**Kaunas University of Technology**

Faculty of Social Sciences, Arts and Humanities

# Assessment of Governance of Climate Change Induced Risks to Public Health in Lithuania

Master's Final Degree Project

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Public Policy and Security (6211JX044)

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## Summary

The effects of human induced climate change are one of the most dangerous challenges that we have faced in the entire history of humanity, they affect every aspect of life, nature, society, and are widely acknowledged by experts as the “greatest threat to public health”. It is clear that there needs to be urgent action to address these risks and that effective and holistic systems of climate change and public health governance are necessary to tackle the challenges. To date there is a large body of research on the effects of climate change but only a small percentage addresses the public health risks and how they can be governed, additionally most research covers either polar or tropical regions with a lack of study on Northern Europe and the Baltic states specifically. There are many proposed ideas on how to mitigate climate change effects, but a lack of study on the actual methods being used by national and regional governments, as well as the methods with the results, for effective governance and risk management of these public health threats. This is true both on a global level and even more so on a national level in Lithuania. This paper poses the question: How are climate change threats to public health governed in Lithuania? By looking at the range of public health risks that are caused or increased by climate change, and the governance and risk theories and frameworks that can be used in tackling them it aims to assess the governance of climate change induced risks to public health in Lithuania. There are four research objectives: Conceptualisation of governance of climate change induced risks to public health; A systematic review of climate change induced risks to public health in Lithuania; Developing methodology for assessment of the governance of climate change induced risks to public health in Lithuania; Empirical analysis and assessment of how climate change induced risks to public health are governed in Lithuania. The theoretical chapter employs scientific literature analysis and also relies on the overview of policy relevant documents at national, European Union and global levels. The empirical analysis and assessment employ secondary data, statistical data, and document analysis. Key findings from this research are: there are several immediate climate change induced public health risks affecting Lithuania; climate change and the associated health risks are a global issue and there is a need for integrated and binding international agreements and policies; plans and strategies in Lithuania have evolved over the last decade but there is a need for continued risk management refinement; a holistic and integrated approach to governance is needed across not only different government agencies but also stakeholders at all levels; there is an uneven approach to addressing the public health risks that come from climate change, with widely varying levels of preparedness. This work is structured into three main parts. The first part is theoretical, it conceptualizes governance and describes the health risks induced by climate change. The theoretical chapter concludes with a summary and a presentation of the conceptual model, which is further used in the empirical study. The second part is the methodological part where the data sources, methods and processes of this work are presented. The third part is empirical; the analysis of governance of

climate change induced risk to public health are based on a risk management framework and a comprehensive analysis of legal documents in Lithuania to address governance of climate change.

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## Santrauka

Žmonių veiklos sukelti klimato kaitos padariniai yra vieni pavojingiausių iššūkių, su kuriais žmonija susidūrė per visą istoriją. Jie turi įtakos kiekvienam gyvenimo aspektui, gamtai, visuomenei, o ekspertų plačiai pripažįstami kaip „didžiausia grėsmė visuomenės sveikatai “. Reikalinga imtis skubių veiksmų šioms rizikoms pašalinti ar sušvelninti. Norint įveikti iššūkius būtinos veiksmingos holistinės klimato kaitos ir visuomenės sveikatos valdymo sistemos. Iki šiol yra atlikta daug tyrimų apie klimato kaitos poveikį, tačiau tik nedidelė dalis nagrinėja pavojus ir jų valdymą visuomenės sveikatai, be to, dauguma tyrimų apima poliarinius arba atogrąžų regionus, tyrimų apie Šiaurės Europą ir konkrečiai Baltijos šalis trūksta. Yra siūloma daug idėjų, kaip sušvelninti klimato kaitos poveikį, tačiau trūksta tyrimų apie faktinius metodus, kuriuos naudoja nacionalinės ir regioninės vyriausybės, taip pat metodus su rezultatais, kad būtų galima veiksmingai valdyti šių grėsmių visuomenės sveikatai riziką. Tai galioja tiek pasauliniu mastu, tiek juo labiau nacionaliniu lygiu Lietuvoje. Šiame darbe keliamas klausimas: kaip Lietuvoje valdomos klimato kaitos grėsmės visuomenės sveikatai? Nagrinėjant klimato kaitos keliamų ar padidintų pavojų visuomenės sveikatai, valdymo ir rizikos teorijas bei sistemas, kuriomis galima jas spręsti, siekiama įvertinti klimato kaitos keliamų pavojų visuomenės sveikatai valdymą Lietuvoje. Keliami keturi uždaviniai: klimato kaitos sukeltos rizikos visuomenės sveikatai valdymo konceptualizavimas; sisteminga klimato kaitos keliamų pavojų visuomenės sveikatai Lietuvoje apžvalga; klimato kaitos keliamų pavojų visuomenės sveikatai valdymo Lietuvoje vertinimo metodikos kūrimas; empirinė analizė ir vertinimas, kaip Lietuvoje valdoma klimato kaitos keliama rizika visuomenės sveikatai. Teoriniame skyriuje atliekama mokslinės literatūros analizė, taip pat remiamasi nacionaliniu, Europos Sąjungos ir pasauliniu lygiu dokumentų apžvalga. Empirinėje analizėje ir vertinime naudojami antriniai duomenys, statistiniai duomenys ir dokumentų analizė. Pagrindinės šio tyrimo išvados: Lietuva turi keletą tiesioginių klimato kaitos sukeltų pavojų visuomenės sveikatai; klimato kaita ir su ja susiję pavojai sveikatai yra pasaulinė problema, todėl reikia integruotų tarptautinių susitarimų ir politikos; planai ir strategijos Lietuvoje per pastarąjį dešimtmetį keitėsi, tačiau reikia nuolat tobulinti rizikos valdymą; holistinis ir integruotas požiūris į valdymą reikalingas ne tik skirtingose vyriausybinėse isnstitucijosebe bet ir tap visų suinteresuotų šalių; egzistuoja nevienodas požiūris į klimato kaitos keliamą pavojų visuomenės sveikatai ir labai skiriasi pasirengimo lygis. Šis darbas suskirstytas į tris pagrindines dalis. Pirmoji dalis yra teorinė, joje konceptualizuojamas valdymas ir aprašomas klimato kaitos keliamas pavojus sveikatai. Teorinis skyrius baigiamas konceptualaus modelio santrauka ir pristatymu, kuris toliau naudojamas empiriniame tyrime. Antroji dalis – metodinė dalis, kurioje pristatomi šio darbo duomenų šaltiniai, metodai ir procesai. Trečioji dalis yra empirinė; klimato kaitos keliamos rizikos visuomenės sveikatai valdymo analizė grindžiama rizikos valdymo sistema ir išsamia Lietuvos teisinių dokumentų, skirtų klimato kaitos valdymui, analize.

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## List of abbreviations and terms

**Abbreviations:**

| | |
|---|---|
| CBOs | Community-based organizations |
| DPSIR | Drivers, Pressures, State, Impact and Response |
| ECHP | European Community Household Panel |
| EU | European Union |
| GEO-7 | Seventh Edition of Global Environmental Outlook |
| HiAP | Health in All Policies |
| HEAT | Health Economic Assessment Tool |
| IGI | Infrastructure Governance Index |
| IPCC | Intergovernmental Panel on Climate Change |
| IRGC | International Risk Governance Council |
| OECD | Organisation for Economic Co-operation and Development |
| MLCEDs | Multilevel Climate and Energy Dialogues |
| NDCs | Nationally Determined Contributions |
| NGOs | Non-governmental organisations |
| OECD | Organisation for Economic Co-operation and Development |
| SARF | Social Amplification of Risk Framework |
| SDG | The Sustainable Development Goals |
| UN | United Nations |
| UNEP | United Nations Environment Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |

## Introduction

Human induced climate change, and the multitude of problems directly caused by it, is one of the most dramatic and dangerous challenges of not just the last few decades, but in the entire history of humanity. It has deep effects on every aspect of life in every country in the world, including a wide range of risks to public health, with many experts agreeing that climate change is the "greatest threat to public health" and that there must be decisive and urgent action to address the risks it presents (Atwoli et al., 2021).

National governments around the world have now accepted climate change as fact. Most are making climate pledges and implementing actions to reduce their climate footprint, mitigate the effects of climate change, and manage the disasters it causes. 194 individual countries and the European Union as a block have signed and ratified the Paris Agreement (UNTC, 2023), SDG 13 of the United Nations Sustainable Development Goals explicitly relates to climate action, as well as many individually set national and block, i.e. EU, level action plans, targets, and resolutions.

The majority of the implemented plans and strategies which relate to emissions reduction and climate change mitigation have long timelines and the results cannot yet be assessed. However, the effects of climate change are already clearly visible, and we can make assessments of the actions and policies that governments have put in place for the adaptation to climate change effects and to deal with disaster management and public health risks. To date, these policies are meeting with widely varying degrees of effectiveness (IPCC, 2022). Meanwhile the need continues to grow as extreme weather events and other effects of climate change are having an increasing impact in many countries both in Europe and worldwide.

Lithuania is no exception, and the country faces a number of climate change induced problems, including increased urban and coastal flooding, and an increase in extreme weather events. According to the OECD in 2021 Lithuania had the fourth highest preventable and treatable mortality rates in the EU (OECD, 2021), while the European Centre for Disease Prevention and Control states that the public health system in Lithuania is increasingly vulnerable and at risk from the public health threats rising both directly and indirectly from climate change (ECDC, 2018).

To tackle these challenges, build a climate-resilient public health system and safeguard public health and well-being, there needs to be an effective and holistic system of public health governance. There must be risk management policies and systems in place including, among other factors, strong leadership, public education and awareness, appropriate resource allocation, climate change mitigation, and disaster preparedness (Mosadeghrad et al, 2023).

There is a very large and rapidly growing body of research on all aspects of the effects of human induced climate change, but a surprisingly small percentage of this research to date has investigated the links between climate change and public health, this trend is now changing with 373 studies on the topic published in 2019 compared with just 58 in 2008 (WHO, 2021).

The vast majority of climate change research focuses on either the Polar Regions, or on areas with already hotter climates, for example, the Mediterranean, South East Asia, or sub-Saharan Africa, with comparatively little research devoted to the Baltic States and other regions with similar climates. As an example of this, searching for "climate change mediterranean region" on Google Scholar gives around 2.75 million results, while searching for "climate change Baltic states" gives 370 thousand.

