenhouse gases causing environmental degradation. (Bikomeye et al. 2021: 2.)

In different economic sectors, there are various greenhouse gas releases accelerating global warming: primarily carbon dioxide responsible of approximately 64% of total radiative forcing, and secondly methane accounting for around 23% of radiative forcing with nitrous oxide (Gao et al 2018: 691). Also, other nitrogen oxides, black carbon, fluorinated gases, and ozone are climate-

warming agents (see Gao et al 2018: 685, 691; Vineis et al. 2021: 768). Additionally, black carbon has other possible indirect effects that amplify global warming, such as solar radiation absorption, reduced reflectivity of snow and ice, and effects on clouds. Approximately 93% of human induced black carbon have come from industry, transportation, and housing. (Gao et al. 2018: 691.)

The economic system has caused air and other pollution. Industry has discharged for example particulate matters, including soot, sulphur dioxide and nitrogen oxides, directly inflicting health. It was reported that in the UK in 2012, the combustion releases from industry caused approximately 830 annual premature deaths. (Gao et al. 2018: 690.) In addition, over 140 000 new chemicals have been developed past decades, humans being extensively exposed to 5000 different of them, including pesticides, neurotoxic substances, endocrine disruptors, and plastics due to industry and fossil fuel production, for instance. Negative impacts of different chemicals were said to be recognized gradually, and avoidance of their exposure is recommended. (Pathak & McKinney 2021: 545.) Moreover, prevailing plastic consumption demands resources and releases greenhouse gases immensely. Plastics accounted for about 5% of the greenhouse gas emissions worldwide in 2015, and plastics have substantial impacts on people and environment. (24 Pathak & McKinney 2021: 545.) As mentioned before, especially socioeconomically underprivileged, and different minority groups live close to the polluting sources and are exposed to air, soil, and water pollution but also noise and excessive outdoor light (Pathak & McKinney 2021: 546).

There remain climate and health concerns of some certain industrial fields. One example is tobacco industry, which has caused substantial impacts on public health and has a massive carbon footprint. (Vineis et al. 2021: 765.) Smoking resulted in approximately 7 million deaths in 2015 (Pathak & McKinney 2021: 545). Tobacco use causes respiratory and cardiovascular diseases among other diseases, and it accounts roughly a third of the deaths caused by cancers (Vineis et al. 2021: 765). According to Vineis et al. (2021: 765) annual emissions of one tobacco manufacturer from energy use is more than 4.5 million tons, accounting

energy emissions from manufacturing and clerical work, transportation, distribution, and purchasing.

Economic benefits are often distributed unevenly within society and economic growth has further increased inequalities and chronic stress. For example, labour-saving technology has increased unemployment and decreased physical activity, and hence the disparities in wealth have grown. However, economic growth has reformed working life by creating new duties for unemployed people, but also extended working hours because of the ideology of productivity and increased consumption. Through consumerist culture and “social status competition”, people are pressurised to consume to enhance their social positions. Additionally, long working hours have made people seek ways to spare their limited free time by consuming effort-saving technology and ready-prepared food contributing to obesity. (Lowe 2014: 21.)

Lowe (2014: 21) highlighted that continuous economic growth, and its ability to generate goods, services, and work, cannot be associated with well-being or offered as a solution to every social question anymore on a planet with limited natural resources. Gross domestic product, GDP, which measures economic growth, has been misunderstood to measure the progress of human well-being as well. It was noted that although economic growth in low-income countries is important for improving well-being, in high-income countries further economic development does not enhance well-being anymore and might even weaken it. Besides, gross domestic product measures the market value of all produced and purchased goods and services, even though these goods and services would indicate health issues, for example increased use of health services. (Lowe 2014: 21.) Lowe (2014: 22–23) suggested that to slow down the destructive economy founded on production and consumerism, first act would be de-emphasising economic growth as a main goal in policy. Instead, progress could be measured with “well-being index or gross domestic happiness” (Lowe 2014: 23).

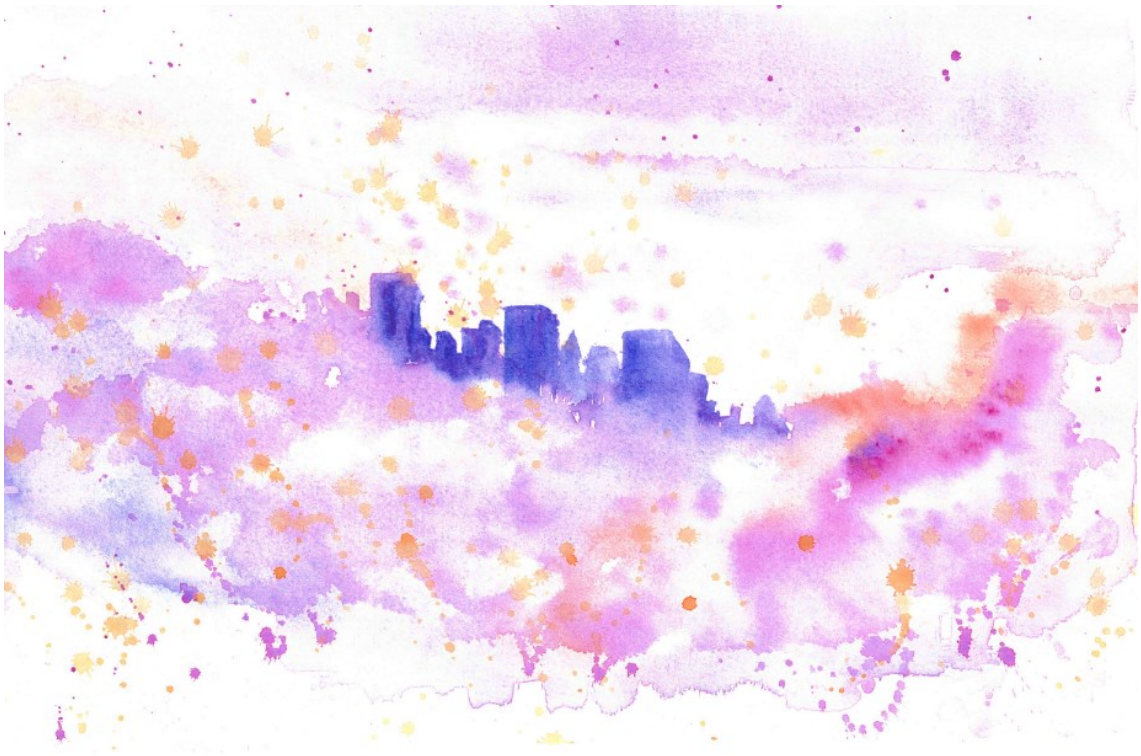

Figure 16 Settling smog

We have created a world around us
Built larger and greater
more highways, buildings, material
so much
that their mass exceeds
the mass of all organic and living

We might move fast and freely
every day, everywhere
around the world
but could we try to see more clearly
what we need
And let the smog settle

According to Sabel et al. (2016: 14), local governments are possibly concerned of slowing down the economic growth by limiting the polluting production although there are possibilities for green economy. Lowe (2014: 23) suggested that reforms in labour market could decrease both obesity rates and releases of

greenhouse gases, if the employment is relocated “towards sectors that are less resource- and emissions-intensive, and more labour-intensive” and working hours reduced. Transfer towards green economy could create work that increases people’s physical activity, for example, in small-scale agriculture, recycling and resource circulation and in renewable energy industry, but also in services providing public transportation, and energy services. Yet, Sutcliffe et al. (2016: 710) mentioned that there remain some concerns in resource circulation and energy saving technologies, such as possibly toxic releases during processing, for example in burning of waste. Another suggestion was that working hours could be reduced to spare time for more sustainable activities, such as bicycling to work rather than driving and growing vegetables or other fresh food. Reducing of working hours was mentioned to relieve the pressure for constant economic growth and work creation. These labour market reforms provide possibilities for increasing the levels of employment and therefore decreasing the income disparities. (Lowe 2014: 23.)

By narrowing the income inequality gap, it is possible to reduce social status rivalry that has advanced environmental and health issues related to consumerism, such as unevenly distributed obesity and vulnerability to climate change. Income inequalities can be decreased by taxation, such as progressive taxation rates and inheritance taxes, and by welfare payments from the most affluent people. There were mentioned also the possibility of personal emissions trading, which means that the emissions are allocated as units among all individuals and these units used when buying products with higher greenhouse gas emissions. This might urge on decreasing consumption. The spare units could be traded and poorer individuals consuming less are able to earn by selling the left-over units for the wealthier high consumers. Emissions-intensive production or companies could be taxed more, and energy-efficient manufacturing could be provided incentives to direct pricing of unsustainable products (Lowe 2014: 23.)

Think of life
with a slower pace
You deciding
what you value
and how to live

5 Conclusions and discussion

With literature review and autoethnographic inquiry I wanted to build evocative interconnections between climate change mitigation actions and human health. In this chapter, I describe current knowledge of how climate change mitigation implementations intertwine with public health in high-income countries based on literature review findings. I reflect the findings to theoretical framework and ideas behind this master's thesis together with reflections from the artwork. After discussion, I elaborate how I used art-based approaches to process understanding of the topic. Then I discuss the reliability, elaborate on some knowledge gaps, and propose further research topics.

5.1 Literature review conclusions

According to the findings, climate change mitigation actions have interconnections with human health in many ways. By alleviating the greenhouse gas emissions in five different sectors (food industry and nutrition, transportation, energy generation and use, industrial processes, and in infrastructure), it is possible to promote public health for example by attaining healthier food intake, improved air quality, increased physical activity and social contacts, and safer and more pleasant environment. These might decrease levels of non-communicable and infectious diseases and improve mental health. Furthermore, it seemed that majority of mitigative measures of the findings were linked with decreased health disparities, and some might promote people's economic and social equality or equity.

In the literature review it was found that livestock production accounted the greatest share of the agricultural emissions, even up to 80%. Livestock production in agriculture contains the production of meat, dairy, and eggs. Particularly consuming red and produced meat was found to be the most harmful

for human health, besides its largest carbon and environmental footprint. It was stated that especially high-meat consumers, benefit from decreasing the daily intake of meat. The prevailing dietary patterns are mainly characterised by high-processed energy-dense food for the most part from animal sources, consisting of especially saturated and trans fats with less fibres and micronutrients and higher greenhouse gas emissions. Thus, it is beneficial to shift towards plant-predominant diet with more nutritious legumes, vegetables, grains, nuts, and seeds. For instance, the increased intake of plant-based food decreases non-communicable diseases and infectious diseases declining overall morbidity and mortality. Yet, there remain few concerns, especially regarding vegan and vegetarian diet's sufficient nutritional intake, such as essential amino acids, B12 vitamin and iron. However, it was stated that unhealthy diets with less plant-based foods expose to inadequate micronutrient intake, as well. More sustainable practices in agriculture, would likely to decrease infectious diseases, occupational hazards, and enhance food security. Allotment gardening, instead, might promote healthy food intake, pro-environmental behaviour, and health inequity.

Energy sector and other sectors expending energy, e.g., transportation and industry, have emitted enormous amounts of greenhouse gases and become the largest sources of pollution. It occurred that it is beneficial for health to curb the greenhouse gas emissions from energy generation and use, transportation, and from industrial processes because the sources of greenhouse gas emissions and air pollutants are mainly the same. By enhancing ambient air quality, it is possible to reduce morbidity and mortality by decreasing the levels of air pollutants, which are detrimental to cardiovascular and respiratory health but also to all organs. Renewable energy alternatives, such as wind energy, were mentioned to significantly decrease greenhouse gas emissions and pollution.

It turned out that there are different methods for decreasing the greenhouse gas emissions in these sectors, and not every measure was improving health nor decrease the overall greenhouse gas emissions efficiently. For example, sometimes releases were transferred elsewhere instead of decreasing global

emissions. One example is electric cars if they are charged with fossil fuel energy mix. It was stated that green shifts in energy production might require remarkably increased biomass burning alongside. Production of biomass, instead, might release additional greenhouse gas emissions because of deforestation, and the use of fertilisers, for instance. Especially, domestic biomass burning was found to increase the levels of particulate matter inflicting health. Also, some low-carbon energy technologies, such as carbon capture and storage, did not decrease the pollution and might have other detrimental consequences to environment and human health, as well.

According to the findings, the transportation sector has required 60% of total global oil demand and 30% of the global energy delivered and further, the volume of traffic was projected to grow over the years. Therefore, to decrease the greenhouse gases, both measures were suggested to be done: fleet electrification and reducing the use of private vehicles. Electric vehicles were found to decline air pollution, thus have health co-benefits, but forthcoming increases in transportation would likely moderate the reduced particulate emissions. However, vehicle electrification does not respond to the remaining issues that car-centricity and traffic has caused, for example, sedentary way of travelling, increased obesity risk, noise pollution, traffic accidents, and other safety concerns, encroachment, and infrastructural barriers limiting people’s physical activity.

Nevertheless, more prominent active travel (walking and bicycling) and efficient public transport could decrease the greenhouse gas emissions from transportation, and concurrently enhance health because of increased physical activity, and social contacts, decreased levels of non-communicable diseases and mental illnesses, improved safety, and equity of accessibility, for example. Some concerns of active travel and public transport were increased traffic injury risk, exposure to air pollution, and the need to invest in functioning infrastructure. Nevertheless, both fleet electrification and decreasing the use of motor vehicles by increasing the use of active travel and public transportation, are needed, and there should be equal possibilities to choose between these means of travelling.

When considering global economic system, it was suggested to de-emphasise economic growth and consumerism which have caused increased energy expenditure, and growing releases of greenhouse gases and pollution, but also physical inactivity, and unemployment because of changes in working life, household duties, and travelling. These were claimed to have contributed to social, economic, and health inequities, chronic stress, and obesity. There were proposed reforms in economic processes, such as labour-intensive work, reduced working hours, and employment in green economy which could decrease obesity rates and improve financial equality, for instance. Although climate change mitigation measures and their health aspects were distinguishable in the findings, there were not stated evident associations between mitigative measures and public health regarding global economic system.

Increases in the amount of greenery and water bodies in urban areas was found to create carbon sinks and simultaneously advantage health by encouraging to physical activity and social interactions, promoting the body's natural resistance to diseases, and by improving mental health, and resiliency – thus even safety. Nonetheless, increasing natural environment in urban areas might raise complex questions, because it could increase pollen, pest dispersion, transmission of vector-borne diseases, and inequity issues. Yet, certain moderating means, supporting of high natural biodiversity, and taking account regional imbalances might prevent some of these issues. Consequently, also the relations between mitigative green and blue infrastructure and human health, need further examination.

Overall, to curb greenhouse gas emissions and achieve co-benefits for public health there was stated that it is required to replace the modern food production and consumption with more sustainable practices and predominant plant alternatives, decrease the use of personal vehicles and electrify the transportation, amplify the amount of carbon sinks, shift towards renewable energy from fossil fuel energy consumption, decrease the energy demand, change the harmful economic processes, and de-emphasise economic growth

and consumerism. The reforms required are enormous, and it is compulsory to examine health aspects also allowing for minorities to find the best solutions for the environment and for all humans equally. Different aspects that prevent from making the needed reforms, such as individuals' behaviour, harmful marketing, and some other economic processes, lobbying, and different barriers hampering policy interventions, should be considered in the shift towards pro-environmental behaviour.

5.2 Discussion of evocative interconnections

Both theoretical framework and the extensive literature review produced evidence of the prevailing lifestyle in high-income countries that has caused climate change and health issues in global scale. More importantly, they produced evidence of certain mitigative measures' distinctive co-benefits to public health which needs to be implemented in further decision-making in policy and daily lives. It was reported that individuals themselves could profit from these health co-benefits even in the short run, while climate change mitigation benefits might be more difficult to notice (Bikomeye et al. 2021: 10). Gao et al (2018: 694) found that more practical and personally meaningful examples of mitigation actions' health co-benefits would "play a more persuasive role" to make people to change their behaviour. Therefore, behavioural changes and their impacts on reducing the greenhouse gases and achieving health gains should be considered more in scientific research and policy interventions, concerning for example transportation, energy, or food industry reform. (Gao et al 2018: 694.) With the poem presented in the end of the chapter of findings, I wanted to express that although the changes required are major, they might provide new opportunities to make life more enjoyable, as well.

The shift towards plant-based diet is well reasoned, due to remarkably lower dietary greenhouse gas emissions, and numerous benefits for health. Yet, there remain some concerns, for example adequate intake of iron and B12 vitamin.

Although, a study that was excluded from literature review's articles, confirmed that non-heme iron is less bioavailable than heme iron of meat, but certain beans with relatively high contents of iron, might prevent from anaemia (see Robinson et al. 2019: 206–207). Lonnie & Johnstone (2020: 282) highlighted that plant-based diet should be planned in international level to answer to the global need for "healthy, economically fair and culturally acceptable" diet, emphasis on the environmental objectives rather than food requirements for certain population groups. It is crucial to tailor interventions in a way that health inequities are decreased. Accordingly, it was found that the shift towards more sustainable food intake and significant reductions in dietary greenhouse gas emissions were possible in every income group. (Lonnie & Johnstone 2020: 288.) Prior et al. (2018: 3) suggested both social and agricultural interventions to advance adopting plant-based diets, decrease undernourishment, and increase social stability.

Literature review findings brought up some points of the barriers in policy interventions, such as industry's pressure and stakeholders' conflicts of interests, that prevent from making the changes towards more sustainable life habits. Also, government's policy in Finland seem to lack interest in shifting towards plant-based diets. Governmental Climate-friendly Food Program has been prepared since 2020 but in the end of the year 2022 it was still postponed (Elonen 2022a). According to Elonen's (2022b) article in Helsingin Sanomat 4th October 2022, the draft of climate food program was done already in the spring 2021 by public servants, but since, some guidelines concerning meat and dairy consumption have been altered or deleted. While painting a cow and a calf in aquarelle "Inseparables" and writing the poem, I thought of the prevalent false impressions concerning meat and dairy production. I thought of meat and dairy industry in Finland, their powerful marketing and lobbying that has been going on for decades possibly interfering in the national nutritional and food recommendations but also health care professionals' and citizens' attitudes.

Recently, the Finnish Central Union of Agricultural Producers and Forest Owners (MTK) ordered a study of Finnish diets' climatic effects from Envitecpolis Ltd.

According to the non-peer-reviewed research, four different kinds of grocery bags were formed from the S Group's grocery store purchases. The vegan and plant-based grocery bags were left out from the study, because, according to the study report, this data did not stand out from the grocery data. The grocery bag that contained fish and eggs but no meat and dairy products, had the least carbon emissions evaluated by CO2 nutrient density index. (Arfman 2022.) After publishing the non-peer-reviewed research in February 2022, the media seemed to summarise the results in a way that made the public understand that the omnivore grocery bag was the most sustainable one – and did not mention that the vegan and plant-based diets were excluded.