That both human induced climate change is a reality and that it has serious and wide-ranging effects on public health are scientifically proven and widely documented. There is a large amount of writing on the topic, both scientific and journalistic, including a lot of ideas about how to mitigate or reverse the effects of climate change, some of it is science-based and attainable while some is wild and unrealistic.

What seems to be much less investigated, with a limited amount of publicly available information and little study or research on the information that is available, are the actual methods being used by national and regional governments, as well as the methods with the results, for effective governance and risk management of these public health threats. This is true both on a global level and even more so on a national level in Lithuania.

**The research question of the thesis:** How are climate change threats to public health governed in Lithuania?

**The aim of the thesis:** To assess the governance of climate change induced risks to public health in Lithuania.

**The research objectives:**

1. Conceptualisation of governance of climate change induced risks to public health.
2. A systematic review of climate change induced risks to public health in Lithuania.
3. Developing methodology for assessment of the governance of climate change induced risks to public health in Lithuania.
4. Empirical analysis and assessment of how climate change induced risks to public health are governed in Lithuania.

**Research methods:** The theoretical chapter of the thesis employs scientific literature analysis and also relies on the overview of policy relevant documents at national, European Union and global levels. Empirical analysis and assessment employ secondary data, statistical data, and document analysis.

**Structure of the thesis:** This work consists of three main parts. The first part is theoretical, it conceptualizes governance and describes the health risks induced by climate change. The theoretical chapter concludes with a summary and a presentation of the conceptual model, which is further used in the empirical study. The second part is the methodological part where the data sources, methods and processes of this work are presented. The third part is empirical; the analysis of governance of climate change induced risk to public health are based on a risk management framework and a comprehensive analysis of legal documents in Lithuania to address governance of climate change induced risks to public health.

# 1. Conceptualizing governance and describing the health risks induced by climate change

In this chapter the governance theories will be explored and the complex and urgent issue of climate change related risks to public health in the context of Lithuania and also in a wider global context. The chapter will be divided into three sections.

The first section will be dedicated to explaining various governance and risk theories and frameworks that are instrumental in tackling climate change related health risks. Concepts like risk governance, Drivers, Pressures, State, Impact and Response (DPSIR further in the text) framework, multilevel governance theory, network governance, adaptive governance, smart public governance theory and risk governance theory. It will be demonstrated how these frameworks can be applied or related to public health in the context of climate change.

The second section focuses on climate change induced risks to public health in the context of Lithuania and the world. This will answer the question what are the main climate change induced risks to public health in Lithuania? It will discuss various aspects of the health risks and effects of human induced climate change including public health system burdens, air pollution, water pollution, infectious diseases, extreme weather events, and food security, and look at the risk multipliers for vulnerable groups.

## 1.1. Theories conceptualizing risk and governance

A variety of different governance and risk theories and frameworks which might be linked with governance of climate change induced risks to public health will be discussed in this section. Some of them will be discussed briefly and a selection of them will have a deeper view and these will be followed and used in all the chapters of this paper.

### 1.1.1. Risk governance for public health

The first one to discuss in this work is the International Risk Governance Council (IRGC further in the text) risk governance framework, which is the risk governance framework that will be followed in this work and is one of the tools for governing bodies to identify and deal with risks which have many stakeholders (IRGC, 2019). The IRGC risk governance framework is presented in Figure 1.

The IRGC risk governance framework has four main interlinked elements: pre-assessment, appraisal, characterisation and evaluation, and finally management (IRGC, 2019). As well as three cross-cutting aspects which consider communicating, engaging with stakeholders and the context. All of these elements combine to lead to understanding and to decision making (IRGC, 2019).

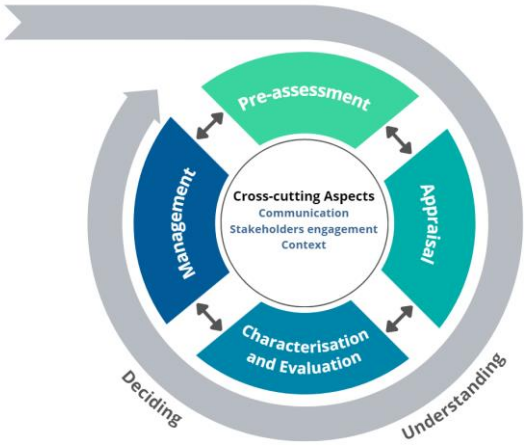


**Fig. 1.** The IRGC risk governance framework (Source: IRGC, 2019)

In the pre-assessment phase, it is important to look closely into the situation and analyse the context by looking at the evidence, clarifying the actors-stakeholders. In the context of this work there are many actors working to address climate change induced risks to public health in different groups: governments, international organizations, businesses, civil society. Actors can be identified at five different levels: local, regional, national, supra-national, and global (IRGC, 2019).

When following the IRGC framework appraisal is the second element. Using scientific and analytical tools and methods, and looking at hazards as well as vulnerabilities and assets, a concern assessment is conducted. The concern assessment would require involving diverse groups to look at the issue from different perspectives, for example the civic society point of view, government point of view, it might be considered international actor's point of view as well (IRGC, 2019).

Following the idea of concern assessment and risk evaluation we can add one more framework. SARF – The Social Amplification of Risk Framework (SARF further in the text). The perception of risks by individuals can depend on how it effects their own well-being in combination with personal values, opinions, views, social factors, culture, and traditions. One more risk framework analysed with a connection to climate change by J. Kasperson, N. Pidgeon or O. Renn the Social Amplification of Risk Framework, which says that hazard related events – climate change related events interact with such processes as social, psychological, cultural and institutional having influence on how individuals and society take, react and respond to risks. (Kasperson et al., 2003, Renn, 2011).

The third element of IRGC risk governance framework is Characterisation and evaluation. The knowledge characterisation, and risk assessment are considered in this part. As was previously mentioned when introducing the SARF framework, the views can be affected by the author's own well-being in combination with personal values, opinion, views, social factors, culture and traditions.

The assessment of climate change induced risks to public health in Lithuania would be that both the probability of occurrence of damage and the extent of damage remain unclear, and uncertainty is high (Klinke and Renn 2006). At present, neither the maximum amount of damage nor the probability of certain damaging events can be estimated in the risk assessment as having a high probability of occurrence and a high extend of damage. According to the model of Greek mythology defined by Klinke and Renn (2006), this is the reason why in the scheme the risk should belong to the "Pythia" risk class, but if the risk would be unattended in Lithuania in the future, the risk with a high probability

of occurrence and with a high extent of damage would be placed in the "Casandra" risk class, which can be seen in Figure 2 (Klinke and Renn, 2006).

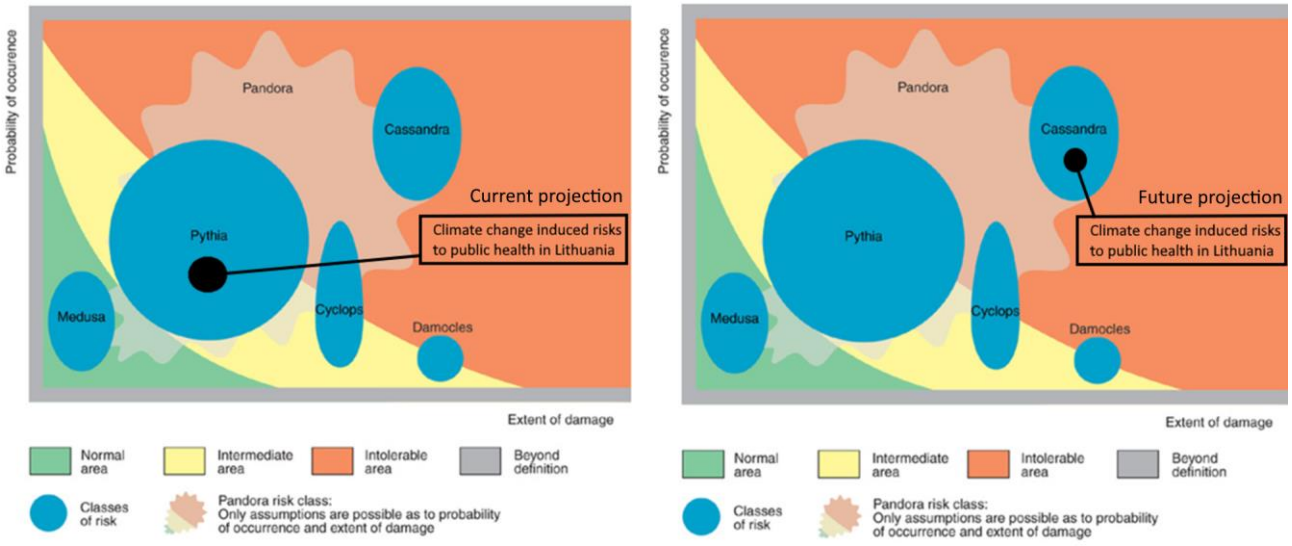


**Fig. 2.** Risk classes assessment of climate change induced risks to public health in Lithuania according to Greek mythology model, on the left current, on the right future projection (assessment of climate change induced public health risks in Lithuania is made by author; source: German Advisory Council on Global Change, 2000 cited in Klinke and Renn, 2006)

Here it will be discussed above mentioned two dimensions: extent of damage and probability of occurrence. Extent of damage simply means how big is the scope of damage by measuring the negative consequences which it is possible to measure such as fatalities, decreased productivity, and similar outcomes in the natural context. The second dimension is probability of occurrence, it means that there is an estimate of the comparative frequency, which can be in the form of discrete or continuous frequencies (Klinke and Renn, 2012).

It is important to elaborate on why there is used Greek methodology in risk classification as metaphors. In this work there are two of them “Pythia” and “Cassandra?. Pythia draws parallels with the ancient Greek oracles, induce intoxication with gases aiming to provide predictions and advice. Applying this analogy to risk assessment, Pythia means that the probability of occurrence and the extent of damage is uncertain, very much suitable for non-linear climatic shifts like global warming, presenting potentially catastrophic outcomes, but it is hardly possible to estimate the damage at the present time. While Cassandra is like a seeress of the Trojans. foresaw the dangers of a Greek victory, but warnings were disregarded. As a risk class both the likelihood and severity of damage are well-known and yet there is a significant chance of risk being ignored and underestimated, as it can be seen in issues like climate change as well as public health, as well this risk class is placed as intolerable in the red area because of the substantial potential for damage and high probability of occurrence (Klinke and Renn, 2006).