I wanted to emphasise the need to decrease dairy products to mitigate climate change, and so I painted cottage cheese pot with pine sprouts in aquarelle "Shift towards sustainability?". Initially, it was unintended that I had set the pine seeds in that certain pot, but later I saw its symbolism of transitional stage between unsustainable and sustainable choices when making the changes, and I wanted to express that. By painting a pretty picture of rye field with cornflowers in "Goodbye monoculture", I wanted to illustrate agriculture that promotes biodiversity, and increase also the positive mindset of cultivation of food.

Energy sector, transportation, and industry need transformations because of the releases that cause climate change, environmental degradation, and health hazard. With the aquarelle painting and the poem "Gas flares" I wanted to highlight the hidden fossil fuel production and the need to find alternative energy sources. Yet, the green shift in energy generation is complex, and for instance, the shift was projected to increase biomass burning, which significantly increases ambient air pollution in indoors and outdoors impacting especially pulmonary and cardiovascular health. It was also mentioned that biomass production has consequences on ecosystem, which I wanted to express in the painting of "Depletable forests". The words "stable, long-term holding, and resource of clean energy" in a poem were attached from the Internet page of a national forest industry company, and in the poem those words are questioned. Other renewable energy alternatives instead, for example wind energy, were mentioned to

significantly decrease greenhouse gas emissions and pollution, but they are not entirely unproblematic, either.

It was stated that economic growth has contributed to climate change but also impacted public health and income disparities. In addition, economic growth, consumerism, and current working life with pressure into productivity, might have increased experienced distress. Pathak and McKinney (2021: 545–546) elaborated that there is an interconnection between chronic stress and physiological changes that provoke certain diseases, not to mention some responses to stress such as comfort eating or substance use. One suggestion to change the predominant economic system was to de-emphasise economic growth. Also, for example by decreasing the working hours, people would possibly have less stress, more spare time to put some sustainable choices into action and additionally the income gaps might be narrowed. Technological progress and daily devices that facilitate work, everyday chores, and travelling, have shift the energy expenditure from human activity to generated power. This might have made life easier, but what are the costs regarding climate and inactivity and sedentary lifestyle? The poem and the painting “Settling smog” presented both current detrimental behaviours impacting environment and the meaningful choices that people can do to make the world a better place.

In the mitigative implementations of transportation, there were found significant health co-benefits and reductions in greenhouse gas emissions. However, some questions, and trade-offs emerged, especially concerning electrification of vehicles. At best, electric vehicles have no tail pipe emissions, but the electricity produced might have released greenhouse gases and the electric vehicles release particulates because of tyre and brake wear. In the research of Maizlish et al. (2022: 431) the limitations and biases of present scientific research and policy concerning transportation reform were well crystallised:

> “Recent national blueprints to achieve carbon neutrality clearly favo[u]r vehicle electrification and understate the role of active travel. These documents do not question the hegemony of car-centric transportation or the impacts of their plans on the social

> determinants of health, and existing health and racial inequities." (Maizlish et al. 2022: 431.)

According to the findings, motor vehicle fleet electrification seemed to be an essential objective among decision-makers, and it appeared that active or public transportation have not been enhanced equally. I painted the aquarelle "Stop before the stop line" of traffic light turned red. With hindside, I should have painted pedestrian signal with green light, as well, to signify the time and place to make policy decisions to advance active travel. The painting could be a quiet manifest of the ongoing problematic car centric policy.

The literature review findings of public transportation and active travel indicated climate change mitigation and multifarious co-benefits for health and well-being, also from the perspective of equity. Active travel and public transportation were found to increase physical activity and social contacts. Yet, Glover et al. (2022: 3–4) noted that in urban life constant encounters with multiple strangers make people want to remain inconspicuous and anonymous, which might even strengthen the feeling of isolation and loneliness among the ones experiencing them. However, routine encounters make strangers become more familiar to each other over time, possibly enabling to establish social contacts. (Glover et al. 2022: 3.) Regardless, I am optimistic that these kinds of manifold and weighty arguments for public transport and active travel, would most likely change ongoing policy concerning mitigative transportation interventions sooner or later.

The aquarelle painting "Passages" of a cyclist in a city crossing the street with yellow taxis parked across could represent transition from private cars to another ways of travelling. This painting made me think of possibilities to use bike or public vehicles, such as buses, metros, taxis, or rental cars instead of private cars. It made me think of ambient air pollution and traffic perils that the cyclist is exposed to until the number of vehicles in roads has decreased. I also thought of prospects of how the street would look when cars would not dominate the view. The colours I used illustrated hope and joy in the passage from prevailing

sedentary way of travelling to more active and climate-friendly ways. Another painting “True freedom” of a cyclist bicycling towards sunset expressed happiness and freedom from the cruelty of fossil fuel production.

Both fleet electrification and decreasing the use of private vehicles are needed – the latter alternative specially to decelerate projected increases of motor vehicles. Maizlish et al. (2022: 426) pointed out that the key question remains, that “how to best optimize simultaneous health and climate benefits and to what extent health benefits potentially offset implementation costs”. There are many viewpoints, but when considering health and well-being benefits, active travel most likely overcome the other options. Also, convenient public transport accessible for all, promotes health and equity.

Increases in the amount of greenery and water bodies in urban areas was found to create carbon sinks and advantage health by encouraging to physical activity and social interactions, and by improving mental health and thus even safety. One idea of increasing greenness was visualised in the painting “Covering with green”. Nonetheless, increasing natural environment in urban areas was stated to be complex and it might increase pollen, and even pollution, promote pest dispersion and transmission of vector-borne diseases, and there remain equity issues. In a study concerning justice in nature-based solutions in climate change, Wijsman and Berbés-Blázquez (2022: 136) raised a question of “why and for whom greening initiatives in cities are realized and with what kinds of ‘beneficial’ consequences”. In the review of Salmond et al. (2016: 104–105), it was acknowledged that there were socio-economic discrepancies in tree density between different areas and their maintenance capacity. Possibly residents in poorer regions regarded the street trees as a nuisance and financial burden, thus increasing tree density might even deepen the environment injustice, preventing disadvantaged participating in decision-making process of urban development. (Salmond et al. 2016: 104–105.)

It was found that urban green areas cannot replace natural areas, although they are seen as valuable for ecosystems. The complexity was expressed through the

paintings and a poem of “Whispering trees” and “Taking fight” with fleeing birds. The poem and the painting of ”Recovering forest” highlighted the need for protecting natural areas, also in urban infrastructure. Furthermore, it was found in the literature review that well-planned green and blue infrastructure might prevent these issues and avoid health problems. However, unambiguous conclusions between green and blue infrastructure, climate change mitigation and human health are difficult to establish, and this topic requires further examination.

Additionally, interdisciplinary work between different fields and branches of science is needed more, to understand the complexity of the issues and their solutions. Health was stated to be under-represented in the debate concerning climate change mitigation. Yet, according to Thomas et al. (2014: 274) some pivotal decision-makers of national health do not give precedence to climate actions or climate threats in health sector. The problem is that different departments are responsible of climate and health, and the work is siloed (Thomas et al. 2014: 274). This could be discussed also in the academic education.

5.3 Emotions in the process

At first, I felt angry and sad – that is the burden of knowing too much. I needed to dive deeper into the scientific world of climate change while I constructed the research design and theoretical framework for this master’s thesis and carried out the literature review. I started to follow influencers raising climate issues from scientific perspective on Instagram to understand the issue further. At the beginning, the more conscious I became, the more sadness and anger awakened. These thoughts and the anxiety I felt, were visible and almost tangible in my poems. Sometimes I felt that they are not publishable, and they do not give hope to anyone. Painting instead, felt so grounding and calming that my anger was flushed away when brushing watercolours on the paper. Only grief and

fragile insecurity towards future and my role in it remained, and I let them out disguised as colourful works.

Figure 17 Mirroring the inner

While I proceeded in my work, I read quite a lot of climate change and the entangled problems. Instead of just being horrified of all the issues raised up, I started to feel thankfulness for the fact that the issues were brought up by someone. I was there to read those issues among plenty more people. Instead of being sad, mad, and insecure, I felt empowered by and proud of all the people who cleared the way for the change. Moreover, I felt hopeful, especially when I saw someone to take climate or environmental action with arts. My anxiousness towards global warming also eased when I started to make the literature review, because my perspective to climate change was from health promotive angle and it forced me to concentrate on the positive side of changing the current lifestyle for the climate.

During the study process I started to interpret the environmental, economic, social, and health issues more broadly and I began to see them in a complex map

of these interconnections with reciprocating motion, as complex as life is. The firstly introduced aquarelle, “The web of life”, illustrated the webbing between different people, their acts and omissions impacting to environment and health.

One rip
can be fixed
but larger apertures
will make the whole web frail

The most difficult part to understand and accept has been that there are so many players with different aims and desires in the world, and some of them are so powerful that my acts feel insignificant. Then, I force myself to think that the ones who are holding the power represent only a fraction of very privileged people and the rest, most of the population, might want things to change for the best. And eventually, majority holds the power. That is why, I started to develop an interest in climate justice movement which made me see that power shifts might be on their way.

I have also made a journey from ignorance to awareness, and I have come a long path since just few years ago when I started to realise the gravity of the situation with global warming. Since, I have learned a lot, but simultaneously I have forgotten that I did not know all this information before, either, and I also was a naive Pollyanna about climate change and environmental issues. I forgot all this and waited everyone to understand my viewpoints and got frustrated if someone argued against the need for changing certain modern life habits. Additionally, I, myself, cannot always make the best choices in my life despite awareness, therefore it is controversial to become irritated if someone else struggles to make the changes, too, without weighty reasons. Yet, issues regarding climate, and health, for instance, are deep-rooted, and it is necessary to acknowledge the harmful patterns of thought and behaviour maintaining the status quo.