The complexity of the risks gives reason to believe that without risk governance strategies in place and with the extent of the damage and risks, evidence of which will be presented in the following section, a prognosis can be made based on the uncertainty of effects which are caused by climate change and their growth in the short and long terms. Based on that prognosis, and the interconnectivity between sectors, according to the Greek mythology model defined by Klinke and Renn, 2016, in the

future climate change induced risks to public health in Lithuania will belong in the "Cassandra" risk class, see Figure 2.

Finally, the fourth element – management. It is dedicated to decision making. It is particularly important to keep all of the cross-cutting aspects in mind: communication, stakeholders' engagement, and context.

### 1.1.2. Climate governance

Climate governance binds a set of policies, agreements, and strategies which aim to address climate change. It includes information sources such as scientific research, international treaties for example the Paris Agreement which will be discussed more in Chapter 3, and national climate action plans, highlighting the importance of a multilevel view in mitigating and adapting to climate change (IPCC, 2021).

The multilevel climate governance is an ongoing process which involves discussions and negotiations between different actors. The actors in climate governance are at local, national, and international levels, such as local and national governments, international organisations, the private sector, non-governmental organisations (NGOs further in the text) and other social actors (Janicek, 2017). This type of governance seeks to promote opportunities, actions, strategies, and policies addressing climate change. It is important to notice that processes can be both formal and informal. See the schema of climate governance in Figure 3.

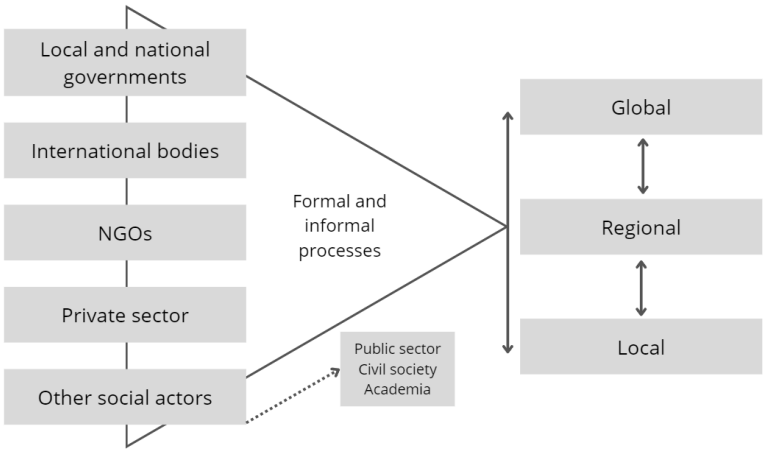


**Fig. 3.** The schema of climate governance (made by author source: Janicek, 2017)

A key takeaway of Climate governance could be intersectoral cooperation and political decision integration between different stakeholders across the different levels: local, national and international.

### 1.1.3. Smart governance for public health

There is an increasing number of complex issues that need to be addressed on the political agenda. Complex problems bring challenges for governance and multidimensional problems that cover more than one area of public management are occurring with increasing frequency. Solving such problems requires complex and integrated government solutions, many of which are solved not just at the national level, but as well at the global level.

It is important to notice that solving many problems requires a wide range of actors, the active participation of social partners, based on the cooperation of government, non-profit and business organizations. The smart public governance concept would fit these criteria as it involves active stakeholder engagement and networking driven by timely, integrated information, enabling rational decision-making, it uses appropriate structures, processes, techniques, and tools, while mobilizing resources to create sustainable public value, with key interconnected dimensions which you can see in Figure 4 (Gaulė, 2014).

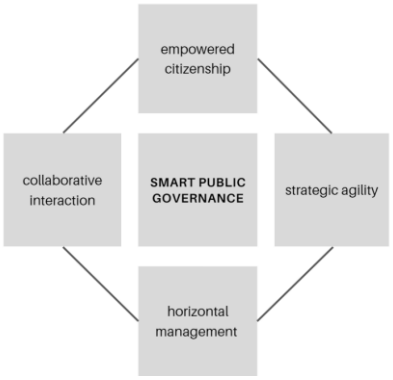


**Fig. 4.** Smart Public Governance dimensions (made my author source: Gaulė, 2014)

Smart public governance places an emphasis on operation in a fast changing and complex social environment. It empowers internal and external resources in decision making to specific situations. It can be looked at the theory from four main dimensions. Strategic dynamics, which involves the ability and flexibility to see political challenges and make active responses, this is very important in governance addressing crisis. Cross sector collaboration, this supports previously discussed theories about cooperation between different stakeholders, various institutions and sectors, which includes public and private sectors, NGOs, putting the emphasis on the collective decision making approach. Interinstitutional cooperation, the aim is non-hierarchical relationships aiming to achieve overall results and overcome that would be challenging for agencies working independently. And empowered citizenship, this means that in the decision making process there is a dialogue between the governance agencies and civic society. The civic society as well is involved in the development of public services. The core principles of smart public governance are transparency, openness, citizen empowerment, the public competences development (Stanislovaitienė, 2016).

It is important to notice that the term “smart” is used and adopted in legal strategic documents of different countries, national and international organisations and governmental agencies. The example of it could be the EU strategy ‘Europe 2020’ as well we found it in the Lithuania’s national documents like the Lithuanian Progress Strategy “Lithuania-2030”(Šiugždinienė, 2019).

There are a couple more governance models worth looking at in connection with smart public governance which have common principles to enhance governance practices and ultimately contribute to better decision-making, public service delivery, and overall societal well-being, even having distinct characteristics and approaches.

The good governance model is one of them. The theory good governance theory was first introduced by the World Bank, it started from a set of principles or policies carried the idea that a modern form

of government is not just about efficiency, and it is also about accountability allaying the state and its citizens (Bjork and Johansson, 2001).

One of the problems is that there is no internationally agreed definition of what good governance entails, with a large number of organisations and researchers assigning their own definitions and criteria. The Human Rights Commission of the United Nations defines five fundamental elements of good governance: Transparency, responsibility, accountability, participation, and responsiveness to the needs of society (OHCHR, n.d).

Another useful model is the Network Governance Theory, which focuses on the importance of collaboration and interorganizational networks instead of more traditional hierarchies, with stakeholders being independently managed and financed but with shared common goals (Assens and Lemueur, 2016). The theory analyses how multiple stakeholders from different sectors can collaborate and work together to address complex challenges such as the impacts of climate change on public health, risk mitigation, public health resilience and adaptation (Powel, 2005). The ties between actors can be either formal or informal, and networks do not need to have a large number of participating organisations, Provan and Kenis defined network governance as three or more independent organisations working together to achieve their own goals as well as shared common goals (Provan and Kenis, 2008).

One more, Multi-level Governance Theory (MLG further in the text). MLG is a conceptual framework that involves governance structures that extend beyond one organisation, or in the case of government beyond the confines of the national level. It extends from local and regional to national and international, as well as involving various non-governmental entities. The European Union (EU further in the text) is commonly used as a core example of multi-level governance, with decision-making and governance interactions taking place at regional, national, and supranational levels, and conversely the term is also often used as a clear and simple paradigm to explain how the EU functions (Stephenson, 2013). Understanding the collaborative and coordinative dynamics among these diverse levels is crucial, especially when dealing with health risks induced by climate change, as challenges and issues which transcend national boundaries can only be fully resolved by governance at a supranational level (Hooghe and Marks, 2008).

Finally, Participatory Governance Theory. This theory focuses on the involvement of citizens in governance, encompassing their active or indirect engagement in making decisions concerning policies, plans, or programs that pertain to their concerns or interests (Holland et al, 2012). Empowerment is at the centre of the idea of participatory governance, with a far wider and more diverse group of participants taking part in discussions, deliberation, and decision making, which should lead to better informed and more equitable results (Fung and Wright, 2001).

There are a number of mechanisms that can be used in participatory governance with the public including referendums, citizen assemblies, and forums. One of the key challenges with participatory governance is ensuring that civil engagement actually has any real influence and it not just symbolic.

While talking about climate change it is not enough to talk about mitigation and especially with such areas like public health it is important to pay attention to adaptation as well. Here the Adaptation theory might be considered. It offers a framework for addressing emerging challenges and improving the health resilience of other systems and institutions. The main suggestion is based on the idea that “mitigation is global, adaptation is local”.

The 2015 Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) adopted a set of several customization settings which allow more diverse methods and additional stakeholders to manage adaptation in various ways, for example to advance, regulate, facilitate, and to force adaptation measures to be adopted from higher levels (Persson, 2019).

A good example is the Action Theory of Adaptation to climate change. This theory underlines the collaborative efforts of different actors in responding to the challenges induced by climate change. Emphasizing a principle of "act local" it recognizes the importance of considering local contexts and involving actors at the local level – communities (Earth System Governance, 2011). The theory says that adaptation actions are often most effective when designed to fit specific local concrete needs, vulnerabilities, and according to resources of local communities. This framework encourages the active participation of local level actors, like communities, governmental agencies, and non-governmental organizations (NGOs) in the design process and implementation of adaptive strategies. By encouraging local engagement and cooperation between actors, the theory puts the importance of empowering communities to address their distinctive adaptation needs (Earth System Governance, 2011).

### 1.1.4. The concept of the Health for All Policy

The case of the COVID-19 pandemic across the globe showed that a risk in one sector, in the case of COVID-19 - the public health sector, might be the reason for collapse in other sectors such as economy, infrastructure, and social security as well as having an impact on the environment. There are overlaps between the different sectors and perhaps we might say that it was, and still is, one of the best examples of how during the management of this international crisis, health ministries in different countries worked closely together with other ministries at the national level as well as international level in coordination and cooperation.

Already in 1999, the European Centre for Public Health Policy had suggested a tool for policy makers called Health Impact Assessment (ECHP, 1999). It was proposed by R.J. Quigley and L.C. Taylor that this set of tools would be used for decision making and it is accepted as a collection of well-founded suggestions to guide policy making based on evidence (Quigley and Taylor, 2004). One of the presented tools was Health Economic Assessment Tool (HEAT further in the text) for walking and cycling, which can help to estimate the health and economic impacts of pedestrian and cycle travel. The World Health Organization (WHO further in the text) has also emphasized the relationship between sectors in connection with health problems such as economic sectors like agriculture, transport, and housing have impacts on health by causing pollution, injuries. (WHO, n.d.).

Following the COVID-19 pandemic, S.L. Greer and others reiterated the Health in All Policies (HiAP further in the text) concept which had initially been mentioned in 2006 (Greer et al, 2022). The authors expand on the idea of considering health in all policies, supporting collaboration between sectors to improve health, and reinforcing health policies and enhancing health outcomes to yield significant benefits for various sectors like economy, food security, and the environment (Greer et al, 2022). See Figure 5.

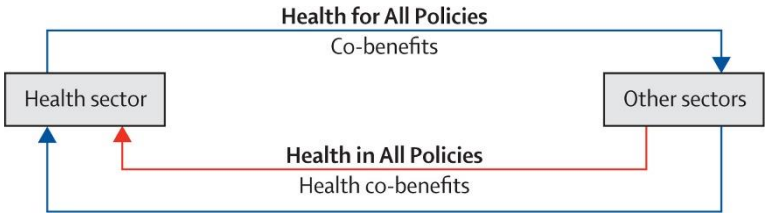


**Fig. 5.** The association between health and other sectors (source: Greer et al, 2022)

HiAP is an approach which recognizes the impact of non-health policies and decisions on the health sector and well-being. It refers to the integration of health policies across various sectors beyond traditional public health system settings. It can be raised these key principles for HiAP: intersectoral collaboration, policy coherence, equity, community engagement, evidence-based decision making, and sustainability. It means that it is important not the short, but long-term impact of policies on health. For example, HiAP is very much relevant addressing chronic diseases, environmental issues, climate change (Greer et al, 2022).

According to a study conducted in Lithuania it was confirmed that health is one of the main components of human capital (Railaite and Ciutiene, 2020). The findings from this study as well demonstrate a meaningful link between increased public health expenditure and notable enhancements in life expectancy. Additionally, the analysis using fixed-effects panel data models reveals significant positive effects of GDP growth. Additionally, this study shows the strong connection between health and education, revealing that higher education levels are linked to significantly higher life expectancy, while lower levels of education have a detrimental effect on life expectancy. This is a good example of the relationship between the health sector and others (Railaite and Ciutiene, 2020).

### 1.1.5. The Drivers, Pressures, State, Impact and Response (DPSIR) framework

The DPSIR framework has been chosen to set up the discourse of this work. It was developed in 1999 by the European Environment Agency (EEA further in the text), the aim of it is to examine the ways that society and the environment interact. The DPSIR framework together with environmental indicators can have a positive impact in policy-making support by public giving the possibility for awareness on environmental issues (EEA, 2016).

As was already discussed in this chapter climate change comes with a high level of uncertainty and complexity. This is the place where the DPSIR framework empowers public governance and society to analyse and see in a more structured way, understanding the complexity of relationships between different environmental drivers, pressures, states, impacts and responses in relation to climate change. This tool could be used to facilitate more effective policy formulations followed by implementation of public governance engagement (Environmental indicators: Typology and overview, 1999).

There are five main elements in the DPSIR framework: driving forces, pressures, state, responses, and impacts. To fully understand the DPSIR framework it is significant to pay attention to the links between the DPSIR elements and the dynamics linking them (EEA, 2016)

When it comes to policymaking then very clear, specific, and concrete information based on evidence is needed on driving forces – human activities, which are resulting in the environmental pressures which leads on to the environmental state which have impacts on human health and leading to the

responses in the society (EEA, 2016). It is necessary to mention that correctly chosen environmental indicators play an important role in usage of the DPSIR framework, this framework can be a strong support in order to make decisions in public governance.

### 1.2. Climate change induced risks to public health

At this point there is scientific certainty that human induced climate change is a reality and one that is continuing to intensify and affect every aspect of life on the planet. Despite other issues being more talked about and researched, arguably the area that climate change is having the largest impact on is public health.

In September 2021 more than 200 medical journals including The Lancet, BMJ, and the European Journal of Public Health all published a joint article stating that climate change is the greatest threat to public health and that although the COVID-19 pandemic was at its height the world could not afford to wait to tackle climate change and restore nature (Atwoli et al., 2021).

The effects of climate change on public health are wide ranging, and while some are direct and easily visible like the effects of higher summer temperatures on people with cardiovascular health problems, or the direct effects of an increasing number of extreme weather events that occur, others are less obvious. Both the highly visible and the less direct health effects suffer from a lack of public awareness, and in many cases also from a lack of research and a lack of public governance response. Despite the very real health threats rising from climate change, the public seem to be generally quite unaware of them. A recent public survey conducted in the UK found that the participants were concerned about the effects of climate change but that most of them did not make direct links between climate change and impacts to their own health or public health in general (Martin-Kerry et al, 2023). A similar study conducted in Canada found that respondents had a similar level of concern about health impacts as they did about other climate change effects, i.e. national security or economic impacts, and that although they were aware of the dangers from air pollution, water and food quality, they were not concerned about infectious diseases, heat-related dangers, or mental health issues (Casson, et al, 2023)

This is a global problem with every region facing both common and individual potential public health issues. Countries with tropical climates or made up of low ocean islands may seem like the ones that are most likely to feel the effects of climate change, but the reality is that there are major climate change induced threats to public health in Europe and Lithuania.

According to the European Environment Agency climate change has already started to have a significant level of negative impact on public health across Europe, including but not limited to, heat-related illness, cardiovascular and respiratory complications, mental health issues and increased rates of infectious disease transmission (EEA, 2022).

It is important to note that it would be easy but very simplistic to try and take each of the effects on public health of climate change as isolated and separate, they are tightly linked with each one having a high chance of being partially caused by or causative of others. For example, extreme heat events increase the likelihood of wildfires, which contribute to air pollution and increase the incidences of allergy related illnesses. There are a number of very direct public health risks that are either directly caused by, or have highly increased risks due to, climate change in Lithuania and across Europe in general: extreme heat events, wildfires, flooding, air pollution, allergens and pollen, airborne

pathogens, infectious diseases, waterborne pathogens, vector-borne pathogens, food insecurity, mental health and other indirect risk factors as well as risks multipliers.

***Extreme heat events***

Heat waves across Europe are occurring more frequently and with much higher intensity than they did previously. Prolonged exposure to high temperatures leads to dehydration and heatstroke but can also be a contributing factor to many other serious health issues, especially for vulnerable groups within the population including the elderly, children, and people with chronic cardiovascular and respiratory health conditions (IPCC, 2022). A 2023 article published in the journal Nature used the Eurostat mortality database to arrive at an estimate of just over 61,000 heat related deaths across Europe during a 3-month period in 2022 (Ballester et al, 2023). A global study by Zhao et al found that more than five million deaths per year could be attributed to abnormal temperatures, both hot and cold, and that Europe had the highest excess death rate due to extreme heat exposure per 100,000 people (Zhao et al, 2021).

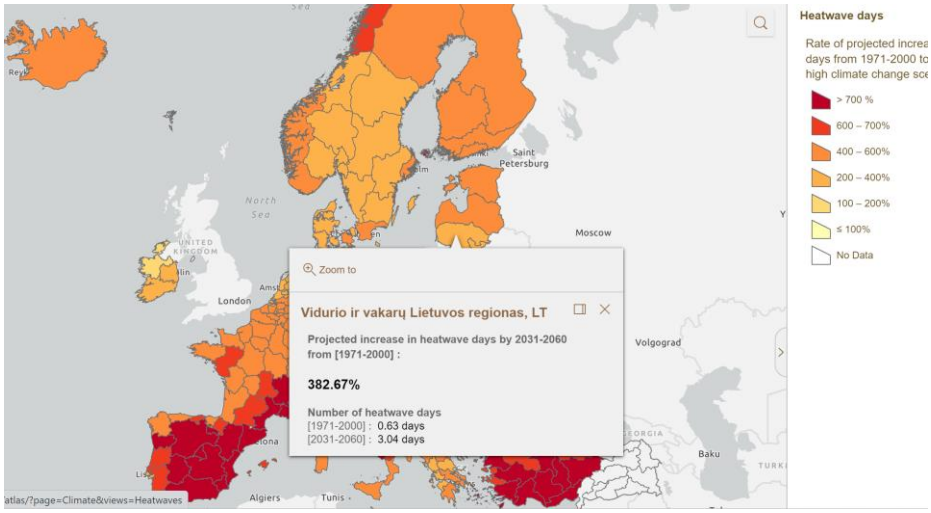


**Fig. 6.** The projection of heatwaves days in central western region of Lithuania 2021-2060 (source: Climate-ADAPT).

Climate scenarios are a key tool for future climate change estimations. Climate change is associated with typical concentration scenarios Representative Concentration Pathways (RCP ).The European Climate Adaptation Platform Climate-ADAPT a partnership between the European Commission and the European Environment Agency using high climate change scenario RCP8.5 to project the increase in heatwave days from 1971-2000 to 2031-2060, according to it in central western region Lithuania heatwave days will be increased by 382,67 percent, see Figure 6 (ClimAdapt-LT, 2023).

To look more closely at Lithuania, it can used different indicators. For example, one of them is rising temperatures, which will increase the number of heatwaves it might increase from current 2 days to 7 days per year. Another one tropical nights will become more frequent. From 1 tropical night per 2 years is to 7 according to scenario RCP8.5 by the end of the century and in Vilnius region event up to 10. The indicator of cold days with a minimum daily temperature below -15 °C according to the scenario RCP4.5 will decrease from the current 9.5 days by the end of the century (ClimAdapt-LT, 2023).

The health dangers from extreme weather events, whether they are heatwaves, storms, flooding, or others, go deeper than just the individuals who are physically directly affected by the event. Large groups of people needing to be treated urgently and at the same time puts a lot of strain on healthcare and emergency response systems. The risks from extreme weather events need to be evaluated not just on the actual physical danger, but also the vulnerability of communities and individuals, and the systems that are in place to prepare for, manage, and also to recover from the event (Ebi et al, 2021).