At this point, as I mentioned, I do not want to judge anyone anymore, because the conversation is quite impossible to continue after doing so. Nonetheless,

when I wrote the first actual poem for this autoethnographic inquiry, it was clearly judging. I wrote it right after I had spoken to my dear friend about my master's thesis, about mitigative actions, and how I wanted to make sustainable lifestyle a norm, and how this thesis could be the way to do it. We also talked about air travelling, a topic that strikes a chord with a lot of people for and against. I told how I miss travelling and that I cannot justify myself holiday flights anymore. My friend wanted to console, but I took my friend's well-intentioned words to heart and made a poem of them. Obviously, the words are disconnected from the discussion and do not give a picture of my friend, her way of thinking or living. I added to the beginning some words that had been brought up by few climate activists and influencers at that time. This poem makes visible my repressed anxiety, and a need for channelling the difficult emotions and tricky discussion topics.

I am privileged
I have got every right
and for that I'll fight

Who causes this, it mustn't be Finns
but the distant others, in some other place
And it doesn't impact us, anyways

So, don't feel distressed, don't think about that
It can't be that bad
That you need to feel quilty and sad

We do a lot already, don't we
lot of good choices
So where is the shift needed?

I left this poem behind and after six months, I read it again. I noticed how awful it looked when these accusing words were written down, even in a form of a poetry, even if some of these are actually said on daily basis. I started to think of the emotions that are hidden behind anger and sadness, or denial, the emotions that are more vulnerable ones and are preferred to be hidden. Pain of admitting the status quo. Disgrace and guilt of making unintended errors. Grief of letting go and

fear of facing the instable future. These words said aloud are like tears that are at liberty to roll down and when these inmost emotions are released, the mind could be cleared to something brighter and new – to new thoughts and probably a new way of living. So, after processing my vulnerable feelings, I was able to write a new poem and I thought of my dear friend, and me.

Too much time has passed
But we'll all do that
In our own pace
The meaningful journey of letting go

Final goodbyes
For the previous life
Rapidly or gradually
First waking up, pondering, contemplating
Denying, and again admitting
The reasons that feel uncomfortable, embarrassing
Difficult, unreachable, frightening

And when it is time
We'll abandon some habits
Small great ones
Meaningless, meaningful
Important and insignificant for us
We give up and we are given
Something priceless

And eventually, we say farewell
We say
Welcome new lifestyle
More free, happier, like us

Figure 18 Glimmer of hope

5.4 Reliability

There were quite diverse research articles addressing the health aspects of mitigation actions, and I chose the ones providing the most versatile selection of them. By versatility, I mean studies that encompassed different aspects of what are the interconnections of climate change mitigation measures to public health: both health co-benefits and trade-offs of mitigative actions in different sectors.

In this phase, there was a possibility of subjective biases impacting in the selecting process of final research articles. For example, when choosing papers regarding transportation measures and their health aspects, I prioritised the ones that comprised all three ways to curb the greenhouse gas emissions (fleet electrification, public transport, and active travel), although there were articles presenting only electric cars', and public transportation's health contributions. Some research articles that I skimmed through (e.g., Chapman et al. 2016: 384; Maizlish et al. 2022: 431; Sutcliffe et al. 2016: 710) brought up social and health

issues of electric vehicles and compared them to other mitigative strategies in transportation sector. I considered that these articles provided more perspectives than just health benefits of electric vehicles and chose two of them. Yet, I cannot say for sure, that did I want to choose the papers that emphasised the benefits of public transportation and active travel and verbalised their supremacy in health co-benefits over the electric cars – especially because electrification of vehicles has lately been placed in the central when discussing of climate change mitigation measures in policy and everyday life.

I excluded the research articles that had clear affiliations with associations of industry. However, I might have excluded articles under false pretences. One of the excluded research articles was conducted with Food and Agriculture Organisation and it reported the livestock food production's role in providing food security and sustainability. For me, the article seemed to dispel the problems of livestock production and herbivores without addressing any ethical issues or declaration of interests, but I, myself, might have had biases that made me exclude that article. Also, because I am not aware of all associations' interests around the world, there is a possibility that some of the chosen research articles might have had funding from organisations engaging in green washing, for example.

Because this master's thesis was a qualitative health research, I possibly preferred studies that involved as much qualitative data as possible. However, if the article provided valuable and reliable knowledge of the subject, I chose them regardless quantitative approach, because study design was not limited. According to Dixon-Woods (2004: 2, 29–30) in qualitative review, synthesising data from different traditions, such as quantitative approaches, can further convergence but it can be questionable, as well. In addition, low competence of quantitative approaches and methods, decreased the dependability of the synthesis.

Majority of the research articles were reviews, and although it can be problematic, for descriptive review it was important to include what has been found in scientific

field. Moreover, by including previous review studies, the data of the literature review was more versatile. Yet, because the results of the reviews were already synthesised, the report had third-order constructs (see Dixon-Woods et al. 2004: 30). Therefore, the whole context and limitations of the data do not transpire in the review and cannot be assessed. Six of the review articles did not assess quality of the used data, which reduced transparency of the review articles. Some of these articles were seemingly narrative reviews. Xiao and Watson (2017: 95) found that narrative reviews are the least rigorous, because they are concentrated on collecting the applicable information supporting authors' arguments and does not emphasise evaluating the quality of the research. There is a risk that narrative reviews are biased by subjectivity (see Xiao & Watson 2017: 95). However, these studies were peer-reviewed, and were selected according to inclusion and exclusion criteria. All other studies evaluated with CASP checklists for systematic review and cohort study were found to be adequate. The references in four different reviews were a lot older, some of them published starting from 1990, which might have provided outdated knowledge.

Halonen et al. (2021) stated that climate change requires interdisciplinary work and climate change related research must be done in multiple disciplinary fields. For the literature review, the papers that I used as a literature review data, had approaches from different and even multiple disciplines. Because the literature review data was from different scientific disciplines, some concepts and terms were difficult to understand, and there might be some misinterpretations. For example, to understand the distinction between preservation and conservation at some level, or what means clean energy technology, made me extra investigation work. Because the research topic was vast and complicated, I cannot assure that I comprehended all the concepts correctly, and especially I was not aware of the perspectives and assumptions, the paradigms, behind different disciplines. I noticed that some of the comparisons between different sectors' greenhouse gas emissions varied a bit depending on the research. For example, there were variation of how much agricultural sector was producing greenhouse gases, and how much different sectors released emissions compared to the others.

In the data, some words were indeterminate, such as “carbon emissions”. It was challenging to know whether carbon refers to carbon dioxide emissions, or greenhouse gas emissions generally, but I chose from these two options according to the context. Some articles expressed greenhouse gas emissions accurately even with carbon dioxide equivalent measure.

When considering the findings, some research gaps appeared. In few review articles, it was stated that especially empirical data for establishing reliable associations between mitigative measures and health aspects is needed. For example, in the review of Gao et al. (2018: 693), it was noted that especially intervention and surveillance studies of mitigation implementations’ health co-benefits should be conducted. Some cohort studies chosen for the literature review, filled this gap, but still there remained some questions, for instance regarding causality between green infrastructure and public health and well-being. For example, in the review of Demuzere et al. (2014: 110) it was found that good access to green areas in urban environment was linked “with higher physical activity levels, and a lower likelihood of being overweight or obese” and concurrently it was emphasised that it is difficult to find causal effects. What if people who are initially more physically active, value neighbourhoods with possibilities of outdoor activities over other conveniences and properties in housing? What if only some people could move to areas with greenness or blue spaces, for example only the wealthy ones? This is one potential reason why it is difficult to establish causal relationships between certain mitigation measures and health co-benefits.

Moreover, there was lack of some supplementary knowledge. For example, it was found that all livestock food production needs to be decreased, but the data emphasised especially decreasing meat consumption. What the research findings did not describe was dairy production’s position in the meat production: how cows need to deliver calf to keep milk production up, which simultaneously profit meat production (Brombin et al. 2019: 17). Also, health consequences of dairy products were not examined very much.

In addition, the findings did not cover all the important mitigative measures. For example, decreasing of air travel was conspicuous by its absence, although aviation is the most emitting and harmful mean of travelling (Falk & Hagsten 2020: 22969).

Inequity issues and solutions should be acknowledged and discussed in every mitigation strategy. The findings presented few aspects of health inequities, but the issues of structural racism and the aspect of climate justice were tangential. Either there were no discussion whether more sustainable lifestyle or activism for it, can promote mental health.

What needs to be kept in mind, is that this master's thesis had only narrow perspective to the two enormous issues we are confronting. There are still multiple other factors that accelerate global temperature rise and increases global burden of diseases. Some of them are human-induced, and some of them are not. This study took part in the cultural discussion of how to change some of the harmful habits and operations into more sustainable ones. As everyone is needed to make the structures change in our society – individuals, corporations, policymakers, and other stakeholders – there were different aspects for the mitigative actions. However, there remain still many questions concerning the whole picture.

Did I understand enough of the climate system
of radiation balance
climate sensitivity
and its different variables?

Did I apprehend
the complex system
of natural environments
the biodiversity, the nature's value itself?

Did I consider enough
of the economic aspects?
Did I purposefully left unsaid
what economic progress has meant for our wealth, my wealth?

Was I aware of
the real carbon footprint
of people, corporations, countries?
And did I emphasise enough of the responsible?

Did I recognise
equality, equity
and climate justice
before all these mitigative actions?

What I acknowledged was complexity of health
interfering with environment, culture, and wealth
And to understand these networks between
We need interdisciplinarity

5.5 Propositions for further research

This master's thesis provided some knowledge of how climate change mitigation implementations intertwine with public health in high-income countries. The research was implemented to give reasons for people with higher incomes, thus higher carbon footprints, to act for the climate: to decrease the greenhouse gas emissions and require change. Similar research concerning mitigative measures' health co-benefits in low- and middle-income countries is needed, as well. Gao et al. (2018: 694) mentioned that "both climate and health benefits are typically greater in developing countries" compared to high-income countries. In social and health field and in health research, it is essential to take climate and environmental into account, to understand human health and well-being more holistically and to give people more reasons to act for the climate and for their health. However, not everyone is interested in environmental issues nor promoting health, therefore multiple viewpoints and approaches should be harnessed to encourage as many people as possible to act urgently.

This research touched on a topic of mitigation measures' diminishing impacts on health inequities. This viewpoint was stated at some level in every mitigation strategy reported in the findings. Additionally, I found some overviews of how

mitigative and adaptive actions promote justice and equity in society. For example, Wolf et al. (2021: 1753 – 1756) reviewed commentary articles published in scientific journals that addressed mitigation policy and social justice. The mitigative measures in decision making that might improve justice, were found to be food production reforms and healthy plant-based diets, protection of natural environment, renewable energy and energy saving, policy supporting economic degrowth, and population policies. For example, curbing of population growth as a mitigative action might promote justice, if it is about enhancing education, health, income equality, accessibility to voluntary family planning services, and integrity of girls and women. (Wolf et al. 2021: 1753 – 1756).

To understand what is equitable and just, it is important to define what the needs and obstacles are from the diverse viewpoints, especially regarding vulnerable people of the population. Which mitigative measures decrease health, social, and economic disparities and on what grounds? What is required to be considered in these measures? For example, at best, public transport might be affordable and accessible, but could it be barrier-free and safe for every population group? Therefore, mitigation measures should be considered carefully from multiple vantage points, so that the mitigation measures and health do not become exclusionary. Thus, future research could survey how different mitigation measures are seen from diverse perspectives, for example by minorities regarding their ethnicity, race, religion, gender, or sexuality, persons with disabilities, or women, children, youth, and elderly from different backgrounds.

Klein (2014b: 5, 7) suggested that rather than just inspecting the adaptation and mitigation measures of climate change, the approach of climate justice emphasising the standpoint and understanding of less developed countries and vulnerable communities, could urge on positive climate solutions by creating safer and more equitable world. For instance, Indigenous people, and their relation to nature could offer more sustainable answers for mitigating climate change and Saami people in Northern Europe could be one important minority group speaking for Indigenous knowledge. The ones who have different kind of wisdom should have their voices heard and be involved, for example through

community-based participatory research, in which the research is conducted “from the ground up, with those whose lives are most impacted by the problem at hand, in an effort to create needed change” (Leavy 2017: 224).

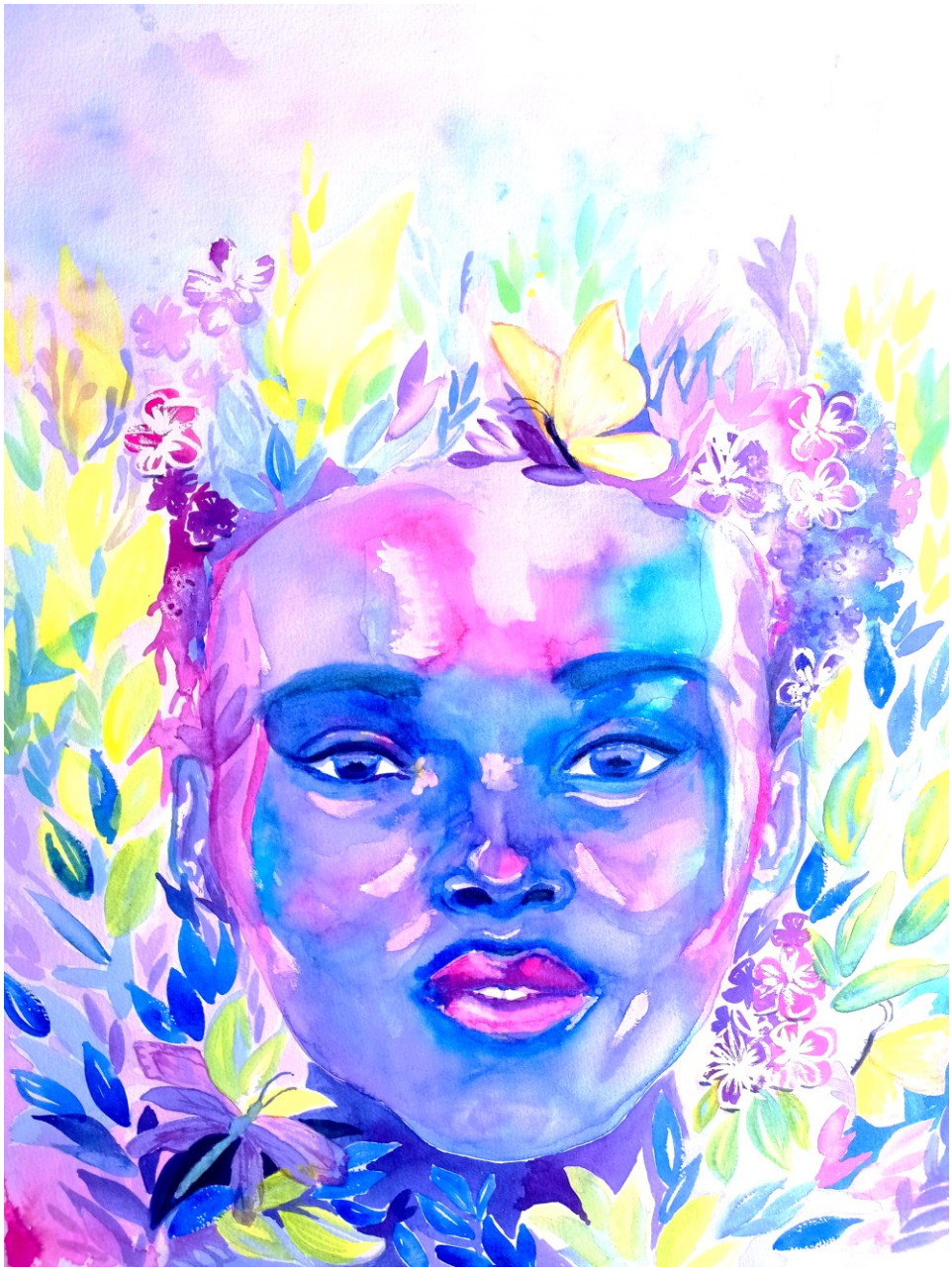

Figure 19 Viewpoint of wisdom

According to planetary health paradigm, people and natural environment are connected, intertwined, and equally important – yet human beings’ perspectives are often placed in the central. It seemed that in some of the studies human’s

standpoints were valued over the natural environment's protection, especially concerning green and blue infrastructure in urban environment. Nature should be valued for its own sake, too. Not only because resilient natural environment can act as a carbon sink and sequester, help adapting to global warming, and other environmental crises, and provide aesthetics, services, and resources for humans, but because non-human lives equally matter. It is required to find alternative approaches in scientific field research concerning health, environment and climate change, and alternative ways to present them, possibly with arts. Accessible, creative, and participatory science done across different disciplines emphasising diversity and equity could act as a counterforce to current attitudes that maintain the status quo.

References

Amelung, D., Fischer, H., Herrmann, A., Aall, C., Louis, V. R., Becher, H., Wilkinson, P., & Sauerborn, R. 2019. Human health as a motivator for climate change mitigation: Results from four European high-income countries. Global environmental change, 57, 101918. doi:10.1016/j.gloenvcha.2019.05.002.

Arfman, S. 2022. Ilmasto ja ravitsemus – Ruokakassit puntarissa [Climate and nutrition - Food bags weighed]. Published on 9th February 2022, retrieved on 10th March 2022 from https://www.envitecpolis.fi/post/ilmasto-ja-ravitsemus-ruokakassit-puntarissa.

Arup 2019. The Future of Urban Consumption in a 1.5°C World. C40 Cities. Headline report. https://www.c40.org/wp-content/uploads/2021/08/2270_C40_CBE_MainReport_250719.original.pdf.

Bardy, M. 2010. Tavallisen hyvä elämä – ja hyvinvointitutkimus [Ordinarily Good Life – and Community Well-being Research]". In Bardy, M. & Parrukoski, S. P. Hyvinvointi ilmastonmuutoksen oloissa [Well-Being in the Circumstance of Climate Change], 24–32. Finnish institute for health and welfare.

Barrett, B. 2022. Health and sustainability co-benefits of eating behaviors: Towards a science of dietary eco-wellness. Preventive medicine reports, 28, p. 101878. doi:10.1016/j.pmedr.2022.101878.

Bikomeye, J. C., Rublee, C. S. & Beyer, K. M. M. 2021. Positive Externalities of Climate Change Mitigation and Adaptation for Human Health: A Review and Conceptual Framework for Public Health Research. International journal of environmental research and public health, 18(5), p. 2481. doi:10.3390/ijerph18052481.

Brenndorfer, M. 2020. Nurses are crucial in the fight against climate change: Nurses understand the impact of the environment on individual and population

health. That understanding is crucial to ensuring health justice in interventions to mitigate climate change. Kai Tiaki Nursing New Zealand, 26(9), 22–23.