### *Wildfires*

Forest fires are increasing at an alarming rate worldwide, with fires in California, Australia, Spain, and Greece rarely out of the news during the last few summers. Outside of these high-profile cases, statistics show that almost every country in the European Union has increasing rates of forest fires in recent years. In Lithuania, the average number of hectares destroyed by forest fires each year between 2006 and 2022 was 16.41 while the European Forest Fire Information System estimate for forest fires in Lithuania in 2023 is 305 hectares (EFFIS - Statistics Portal, 2023). Together with the increasing rate of forest fires the impact on public health is also increased due to the increase of urban sprawl in to fire prone areas (Urban Adaptation, 2020)

Particulate matter that is smaller than 2.5 μm in diameter ($PM_{2.5}$) is generally regarded as being a contributory factor in cardiovascular problems. Most research on the health effects of air pollution has studied the effect of $PM_{2.5}$ in urban areas from industrial and vehicle emissions. Recent studies have shown that the $PM_{2.5}$ in wildfire smoke has a different chemical makeup than particulate matter from other emissions, as well as being released in much higher concentrations over short periods. A large-scale study in the US found that on high $PM_{2.5}$ level days with clear air, hospital admissions caused by asthma, bronchitis and wheezing increased by around 1.3% while on smoky high $PM_{2.5}$ days hospital admissions for the same issues increased by 6.9% (Deflorio-Barket et al, 2019).

There are clear effects of $PM_{2.5}$ on respiratory health, but wildfire smoke is a complex mix of compounds that also includes gases including carbon monoxide and nitrogen oxide, and there are likely other long term health effects from inhalation. There is some evidence of links between wildfire smoke inhalation and cardiovascular health problems, but there are a number of knowledge gaps and more research needs to be done to investigate these links (Chen et al, 2021).

As well as the immediate effects of wildfire smoke and other physical dangers, they also form part of a vicious circle, releasing huge amounts of carbon dioxide and other greenhouse gases into the atmosphere and contributing to continuing climate change (Singh, 2022).

### *Flooding*

Climate change is increasing the likelihood of and public health risks from flooding in multiple ways. Rising sea levels lead to a higher chance of coastal flooding, and extreme weather events including extended periods of heavy rainfall and storms lead to an increased risk of inland and urban flooding. As well as injuries sustained during flood events and the risk of drowning, flooding also leads to a high risk of infectious diseases caused by an increased level of exposure to waterborne bacteria and pathogens and contamination of water supplies with sewage. In addition to diarrhoeal illnesses, the risks of which are increased by a multiple of twenty (Jung et al, 2023), this raised pathogen level increases the risk of wound infections (The Lancet, 2017). There is also a very real danger of hypothermia due to exposure to cold floodwater.

### *Air pollution*

According to United Nations Environmental Program (UNEP further in the text) estimates, air pollution is a contributing factor in around 7 million premature deaths each year globally (UNEP, 2021) and around 99% of the world population regularly breathes air that does not meet WHO air quality guidelines (WHO, 2022).

Numerous studies including one published by the Canadian Cardiovascular Society in 2023 show that climate change alters both weather patterns and atmospheric chemistry in ways which increase the levels of formation and retention of airborne pollutants, a phenomenon that has come to be known as the climate penalty (Alahmad et al, 2023). This increase in airborne pollutants can significantly increase health risks for vulnerable groups, including those with cardiovascular issues.

A study by the world bank estimated the cost to the world economy from lost productivity and healthcare spending due to air pollution at around $5 trillion in 2016 and this figure will have increased substantially as air pollution levels have continued to rise since then (World Bank, 2016).

### *Allergens and pollen*

Increases in air temperature due to climate change are causing pollen seasons to start earlier and last longer, as well as allowing plant species to migrate to areas where they would not previously have been able to survive (Beggs et al, 2023), this has an effect on the level of pollen and fungal spores that are produced and emitted into the atmosphere. It is compounded by increased levels of carbon dioxide ($CO_2$) in the atmosphere which were at 280ppm before the industrial revolution and had risen to around 410ppm by January 2019 (D'Amato et al, 2020). These increased concentrations of atmospheric $CO_2$ have been shown to have effects on plants, leading to higher levels of photosynthesis, longer flowering periods, and the production of greater amounts of pollen (D'Amato et al, 2020).

The increase in extreme weather events, such as storms and flooding also increases the risks of allergies by allowing for greater amounts of mould and fungus growth (Katelaris and Beggs, 2018).

### *Airborne pathogens*

Climate change is having a significant effect on the transmission of airborne diseases indoors, as rising temperatures increase the use of air conditioners in residential and commercial spaces and also within health-care facilities (Nardell et al, 2020). At the same time, changes to ambient air temperature, humidity and pollutant levels in the atmosphere all play a part in increasing the life cycle and survivability of outdoor airborne pathogens.

### *Infectious diseases*

The fact that climate change is an important contributing factor in the increase of cases of many kinds of infectious diseases is one that is often overlooked by the public, the media, and public health governance.

The level of impact of infectious diseases is directly affected by and linked with a combination of factors, including a lack of sanitation, access to clean water and nutritious food, and access to and quality of public health services (Caminade et al, 2019), with each of these stressors being directly or indirectly affected by climate change.

We can broadly divide infectious diseases by transmission methods: vector-borne, waterborne, foodborne, zoonotic, and airborne.

***Waterborne pathogens***

Waterborne diseases are not generally a major problem in Europe or other parts of the world where there is sufficient access to clean drinking water and sanitation, but they are common and deadly in other parts of the world. Changing temperatures and other climate conditions has been predicted to have a significant impact on the infection rates from many waterborne pathogens including Cholera, Typhoid, Leptospirosis, Toxocariasis, Cryptosporidiosis, and Giardiasis (Jung et al, 2023).

Although many of the deadliest waterborne diseases are not common in Northern Europe, they are also not unheard of, and even if we look only at the most common diarrhoeal infections then climate change is estimated to cause an additional 250,000 deaths per year from diarrhoea by 2050 (Jung et al, 2023). Flooding, increased water temperatures, and increased chemical run-off from agriculture into drinking water supplies are all contributing factors to higher levels of infection. Rising sea levels can also play a part in increasing the risk of waterborne diseases as a consequence of saltwater intrusion into freshwater supplies (UNEP, 2021).

***Vector-borne pathogens***

In areas of the world where malaria, dengue fever, zika, and others are carried by mosquitos and similar insect vectors, studies have shown an increase in both insect populations and disease prevalence rates. This can be partly attributed to the effects of climate change on pathogens and vectors directly, by changing their life cycle and reproduction conditions, but also to more indirect effects of climate change, such as the number of competing pathogens/vectors or the contact patterns of humans and vectors (Chala and Hamde, 2021). In addition to an increase in populations in previously endemic areas, vector insects are increasing in their geographic distribution with areas of Europe being affected which previously were not. Populations of the Asian tiger mosquito, which is the world's most invasive, spread to Italy in 1990 and have since spread to multiple other EU and neighbouring countries (Semanza and Suk, 2018). This particular vector insect can transmit dengue fever, chikungunya and Zika.

While this is not applicable in Northern Europe and Lithuania specifically, there has been a steady rise in the number of cases of tick-borne encephalitis and Lyme disease in the Baltic States over the past few decades with strong evidence to suggest that this is linked to climate change (Voyiatzaki et al, 2022). Lyme borreliosis is already the most widespread vector-borne disease in the European Union and there has been an increase in reported cases of almost 400% over the last 30 years (Semanza and Suk, 2018). Changes in temperature and weather patterns across Europe are increasing the geographic range of ticks across the continent, and warmer winters mean that the tick season is both starting earlier and lasting longer than in previous decades (Tsoumani et al, 2023). Multiple studies reach similar conclusions, that the prevalence of Tick-Borne Encephalitis and Lyme Disease are both expected to increase by about 10% before the end of this century (Donša et al, 2021) (Voyiatzaki et al, 2022).

The actual current prevalence rates and levels of increase of these diseases across Europe are difficult to track accurately as most countries do not have national registries of cases and statistics in many countries rely on physician surveys. However, it is clear that the Baltic States including Lithuania

have some of the highest levels in Europe. The estimated prevalence rate of Lyme borreliosis in Western Europe in 2016 was 22.05 cases per 100,000 people (Sykes and Makiello, 2017), while the prevalence rate in Lithuania, which does keep a mandatory register, was 101.6 cases per 100,000 people (Petrulionienė et al, 2020), see Figure 7.

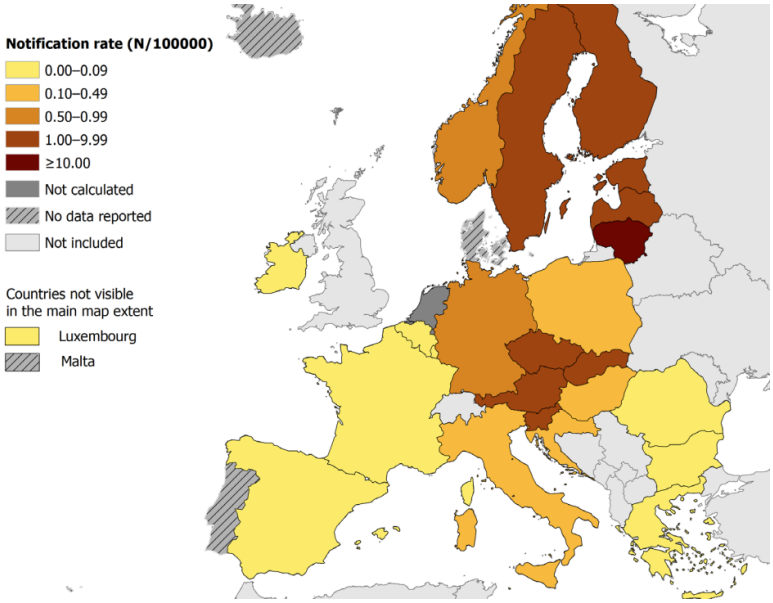


**Fig. 7.** Distribution of confirmed tick-borne encephalitis cases per 100 000 population by country, EU/EEA, 2020 (source: OEDC, 2021)

### *Food insecurity*

Although extreme weather events and melting polar ice are the most sensational and visible effects of climate change, the effects on food security globally are possibly the biggest effect of climate change on human society and health.