Brombin, A., Pezzuolo, A. & Brščić, M. 2019. Are we ready for the big change in the dairy production system? *Research in veterinary science, 126*, pp. 17-19. doi:10.1016/j.rvsc.2019.08.006.

Bunde-Birouste, A., Byrne, F. & Kemp, L. 2019. Autoethnography in Liamputtong, P. Handbook of Research Methods in Health Social Sciences, 509–526. Springer Singapore.

Chapman, R., Howden-Chapman, P. & Capon, A. 2016. Understanding the systemic nature of cities to improve health and climate change mitigation. Environment international, 94, pp. 380-387. doi:10.1016/j.envint.2016.04.014.

Critical Appraisal Skills Programme. 2018. CASP Cohort Study Checklist. Available at: https://casp-uk.net/images/checklist/documents/CASP-Cohort-Study-Checklist/CASP-Cohort-Study-Checklist-2018_fillable_form.pdf
Accessed: 14th Aug 2022.

Critical Appraisal Skills Programme. 2018. CASP Systematic Review Checklist. Available at: https://casp-uk.net/images/checklist/documents/CASP-Systematic-Review-Checklist/CASP-Systematic-Review-Checklist-2018_fillable-form.pdf
Accessed: 14th Aug 2022.

Demuzere, M., Orru, K., Heidrich, O., Olazabal, E., Geneletti, D., Orru, H., Bhave, A. G., Mittal, N., Feliu, E., Faehnle, M. 2014. Mitigating and adapting to climate change: multi-functional and multi-scale assessment of green urban infrastructure. Journal of environmental management, 146, pp. 107-115. doi:10.1016/j.jenvman.2014.07.025.

Dixon-Woods, M., Agarwal, S., Young, B., Jones, D. & Sutton, A. 2004. Integrative approaches to qualitative and quantitative evidence. London: Health Development Agency, 181.

Elonen, P. 2022a. Ilmastoruokaohjelma pantiin virkamiesvalmisteluun vasta, kun HS oli kysynyt kirjallisesti sen valmistelusta [The preparatory work of public servants for Climate-Friendly Food Program was not initiated until Helsingin Sanomat asked of its preparations by letter]. Helsingin Sanomat. Published on 25th October 2022. https://www.hs.fi/politiikka/art-2000009154311.html.

Elonen, P. 2022b. Osa maininnoista lihan ja juuston käytön vähentämisestä katosi ministeriön valmistelemasta ilmastoruokaohjelmasta [Part of the mentions concerning reductions of meat and cheese consumption disapperared from Climate-friendly Food Program initiated by ministry]. Helsingin Sanomat. Published on 4th October 2022. https://www.hs.fi/politiikka/art-2000009108845.html read 3th November 2022.

Falk, M. T. & Hagsten, E. 2021. Determinants of CO2 emissions generated by air travel vary across reasons for the trip. Environmental science and pollution research international, 28(18), pp. 22969-22980. doi:10.1007/s11356-020-12219-4.

Fletcher, F. E., Jiang, W. & Best, A. L. 2021. Antiracist Praxis in Public Health: A Call for Ethical Reflections. The Hastings Center report, 51(2), pp. 6-9. doi:10.1002/hast.1240.

Gao, J., Hou, H., Zhai, Y., Woodward, A., Vardoulakis, S., Kovats, S., Wilkinson, P., Li, L., Song, X., Xu, L., Meng, B., Liu, X., Wang, J., Zhao, J., Liu, Q. 2018. Greenhouse gas emissions reduction in different economic sectors: Mitigation measures, health co-benefits, knowledge gaps, and policy implications. Environmental pollution (1987), 240, pp. 683-698. doi:10.1016/j.envpol.2018.05.011.

Glover, T. D., Todd, J. & Moyer, L. 2022. Neighborhood Walking and Social Connectedness. Frontiers in sports and active living, 4, p. 825224. doi:10.3389/fspor.2022.825224.

González, C. A., Bonet, C., Pablo, M. de, Sanchez, M. J., Salamanca-Fernandez, E., Dorronsoro, M., Amiano, P., Huerta, J. M., Chirlaque, M. D., Ardanaz, E., Barricarte, A., Quirós, J. R., Agudo, A. & Ferrer, M. G. R. 2021, Greenhouse gases emissions from the diet and risk of death and chronic diseases in the EPIC-Spain cohort. European journal of public health, *31*(1), pp. 130-135. doi:10.1093/eurpub/ckaa167.

Gonzalez-Holguera, J., Gaille, M., Del Rio Carral, M., Steinberger, J., Marti, J., Bühler, N., Kaufmann, A., Chiapperino, L., Vicedo-Cabrera, A. M., Schwarz, J., Depoux, A., Panese, F., Chèvre, N., Senn, N. 2022. Translating Planetary Health Principles Into Sustainable Primary Care Services. Frontiers in public health, 10, p. 931212. doi:10.3389/fpubh.2022.931212.

Halonen, J., Erhola, M., Furman, E., Haahtela, T., Jousilahti, P., Barouki, R., Bergman, Å., Billo, N., Fuller, R., Haines, A., Kogevinas, M., Kolossa-Gehring, M., Krauze, K., Lanki, T., Lobo Vicente, J., Messerli, P., Nieuwenhuijsen, M., Paloniemi, R., Peters, A., Posch, K., Timonen, P., Vermeulen, R., Virtanen, S., Bousquet, J. & Antó, A. 2021. A call for urgent action to safeguard our planet and our health in line with the Helsinki declaration. Environmental Research Volume 193, February 2021, 110600.

Hess, J. J., Ranadive, N., Boyer, C., Aleksandrowicz, L., Anenberg, S. C., Aunan, K., Belesova, K., Bell, M. L., Bickersteth, S., Bowen, K., Burden, M., Campbell-Lendrum, D., Carlton, E., Ciss, G., Cohen, F., Hancheng, D., Dangour, A., Dasgupta, P., Frumkin, H., Peng, G. et al. 2020, 'Guidelines for Modeling and Reporting Health Effects of Climate Change Mitigation Actions', Environmental Health Perspectives, vol. 128, no. 11, pp. 115001-1-115001–10.

Horton, R., Beaglehole, R., Bonita, R., Raeburn, J., McKee, M. & Wall, S. 2014. From public to planetary health: A manifesto. The Lancet (British edition), 383(9920), p. 847. doi:10.1016/S0140-6736(14)60409-8.

Häikiö, L. & Saikkonen, P. 2010. Tarvitsemme uusia utopioita hyvinvoinnin politiikkaan [We Need New Utopias in the Welfare Politics]" in Bardy, M. &

Parrukoski, S. Hyvinvointi ilmastonmuutoksen oloissa [Welfare in the Circumstance of Climate Change] 24–32. Finnish Institute for Health and Welfare.

IPCC 1992. Climate change: The 1990 and 1992 IPCC Assessments. IPCC First Assessment Report Overview and Policymaker Summaries and 1992 IPPC Supplement. Digitized by the Digitization and Microform Unit, UNOG Library, 2010. Retrieved on 31th August from 2022.https://www.ipcc.ch/site/assets/uploads/2018/05/ipcc_90_92_assessments_far_full_report.pdf.

IPCC 2001. Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Integovernmental Panel on Climate Change [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA. Retrieved on 31th August from https://www.ipcc.ch/site/assets/uploads/2018/03/front-1.pdfhttps://www.ipcc.ch/site/assets/uploads/2018/03/front-1.pdf.

IPCC 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R. K. and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland. Retrieved on 31th August from https://www.ipcc.ch/site/assets/uploads/2018/02/ar4_syr_full_report.pdf.

IPCC 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R. K. and Meyer, L. A. (eds.)]. IPCC, Geneva, Switzerland. Retrieved on 31th August from https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf.

IPCC 2018. Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global

response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., Zhai, P., Pörtner, H.O., Roberts, D., Skea, J., Shukla, P. R., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors, S., Matthews, J. B. R., Chen, Y., Zhou, X., Gomis, M. I., Lonnoy, E., Maycock, T., Tignor, M., Waterfield, T. (eds.)]. In Press. Retrieved on 31th August from https://www.ipcc.ch/site/assets/uploads/sites/2/2022/06/SPM_version_report_LR.pdf.

IPCC 2022a. Summary for Policymakers. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., Rama, B. (eds.)]. Cambridge University Press, In Press. Retrieved on 31th August from https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf.

IPCC 2022b. Summary for Policymakers. In: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Shukla, P.R., Skea, J., Slade, R., Al Khourdajie, A., van Diemen, R., McCollum, D., Pathak, M., Some, S., Vyas, P., Fradera, R., Belkacemi, M., Hasija, A., Lisboa, G., Luz, S., Malley, J. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.001 Retrieved on 31th August from https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SPM.pdf.

Kelsey, E. 2020. Hope Matters: Why Changing the Way We Think Is Critical to Solving the Environmental Crisis, Greystone Books, 2020. ProQuest Ebook Central.

Klein, N. 2014a. Climate Change Is the Fight of Our Lives—Yet We Can Hardly Bear to Look at It, Guardian. Published on 23th April 2014. Retrieved on 10th

October from https://www.theguardian.com/commentisfree/2014/apr/23/climate-change-fight-of-our-lives-naomi-klein.

Klein, N. 2014b. This changes everything: Capitalism vs. the climate. London: Allen Lane, an imprint of Penguin Books.

Kotcher, J., Feldman, L., Luong, K. T., Wyatt, J. & Maibach, E. 2021. Advocacy messages about climate and health are more effective when they include information about risks, solutions, and a normative appeal: Evidence from a conjoint experiment. The journal of climate change and health, 3, p. 100030. doi:10.1016/j.joclim.2021.100030.