Climate change touches almost every aspect of food security, from the effects of ambient temperature and soil fertility on crop yields, to increased levels of illness from foodborne pathogens, malnutrition and a widening of the poverty and nutrition divides as lower production drives consumer food prices higher. It is a multifaceted problem with most research and solutions focusing solely on the effects on crop yields, while other important aspects of the dangers and risk reduction strategies for food security are frequently overlooked (Campbell et al, 2016). Máté et al also point out that the challenges to food security from climate change are closely linked with other challenges including sustainable energy generation and use (Máté et al, 2020)

Most studies and concerns related to the effects of climate change on food security are concerned with the global south and nations with existing higher levels of poverty, but it is also an important issue for Europe, including the most developed nations. A warming climate actually means that crop yields could increase in some parts of the world including Northern Europe, but the small gains in yield that some regions may see is small compared to the decrease in yields in other areas like Southern Europe. As food supplies are very globalised, it means that even in a country like Lithuania where yields may increase the overall availability and affordability of food will decrease (IPCC, 2022). A recent case study in Sweden, which ranks 7$^{th}$ in the Global Food Security Index 2022 (The

Economist Intelligence Unit, 2023) highlighted the danger from disruption of the global food supply chain and imports of cereal crops and grains specifically (Horn et al, 2022).

As well as agriculture, climate change affects livestock farming, with a warming climate extending the range of vector-borne diseases further into Northern Europe than they were previously prevalent, for example Bluetongue which affects sheep (Jones et al, 2019).

***Mental health and other indirect risk factors***

As well as the more direct health risks rising from climate change there are also a number of less direct physical threats to public health and wellbeing, which can be just as damaging. These include mental health issues, displacement, and the disruption of essential public services.

In a recent publication the EEA highlighted the need for an increase in the levels of resilience of healthcare systems to the changing needs that climate change brings, especially in European cities which are at a higher risk of being overwhelmed during extreme heat events (EEA, 2022).

In the case of mental health, a study conducted in the UK found that people affected by flood events suffered elevated levels of anxiety, depression and PTSD (Waite et al, 2017) while similar research in Canada found similar results and also highlights increased suicide levels in post-disaster areas and higher mental health risk levels of children and young people (Habrok et al, 2020).

It is very hard to quantify the actual levels of mental health issues that are caused or worsened by extreme weather events, due to a lack of accurate reporting. This is partially due to causative links not being identified during treatment, but a far larger factor is that many people who are affected by mental illness do not seek help for their condition. Generally, public understanding of mental health issues has increased, and public stigma has decreased over the last few decades, but this has not been reflected in the level of self-reporting of mental health problems (Gagné et al, 2023). A study composed of interviews with healthcare providers in Lithuania found that the stigma of mental illness remains high in the country, and links this to high levels of status anxiety that is common to post-socialist societies (Doblyta, 2020). This means that we can only work with estimates of the actual number of people who will suffer mental health effects as a result of climate change related events, but a conservative estimate would be that 20% of the affected population will experience some form of mental health problem (Clayton, 2021).

While floods, storms, and heatwaves are generally classified as extreme weather events, there are other weather and climate changes that are less immediate in effect but also have significant mental health impacts. Drought has been linked with an increase in the rate of suicide among farmers, it would be easy to put this down to economic pressures, but studies have also linked it with grief about land changes and a loss of identity and purpose (Clayton, 2021).

It is also very important to note that the actual number of climate change related deaths is probably far higher than recorded, as the death rate from extreme weather events, floods, heat waves, etc. are hard to determine. The contribution of the weather events to the cause of death may not be accurately recorded, and there is often not a clear methodology in place for this.

Multiple studies, including one published in the journal Nature in 2021, claim that climate change related deaths are far higher than any official figures show, estimating that the mortality rate from

climate change related heat alone to be 37% of all heat related deaths globally (Vicedo-Cabrera et al, 2021).

***Risk multipliers***

The consequences of climate change, both on health and other facets of daily life, are not equal, globally, within Europe, or even within individual countries like Lithuania. The poorest and most vulnerable members of society including the elderly and those living with chronic health conditions are more susceptible to the health dangers of climate change. People with higher levels of poverty and lower levels of education are more likely to live in areas that face greater exposure and are more likely to be affected by climate change effects, for example in urban heat islands, on flood plains, or low coastal areas (Van Daalen et al, 2022).

The fact that they will usually have less access to resources which help with climate change adaptation and mitigation adds to their vulnerability (Ganzleben and Kazmierczak, 2020). Tackling the problems of poverty and inequality are essential to reducing the public health burden caused by climate change, with an urgent need to invest in adaptation and resilience tools and systems (Ada-Cristina and Lucian-Liviu, 2020).

The effects of climate change on human well-being, especially in the elderly, are significant. In developed regions, senior citizens are the most likely group to face the health consequences of climate change, including the extreme heatwaves, air pollution, infectious diseases. The exposure to extreme heat has been linked with hospitalization and mortality rate as well as air pollution has been linked to a range of detrimental health effects in the elderly, including respiratory and cardiovascular diseases (Sarkar, 2023).

Looking at the structure of society by age and its future trends and considering forecasts of average life expectancy the conclusions would be that Lithuania is a country with an ageing population. At the beginning of 2020 almost 2.8 million people lived in Lithuania, one fifth of them were aged 65 years and older. Over the last 50 years, the percentage of this age group in society has doubled and it is predicted that in another 50 years it will be one third of the population, the prediction also says that in the next 30 years, Lithuania will be one of the fastest aging societies in the European Union (Eurostat, 2019). It is quite likely that in 2050 half of the Lithuanian population will be 51.5 years old. and older people, while the EU median age will be 48 years.

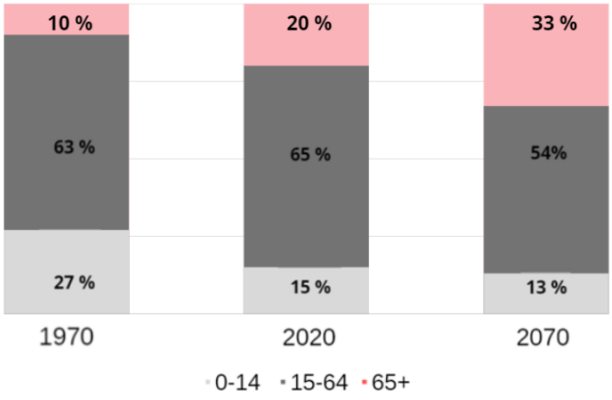


**Fig. 8.** Change and forecast in the age structure of the Lithuanian population (made by author source: EUROSTAT, 2019)

The second health risk multiplier in connection with climate change is the group of people who suffer from chronic diseases or other long term health conditions. According to the Health Interview Survey 2019, 46 % of Lithuania population indicated having chronic diseases or long-term conditions. It is shown that over 14 % of 15-24 year old men and over 18 % women in the same age group already have a chronic disease or long-term health condition in the Figure 9. The highest percentage is for people 75+ years old both men and women, 82 % and over 90 % respectfully (Statistics Lithuania, 2019).

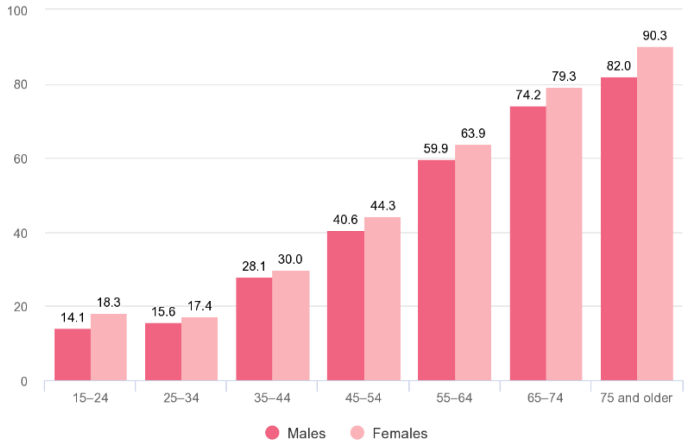


**Fig. 9.** Proportion of population by age with a chronic disease or long-term condition, 2019 (source: Statistics Lithuania, State Data Agency)

### 1.3. Synthesis and conceptual model

Human induced climate change is the greatest single threat to human health that the world has ever faced, many of the challenges that it brings are global while others are more localised, and they are most dangerous to the poorer and most vulnerable groups in society.

The health risks that climate change is a direct cause of or a contributing factor to in Lithuania, and Europe in general, are varied. They include: increased summer temperatures, extreme heat events and reduced air quality due to forest fires; flooding of coastal and urban areas and the associated increase in infection risks; a rise in air pollution, higher pollen count and increased allergy risks; decreased food security and water security; and a heightened level of infectious diseases specifically vector-borne diseases carried by ticks. There are also elevated levels of risk to mental health, and dangers that arise from the public health system being put under increased strain. The DPSIR framework example in Figure 10 shows elements of driving forces, pressures, and state, which are taken from the Seventh Edition of Global Environmental Outlook (GEO-7 further in the text) (GEO-7, 2022) while responses and impacts were suggested by the author according to the thesis are climate change induced risks to public health in Lithuania.

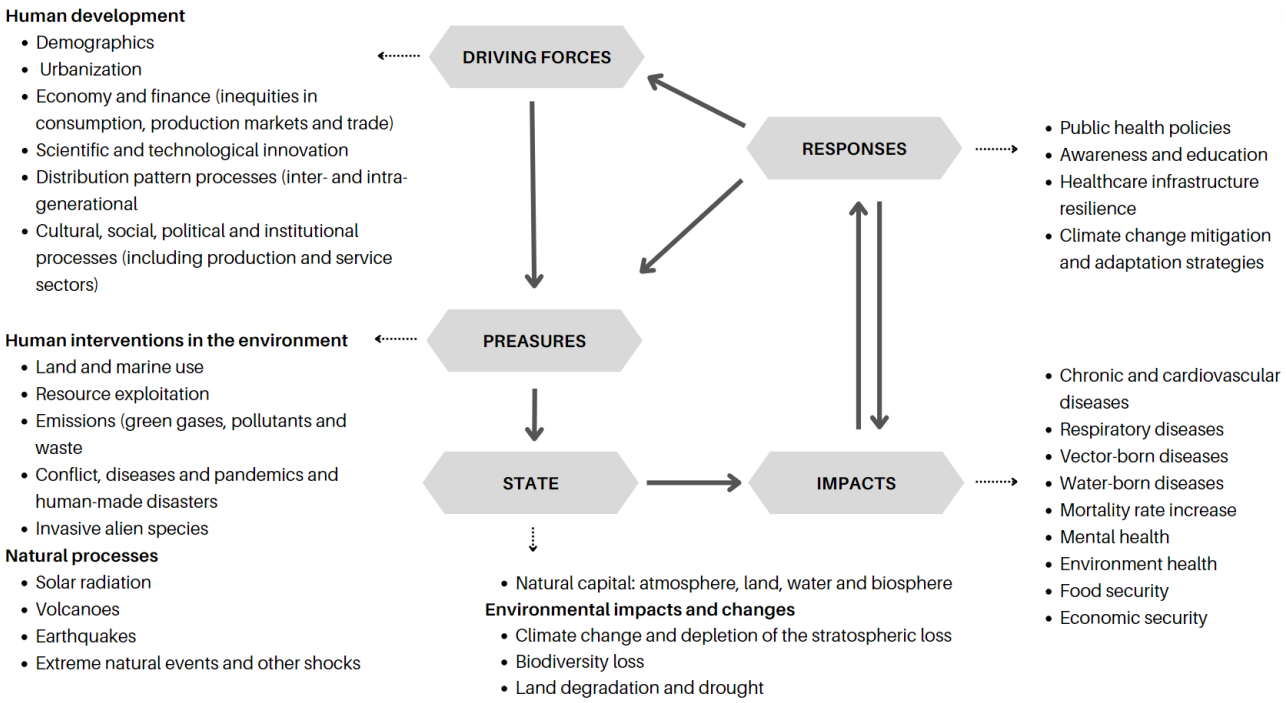


**Fig. 10.** DPSIR framework for assessment of governance of climate change induced risks to public health in Lithuania (made by author, 2023)

The DPSIR framework is a valuable tool for creating conceptual model and for better understanding of the causes and effects relationship of climate change induced risk to public health in this work.