Küçükgöz, K., Trząskowska, M. 2022. Nondairy Probiotic Products: Functional Foods That Require More Attention. Nutrients. Feb 10;14(4):753. doi: 10.3390/nu14040753.

Laine, J. E., Huybrechts, I., Gunter, M. J., Ferrari, P., Weiderpass, E., Tsilidis, K., Aune, D., Schulze, M. B., Bergmann, M., Temme, E. H. M., Boer, J. M. A., Agnoli, C., Ericson, U., Stubbendorff, A., Ibsen, D. B., Dahm, C. C., Deschasaux, M., Touvier, M., Kesse-Guyot, E., Sánchez Pérez, M. J., Rodríguez Barranco, M., Tong, T. Y. N., Papier, K., Knuppel, A., Boutron-Ruault, M. C., Mancini, F., Severi, G., Srour, B., Kühn, T., Masala, G., Agudo, A., Skeie, G., Rylander, C., Sandanger, T. M., Riboli, E., Vineis, P. 2021. Co-benefits from sustainable dietary shifts for population and environmental health: an assessment from a large European cohort study. Lancet Planet Health. 2021 Nov;5(11):e786-e796. doi: 10.1016/S2542-5196(21)00250-3.

The Lancet 2021. Climate and COVID-19: Converging crises. The Lancet (British edition), 397(10269), p. 71. doi:10.1016/S0140-6736(20)32579-4.

Laukkonen, J., Blanco, P. K., Lenhart, J., Keiner, M., Cavric, B. & Kinuthia-Njenga, C. 2009. Combining climate change adaptation and mitigation measures at the local level. Habitat international, 33(3), pp. 287-292. doi:10.1016/j.habitatint.2008.10.003.

Leavy, P. 2017. Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based, and Community-Based Participatory Research Approaches. The Guilford Press.

Lõhmus, M., Balbus, J. 2015. Making green infrastructure healthier infrastructure. Infection Ecology & Epidemiology, 5(1), p. 30082. doi:10.3402/iee.v5.30082.

Lonnie, M. & Johnstone, A. M. 2020. The public health rationale for promoting plant protein as an important part of a sustainable and healthy diet. Nutrition Bulletin, vol. 45, no. 3, pp. 281–293. doi:10.1111/nbu.12453.

Lowe, M. 2014. Obesity and climate change mitigation in Australia: overview and analysis of policies with co-benefits. Australian and New Zealand journal of public health, 38(1), pp. 19-24. doi:10.1111/1753-6405.12150.

Maizlish, N., Rudolph, L. & Jiang, C. 2022. Health Benefits of Strategies for Carbon Mitigation in US Transportation, 2017-2050. American Journal of Public Health, vol. 112, no. 3, pp. 426-433. doi:10.2105/AJPH.2021.306600.

Marinova, D. & Bogueva, D. 2019. Planetary health and reduction in meat consumption. *Sustainable Earth, 2*(1), pp. 1-12. doi:10.1186/s42055-019-0010-0.

Morse, J. M. 2012. Qualitative Health Research: Creating a New Discipline. Taylor & Francis Group. ProQuest Ebook Central.

Osborne, R. 2022. The health community must resist the UK’s expansion of oil and gas. BMJ (Online), 377, p. o947. doi:10.1136/bmj.o947.

Pathak, N., McKinney, A. 2021. Planetary Health, Climate Change, and Lifestyle Medicine: Threats and Opportunities. American journal of lifestyle medicine, 15(5), pp. 541-552. doi:10.1177/15598276211008127.

Pihkala, P. 2022. The Process of Eco-Anxiety and Ecological Grief: A Narrative Review and a New Proposal. Sustainability (Basel, Switzerland), 14(24), p. 16628. doi:10.3390/su142416628.

Phillips, C. M., Chen, L. W., Heude, B., Bernard, J. Y., Harvey, N. C., Duijts, L., Mensink-Bout, S. M., Polanska, K., Mancano, G., Suderman, M., Shivappa, N., Hébert, J. R. 2019. Dietary Inflammatory Index and Non-Communicable Disease Risk: A Narrative Review. Nutrients. 2019 Aug 12;11(8):1873. doi: 10.3390/nu11081873.

Prior, J., Connon, I., McIntyre, E., Adams, J., Capon, A., Kent, J., Rissel, C., Thomas, L., Thompson, S. & Westcott, H. 2018. Built environment interventions for human and planetary health: integrating health in climate change adaptation and mitigation. Public Health Research & Practice December 2018; Vol. 28(4) :e2841831. doi:10.17061/phrp2841831.

Quam, V. G. M., Rocklöv, J., Quam, M. B. M. & Lucas, R. A. I. 2017. Assessing Greenhouse Gas Emissions and Health Co-Benefits: A Structured Review of Lifestyle-Related Climate Change Mitigation Strategies. International journal of environmental research and public health, 14(5), p. 468. doi:10.3390/ijerph14050468.

Redvers, N. 2021. Patient-Planetary Health Co-benefit Prescribing: Emerging Considerations for Health Policy and Health Professional Practice. Front Public Health. 2021 Apr 30;9:678545. doi: 10.3389/fpubh.2021.678545.

Renouf, J. S. 2021. Making sense of climate change—the lived experience of experts, Climatic Change, vol. 164, no. 1-2. doi:10.1007/s10584-021-02986-5.

Rollins, J. 2021 Purpose-Built' Art in Hospitals: Art with Intent. Emerald Publishing Limited. ProQuest Ebook Central.

Sabel, C. E., Hiscock, R., Asikainen, A., Bi, J., Depledge, M., van den Elshout, S., Friedrich, R., Huang, G., Hurley, F., Jantunen, M., Karakitsios, S. P., Keuken,

M., Kingham, S., Kontoroupis, P., Kuenzli, N., Liu, M., Martuzzi, M., Morton, K., Mudu, P., Niittynen, M., Perez, L., Sarigiannis, D., Stahl-Timmins, W., Tobollik, M., Tuomisto, J., Willers, S. 2016. Public health impacts of city policies to reduce climate change: findings from the URGENCHE EU-China project. Environmental health, 15 Suppl 1(43), p. 25. doi:10.1186/s12940-016-0097-0.

Salami, M. 2020. Sensuous Knowledge: A Black Approach for Everyone. Amistad Press.

Salmond, J. A., Tadaki, M., Vardoulakis, S., Arbuthnott, K., Coutts, A., Demuzere, M., Dirks, K. N., Heaviside, C., Lim, S., Macintyre, H., McInnes, R. N., Wheeler, B. W. 2016. Health and climate related ecosystem services provided by street trees in the urban environment. Environmental Health, 15 Suppl 1(43), p. 36. doi:10.1186/s12940-016-0103-6.

Selvik, H. & Fullilove, R. 2020. From Global Thinking to Local Action: The Planetary Diet as Chronic Disease Prevention. Public health reports (1974), 135(4), pp. 424-427. doi:10.1177/0033354920935070.

Simmonds, K., Breakey, S. & Nicholas, P. K. 2022. Educating Nurse Practitioners About Climate Change, Health, and Climate Justice. Journal for nurse practitioners, 18(4), pp. 429-433. doi:10.1016/j.nurpra.2021.10.006.

Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaletta, L., de Vries, W., Vermeulen, S. J., Herrero, M., Carlson, K. M., Jonell, M., Troell, M., DeClerck, F., Gordon, L. J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., Godfray, H. C. J., Tilman, D., Rockström, J. & Willett, W. 2018. Options for keeping the food system within environmental limits. Nature 562, 519–525 (2018). doi: 10.1038/s41586-018-0594-0.

Stein, C. H. & Faigin, D. A. 2015. Community-Based Arts Initiatives: Exploring the Science of the Arts. American journal of community psychology, 55(1-2), pp. 70-73. doi:10.1007/s10464-014-9698-3.

Sun, Z., Scherer, L., Tukker, A. et al. 2022. Dietary change in high-income nations alone can lead to substantial double climate dividend. Nature Food 3, 29–37 (2022). doi: 10.1038 /s43016-021-00431-5.

Sutcliffe, R., Orban, E., McDonald, K. & Moebus, S. 2016. The German Energiewende – a matter for health? European Journal of Public Health, vol. 26, no. 4, pp. 707–712. doi:10.1093/eurpub/ckv212.

Tannock, S. 2021. Educating for Radical Social Transformation in the Climate Crisis. Springer International Publishing.

TENK 2012. Responsible conduct of research and procedures for handling allegations of misconduct in Finland. Guidelines of the Finnish Advisory Board on Research Integrity 2012. Retrieved on 7th February 2022 from https://tenk.fi/sites/tenk.fi/files/HTK_ohje_2012.pdf.

Tieges, Z., McGregor, D., Georgiou, M., Smith, N., Saunders, J., Millar, R., Morison, G., Chastin, S. 2020. The Impact of Regeneration and Climate Adaptations of Urban Green-Blue Assets on All-Cause Mortality: A 17-Year Longitudinal Study. International journal of environmental research and public health, 17(12), p. 4577. doi:10.3390/ijerph17124577.

Thomas, F., Sabel, C. E., Morton, K., Hiscock, R. & Depledge, M. H. 2014. Extended impacts of climate change on health and wellbeing. Environmental science & policy, 44, pp. 271-278. doi:10.1016/j.envsci.2014.08.011.

UNICEF 2022. Climate Justice Roundtable: RECAP AND REFLECTIONS: An online discussion with activists and experts, February 2022. New York. United Nations Children's Fund (UNICEF). Retrieved in 7th April 2023 from https://www.unicef.org/globalinsight/media/2866/file.

Vineis, P., Huybrechts, I., Millett, C., Weiderpass, E. 2021. Climate change and cancer: converging policies. Molecular oncology, 15(3), pp. 764-769. doi:10.1002/1878-0261.12781.

Wheeler, N., & Watts, N. 2018. Climate Change: From Science to Practice. Current environmental health reports, *5*(1), 170–178. https://doi.org/10.1007/s40572-018-0187-y.

Wijsman, K. & Berbés-Blázquez, M. 2022. What do we mean by justice in sustainability pathways? Commitments, dilemmas, and translations from theory to practice in nature-based solutions. Environmental science & policy, 136, pp. 377-386. doi:10.1016/j.envsci.2022.06.018.

Williams, M. L., Lott, M. C., Kitwiroon, N., Dajnak, D., Walton, H., Holland, M., Pye, S., Fecht, D., Toledano, M. B., Beevers, S. D. 2018. The Lancet Countdown on health benefits from the UK Climate Change Act: a modelling study for Great Britain. The Lancet. Planet Health 2(5): e202-e213. doi: 10.1016/S2542-5196(18)30067-6.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J., De Vries, W., Majele Sibanda, L., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S., Reddy, K., Narain, S., Nishtar, S. & Murray, C. 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet (British edition), 2019-02-02, Vol.393 (10170), p.447-492. doi:10.1016/S0140-6736(18)31788-4.

WWF 2023. What's the difference between climate change mitigation and adaptation? Retrieved on 17th February 2023 from https://www.worldwildlife.org/stories/what-s-the-difference-between-climate-change-mitigation-and-adaptation.

Wolf, C., Ripple, W. J. & Crist, E. 2021. Human population, social justice, and climate policy. Sustainability science, 16(5), pp. 1753-1756. doi:10.1007/s11625-021-00951-w.

Xiao, Y., Watson, M. 2019. Guidance on Conducting a Systematic Literature Review. Journal of Planning Education and Research 2019, Vol. 39(1) 93–112.

Appendices

Work plan and estimated schedule

Table 4 presents the preparatory work plan and estimated schedule. The schedule was flexible, and it eventually was extended by few months. Every stage of conducting this master's thesis had not particular disposition in the schedule. The artwork was done during the whole process, as thoughts and ideas evoke. Also documenting the process and writing the report was included in every stage.

Task	**Due in**
Preliminary research plan	January – February
Theoretical framework: Theory base, methodology, ethics, planning the review protocol (with PRISMA 2020 checklist), (also test searches for literature review to find precise keywords with CASP checklist)	February – March
Planning the literature review: Keywords, databases and criteria for inclusion and exclusion defined (with PRISMA 2020). Criteria is approved by the thesis supervisor	In March
Literature review: Searches done, selecting the articles by screening headings and abstracts (according to the inclusion and exclusion criteria and CASP checklist). Documenting the process.	March – April
Literature review: Skimming through the articles and selecting the articles by reading full texts (according to the inclusion and exclusion criteria and CASP tool). Doing also backward and forward searches from the valid	April – May

Task	**Due in**
references? Documenting the process.	
Literature review: Data extraction (from printed articles), identifying the subtopics and coding. PRISMA 2020 checklist will be used when assessing and coding the data of the review. Coding the findings together with the artistic work? Documenting the process.	May – June
Literature review: Synthesis. PRISMA 2020 checklist will be used when synthesizing the data of the review. Synthesizing the review data with the artistic work that has been done. Documenting the process.	June – July
Literature review: Analysis. Analysing the literature review findings with the autoethnographic findings. PRISMA 2020 checklist will be used when assessing the data of the review.	August - September
During the whole process: Writing the thesis, completing the theoretical framework, the theory and ethics, producing expressive aquarelles and poems that spring up from the findings.	In October
Publication from the key findings desinged	In November
Seminar and maturity test	November – December

Table 4 Planned schedule for implementing the master's thesis

Summary of the selected articles for the literature review

Authors and the year of publication	Research paper title	Research task	Data collection	Main resullts
Barrett B. 2022.	Health and sustainability co-benefits of eating behaviors: Towards a science of dietary eco-wellness.	To review prevailing environmentally sustainable and healthy dietary behaviours and suggest priorities in behavioural nutritional science to support health and sustainability	Review of relevant studies from several countries	Overconsumption of foods from animal sources has contributed to non-communicable diseases and environmental issues and therefore dietary change is required and further research of certain interventions suggested.
Bikomeye JC, Rublee CS, Beyer KMM. 2021.	Positive Externalities of Climate Change Mitigation and Adaptation for Human Health: A Review and Conceptual Framework for Public Health Research	To summarize climate change impacts to public health, describe mitigation and adaptation measures and their health co-benefits globally and provide conceptual framework for improving climate resiliency and health equity.	A literature review to develop conceptual framework	There are several health co-benefits of climate mitigation and adaptation, but they are possibly under-represented and further inter-sectoral research is needed. Conceptual framework for future research was reported.

Demuzere M, Orru K, Heidrich O, Olazabal E, Geneletti D, Orru H, Bhave AG, Mittal N, Feliu E, Faehnle M. 2014..	Mitigating and adapting to climate change: multi-functional and multi-scale assessment of green urban infrastructure	To explore the present evidence of green spaces' adaptive and mitigative properties and to build a framework of ecosystem services benefitting health and climate, and reducing the adverse effects.	Review synthesizing empirical evidence	There is body of evidence regarding green spaces contribution of climate change adaptation, mitigation, and health. Yet unambiguous conclusions are problematic to draw. Research provided Infrastructure assessment framework.
Gao J, Hou H, Zhai Y, Woodward A, Vardoulakis S, Kovats S, Wilkinson P, Li L, Song X, Xu L, Meng B, Liu X, Wang J, Zhao J, Liu Q. 2018.	Greenhouse gas emissions reduction in different economic sectors: Mitigation measures, health co-benefits, knowledge gaps, and policy implications.	To review extensively greenhouse gas mitigation measures' health co-benefits, find knowledge gaps, and recommend further policy interventions accordingly	Review	Comprehensive findings discussed health co-benefits of mitigative measures in five different sectors: food and agriculture, transportation, and in residential, industrial, and economic sectors. Further policy interventions were suggested.
González CA, Bonet C, Pablo M de, Sanchez MJ, Salamanca-Fernandez E, Dorronsoro M, Amiano P, Huerta JM, Chirlaque MD, Ardanaz E, Barricarte A, Quirós JR, Agudo A & Ferrer MGR. 2021.	Greenhouse gases emissions from the diet and risk of death and chronic diseases in the EPIC-Spain cohort	To analyse the association between dietary greenhouse gas emissions and the risk of total morbidity and mortality of chronic diseases	Data was collected from the EPIC-Spain prospective study of 40 621 participants. Values for dietary greenhouse gas emissions were based on systematic review	Reduces in red-meat consumption could decline greenhouse gas emissions and decrease risk of overall mortality, type 2 diabetes and cardiovascular disease.

Küçükgöz K, Trząskowska M. 2022.	Nondairy Probiotic Products: Functional Foods That Require More Attention.	To provide an overview of functional non-dairy probiotic products' possibilities	Review	There is a need for advantageous non-dairy probiotic products because of fibre content, phytochemicals, sensory properties, and decreased greenhouse gases, for instance.
Laine JE, Huybrechts I, Gunter MJ, Ferrari P, Weiderpass E, Tsilidis K, Aune D, Schulze MB, Bergmann M, Temme EHM, Boer JMA, Agnoli C, Ericson U, Stubbendorff A, Ibsen DB, Dahm CC, Deschasaux M, Touvier M, Kesse-Guyot E, Sánchez Pérez MJ, Rodríguez Barranco M, Tong TYN, Papier K, Knuppel A, Boutron-Ruault MC, Mancini F, Severi G, Srour B, Kühn T, Masala G, Agudo A, Skeie G, Rylander C, Sandanger TM, Riboli E, Vineis P. 2021.	Co-benefits from sustainable dietary shifts for population and environmental health: an assessment from a large European cohort study.	To evaluate the potential health co-benefits of sustainable diets and find the associations between dietary greenhouse gas emissions and overall mortality and cancer morbidity.	Prospective cohort study using data of 443 991 participants in the EPIC study in Europe	Shifting towards sustainable diet declined greenhouse gas emissions and benefitted health by decreasing mortality and cancers, and thus dietary patterns that decrease greenhouse gases are recommended.
Lõhmus M, Balbus J. 2015.	Making green infrastructure	To consider possible health hazards caused	Review article	Urban ecosystem's services provide

	healthier infrastructure.	by increased biodiversity, kerbside trees, and water bodies in urban environments, and to provide details of how to prevent or decrease potential risks.		sustainability but their complexity needs to be addressed so that potential negative health effects can be prevented.
Lonnie M & Johnstone AM. 2020.	The public health rationale for promoting plant protein as an important part of a sustainable and healthy diet	To discuss questions of protein sustainability and health, and consumers' knowledge of them, and to review possibilities to change current diet patterns more sustainable.	Review	There is a need to shift towards plant-based diets, and health interventions and other strategies should be developed carefully addressing target groups, for example.
Lowe M. 2014.	Obesity and climate change mitigation in Australia: overview and analysis of policies with co-benefits.	To review shared causes between obesity and climate change and consider possible policy measures.	Literature review	There are complicated mutual causes for obesity and climate change and all measures benefitting both should be taken into action in policy.

Table 5 Summary of the selected articles for the literature review

The synthesis process exemplification