There are a variety of governance and risk governance theories which can be used to address and to explore different aspects of governance in relation to climate change and public health. In the Chapter one some of them were chosen in the connection with climate change induced risks to public health governance. Each of them supplements one another.

Starting up with IRGC risk governance framework as the topic of these thesis is analysing the specific risk – climate change induced risks to public health. This theory emphasises the need to make pre-assessment of the risk, appraisal of the risk, characterisation, and evaluation of the risk. It also emphasizes the management element of the risk governance. IRGC risk governance framework has as well important cross-cutting aspects which are communicating, engaging with stakeholders and the context. Complementing IRGC risk governance framework, climate governance theory further discusses the importance of actors' involvement in the process at the different levels (international, regional, national and local). Climate governance theory lists these most important actors: local and international governments, international organisations, the private sector, NGOs and other social actors. The climate governance theory as suggest formal and informal processes considering opportunities, actions, policies, and strategies. The most important elements from these theories in this work will be communication processes, engagement between stakeholders at the different levels.

Smart governance theory adds to previous theories the importance of collaboration between the actors and the active stakeholder engagement and networking, as well pointing out the citizen's engagement. This is further elaborated by the network governance theory which emphasizes the collaboration and interorganizational networks and participatory governance theory which as well puts attention Citizen's engagement importance in governance by direct or in direct activities. The Good

Governance model adds one more important aspect into governance accountability between the state and its citizens.

For mitigation or adaptation of the risk – climate change induced risks to public health, the focus needs to be on integrated government solutions to address complex issues, including those related to public health and climate change. Health for All Policies like Climate Governance theory suggest that that it is co-beneficial to involve health and climate related policies into other sectors' policy areas.

The conceptual model for analysing the governance of climate change induced risks to public health in Lithuania is presented in Figure 11.

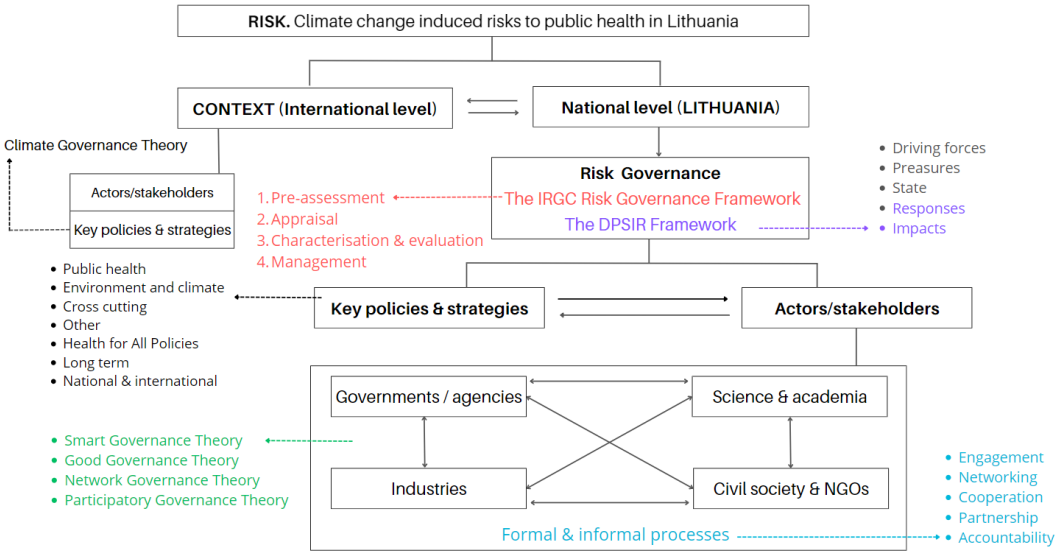


**Fig. 11.** The conceptual model for assessing the governance of climate change induced risks to public health in Lithuania (made by author, 2023)

## 2. Data sources and methods

This master's thesis is based on scientific literature analysis, overview of policy relevant documents at national, European Union and global levels, and content analysis methodologies. Empirical analysis and assessment employ secondary data, statistical data, and document analysis. This chapter will discuss the methodology of this work more closely.

The methodological framework of this thesis follows the conceptual model presented in Figure 11 of the 1.3. sub-chapter. This research is problem driven (as opposed to "methods driven"), therefore it is based on a range of information sources and methods, all of which serve to answer the research questions. The research questions relate to the key elements of governance of public health risks caused by climate change in Lithuania, as presented in Figure 11: international context, content of national policies and governance actor network.

There are six questions raised by the author that are operationalized in Table 1.

**Table 1.** Operationalization of the main research questions to be answered in the empirical chapter (made by author, 2023)

| No. | Question | Methodology | Theory |
|---|---|---|---|
| Q 1 | What is the international context for the governance of climate change induced risks to public health in Lithuania? | Scientific literature review; document analysis and content analysis of key policies & strategies. | Climate Governance Theory (Janicek, 2017). |
| Q 2 | A. If and how the assessment of climate change induced risks to public health are being implemented in Lithuania?<br>B. Are all specific vulnerable groups covered in those assessments? | Document analysis and content analysis of national key policies and strategies, recommendations; statistical data overview on the risks' multipliers. | The IRGC risk governance framework (IRGC, 2019); DPSIR framework (EEA, 2016). |
| Q 3 | What indicators are employed for assessing climate change induced risks to public health in Lithuania? | Document analysis and content analysis of national key policies and strategies. | The IRGC risk governance framework (IRGC, 2019). |
| Q 4 | Who are the stakeholders and what is the actors' network in the governance of climate change induced risks to public health in Lithuania? | Scientific literature review – the IRGC risk governance framework actors/stakeholders at local, regional, national level; governance theories for public health. | The IRGC risk governance framework (IRGC, 2019); Climate Governance Theory (Janicek, 2017); Smart Governance Theory (Gaulė, 2014), Network Governance Theory (Assens and Lemueur, 2016); Participatory Governance Theory (Holland et al, 2012); Good Governance model (Bjork and Johansson, 2001). |
| Q 5 | Is there dialogue, transparency, and involvement between horizontal governance stakeholders in Lithuania? | Document analysis of national key policies and strategies; study recommendations; informal guidelines. | The IRGC risk governance framework (IRGC, 2019); DPSIR framework (EEA, 2016). |
| Q 6 | How diverse climate change induced risks to public health are covered by policy documents in Lithuania? | Document analysis of national key policies and strategies for each risk. | |

To answer the research questions, a range of information sources and methods was employed. The main information source is the various publicly available documents: legal documents, key policies, strategies, studies, action plans, recommendations, etc. These documents were selected based on purposive criterion sampling. The keywords for document search and sampling included: climate change, public health risk and other risk-specific keywords, e.g. heat wave, etc. Three main public document repositories were used for document search:

1. Seimas public documents repository, access through https://e-seimas.lrs.lt/.
2. European Commission public documents repository, access through https://ec.europa.eu/transparency/documents-register/.
3. The United Nations public documents repository, access through https://documents.un.org/prod/ods.nsf/home.xsp

Documents searches were also carried out on the official websites of individual organisations and ministries:

1. Climate-Adapt for European Union adaptation policies, access through https://climate-adapt.eea.europa.eu/?set_language=en
2. Organisation for Economic Co-operation and Development, access through https://www.oecd.org/environment/reform-options-for-lithuanian-climate-neutrality-by-2050-0d570e99-en.htm
3. Ministry of Health of the Republic of Lithuania, access through https://sam.lrv.en
4. Ministry of Environment of the Republic of Lithuania, access through https://am.lrv.lt/en/
5. My Government, access through https://epilietis.lrv.lt/en.

In total, 67 different documents were employed for the research. The documents were analysed manually using a qualitative interpretative approach.

Two open data repositories were used to obtain the statistical data needed to answer the research questions:

1. Eurostat: the statistics office of the European Union. Access: https://ec.europa.eu/eurostat
2. State data agency ‘Statistics Lithuania’. Access: https://www.stat.gov.lt/home

The results are described in research-question centred approach. Each section of the results chapter is devoted to answering one of the questions posed in Table 1.

## 3. Empirical analysis and assessment of climate change induced risks to public health governance in Lithuania

In the third part of this thesis, the analysis of legal documents, key policies, strategies, as well studies and methodical material will be presented, with the aim to answer the 6 raised questions in the Chapter 2. The findings from the analysis will be summarized in the section of conclusions.

### 3.1. International relations, agreements, and policies

This subchapter will investigate Q1 what is the international context in the governance of climate change induced risks to public health in Lithuania? Starting with importance of international relations and the key agreements and policies related to climate change and public health.

Climate change is a global issue with effects that are not geographically constrained to nations or areas that contribute the most to greenhouse gas emissions and other causative factors.

Within Europe specifically, the public health risks from climate change affect people across the continent from, for example, an increase in mosquito borne diseases in the Mediterranean to an increase in tick-borne diseases in the Baltic States (Semanza and Suk, 2018), while air pollution and heat related issues affect everyone. A lack of physical borders and freedom of movement also contributes to the risk of increased levels of infectious diseases, with over 86% of chikungunya cases and over 93% of dengue cases being travel associated (*Climate Change as a Threat to Health and Well-being in Europe: Focus on Heat and Infectious Diseases*, 2022). Looking further outside of Europe, there are many wider risks including challenges to food security, as our food supplies are global in nature and agriculture is strongly affected by the effects of climate change (Kovats et al, 2020). The global and transnational nature of the health risks that climate change brings mean that there must be cooperative international responses, both across the European Union and also globally.

One of the areas that can have a large and meaningful impact on climate change health risk mitigation is the sharing of scientific knowledge, policy models and best practices. This helps avoid duplication of efforts and avoids conflicting responses (*Climate Change as a Threat to Health and Well-being in Europe: Focus on Heat and Infectious Diseases*, 2022). Transparent information sharing and access to open and integrated bigdata also increases the speed and efficacy of research (Zhang et al, 2022). There are some good examples of the results of both international cooperation and public/private sector cooperation that arose during the COVID-19 pandemic, for example a significant acceleration of vaccine development. This not only highlights the importance of cooperation but also can be directly applied to fighting the climate change induced increase in infectious diseases (Semenza and Paz, 2021).

Another area where international cooperation is important in health risk mitigation the share of resources between more and less developed states and regions. This includes financial, technical, and educational support (European Commission, 2018), and is one of the key principles set out in the Paris Agreement, which all EU states are party to (UNTC, 2023). Some organizations argue that this does not go far enough, with the World Health Organization calling for international debt alleviation, and a more equitable sharing of what it refers to as the world's common property resources, with the atmosphere included in that grouping (Kovats et al, 2020).

International cooperation, and specifically treaties and agreements, for example the Paris Agreement, also have an important part to play in enhancing transparency and accountability and in increasing levels of public awareness of the risks and issues.

*The Paris Agreement.*

The Paris Agreement is probably the most widely known climate change or environmental agreement in recent history, most people have heard of it even if they are not actually sure what it comprises of. The Agreement was adopted in 2015 as a part of the United Nations Framework Convention on Climate Change.

The central premise of the agreement is simple: to limit the rise of the global average temperature to less than 2 degrees C above pre-industrial levels, and ideally to limit the increase to 1.5 degrees. The United Nations Framework Convention on Climate Change (UNFCC) (UN, 2015) had at this point acknowledged that climate change and an associated global temperature rise were now unpreventable, and the Paris Agreement is effectively a damage limitation strategy.

The Paris Agreement sets out a framework for countries to create and submit Nationally Determined Contributions (NDCs) which are the nations specific plans and pledges on how they will reduce greenhouse gas emissions and adaption plans for dealing with climate change. The agreement contains various points which cover things like climate finance – developed nations providing financial support to developing ones, transparency and accountability, and technology transfer, all of which highlight the need for international cooperation to tackle both limiting the scope of climate change and dealing with the issues it causes, but the core of the agreement remains what each individual nation is willing to do and how they will implement it.

The only explicit reference to health in the Paris Agreement is regarding human rights and the right to health which governments should not sacrifice when they are taking action to address climate change. Even though it is barely explicitly mentioned, and the key focus of the agreement is on cutting carbon emissions, it can be argued that it is a health agreement as well. Speaking in 2018 Dr. Diarmid Campbell-Lendrum, the WHO Team Lead on Climate Change and Health stated that they see the Paris Agreement as a public health agreement, and "potentially the most important public health agreement of the century" (UNFCC, 2018). A 2021 modelling study published by The Lancet found that countries meeting their NDCs would result in significant annual reductions of deaths attributed to air pollution and diet among others (Hamilton et al, 2021). According to the last ES NDC Lithuania's greenhouse gas emission reduction target for 2030 is 21 percent and greenhouse gas emissions and removals for the period from 2026 to 2029 is 661Kt CO2eq (General Secretariat of the Council, 2023).

The Paris Agreement states that it is legally binding, but there are serious questions that can, and have been, asked about the lack of enforcement mechanisms. The compliance committee only has the ability to make recommendations to signees who are not complying with the agreement, but it does not have the power to issue any actual punishment or sanctions. This has led to criticism from many environmental groups, especially as some countries have recently been walking back some of their climate pledges, but others note that it was a compromise that was needed to get all participating parties to sign, and that it remains an important and highly visible treaty.

There are a number of international agreements and treaties that aim to address both the causes and the effects of climate change. In some, like the Paris Agreement, it is the central premise and whole point, while in others like the UN Sustainable Development Goals it is one of many parts. In this section a few of the more notable and important agreements are discussed, and any relationship to public health is highlighted.

The Paris Agreement was adopted in the 21th UN Climate Change Conference (COP21). The last the 28th UN Climate Change Conference (COP28) is significant for public health in relation with climate change. The COP28 UAE Presidency, in collaboration with WHO and other actors, organised the first Health Day and the first ever Ministerial Meeting on Climate and Health. WHO and the Wellcome Trust also hosted the COP28 Health Pavilion, it was the third time. At COP28, the 'COP28 UAE Declaration on Climate and Health' was announced, representing a global commitment to actively address the health impacts of climate change. It was endorsed by 123 countries, which committed to improving the capacity of health systems to implement adaptation measures for climate-sensitive diseases and climate-related health risks. Lithuania was one of the countries signed the declaration. The importance of development od climate-health finances was pointed out at COP28 as well suggestion to strengthen national and multilateral cooperation on climate change and health, including the Alliance for Transformative Action on Climate and Health, which promotes collaborations between local, regional and global stakeholders/actors (COP28, 2023)

*Alliance for Transformative Action on Climate and Health*

The 26th UN Climate Change Conference (COP26) in 2021 brought a highly significant milestone in pushing public health to the front of the climate change agenda. This was the first time that a health programme had been promoted at a COP conference, led by the UK government, WHO, Health Care Without Harm (HCWH) and the UNFCC. The key initiatives to come out of the programme are to support countries in developing health care systems that are both climate resilient and low carbon sustainable.

Commitments made by a number of countries at COP26, led to the creation of the WHO-led mechanism the Alliance for Transformative Action on Climate and Health (ATACH).

ATACH provides a framework for climate resiliency in health systems based on conducting vulnerability and adaptation assessments and then developing a health national adaptation plan and using these tools to access climate change funding for health and build resilient systems. It also provides a framework for assessment and road mapping to create net zero emission health systems.

As of October 2023 more, than 70 countries have made commitments at the national health ministry level to reach targets on health in climate resiliency, low carbon sustainability, or both, including 10 European countries: Austria, Belgium, France, Germany, Ireland, Netherlands, Norway, Poland, Spain, UK (WHO, 2023).

Unfortunately, while ATACH is one of the most important international initiatives yet on public health and climate change, it is not legally binding and is a voluntary framework and does not have enforcement mechanisms at all.

Lithuania has not signed and there is no evidence of any plans to join ATACH. However, if Lithuania were to join, it would be beneficial to manage the risks of climate change to public health. Networking

and harnessing the collective power of the countries and stakeholders/actors involved in ATACH empowers countries to move the agenda forward and promote the integration of the climate change and health nexus not only in national, but also in regional and global agendas and plans. It would be a political commitment by the Ministry of Health to develop climate resilient and low carbon sustainable health systems, as ATACH aims to turn commitments into action, it's support would be provided to make and implement commitments, including advocacy, technical support, knowledge sharing, monitoring, and access to finance (ATACH, 2021).

ATACH's wide and growing network includes not only government agencies, but also NGOs, international companies, philanthropic foundations and academia would be beneficial to Lithuania approaching and governance climate change induced risks to public health and developing climate resilient public health system. The way in which the ATACH process works is closely linked to climate governance through formal and informal processes at global, regional and local levels; it is networked governance, where multiple stakeholders from different sectors work together; it is also multi-level governance.

*UN Sustainable Development Goals*

The Sustainable Development Goals (SDG) are part of the United Nations 2030 Agenda for Sustainable Development. Although they were adopted by the UN and member states in 2015, the actual level of progress made towards achieving them varies a lot dependent on particular SDG is in question and which state or region we are looking at, and it is likely that the COVID-19 pandemic set back progress on health and poverty related goals.

The SDGs are divided into 17 goals, covering, among other things: poverty, education, gender and other equalities, and the environment. They are ambitious and wide reaching but according to many commentators they are also achievable, with UNDP describing them as a 'call to action for all countries'.

SDG 3 is 'Good Health and Well-Being' and while it does not relate climate change and health, being more focused on things like maternal mortality, it does set targets for ending preventable infant deaths and fighting infectious diseases which are both affected by the effects of climate change. According to OECD overview and assessment of country profile 'Measuring distance to the SDG targets – Lithuania' target - deaths and illness from pollution is not likely to meet target (OECD, 2022). Air pollution is the leading environmental cause of death in Europe. It can cause or trigger chronic and acute respiratory and cardiovascular diseases, 237 810 premature deaths in the EU in 2020 due to PM2.5 exposure (EU, 2023). It is important to note that Lithuania is making progress on SDG 3, but the status is worse than the EU average (EU, 2023).

Each of the individual SDGs cannot be taken in isolation and all 17 are interlinked and integrated (UNDP, n.d.), which means that there is a health dimension where HiAP (Greer et al, 2022) is relevant addressing to all of them including those more closely related to climate change. Some of the simplest examples of this interlinking would be SDG 6: Clean water and sanitation – Unsanitary conditions and non-potable water are major causes of infectious diseases, or SDG 2: Zero hunger – Eradicating famine and malnutrition would significantly improve public health worldwide. Though these are the simplest examples all of the other SDGs can be related to health in some way (UN, d.d.). According

to the OECD overview and assessment mentioned above SDG 6 targets: waste water treatment, water-use efficiency is insufficient to meet the set targets (OECD, 2022).

*European Green Deal*

While it may not be as widely noticed or cited as the Paris Agreement and the SDGs the European Green Deal is a far reaching and extremely ambitious project. The European Parliament declared a climate emergency in 2019 and asked the European Commission to adapt plans and proposals on climate change to a target limit of 1.5 degrees C above pre-industrial levels and a significant reduction in greenhouse gas emissions. The response from the European Commission was the European Green Deal, a set of targets and a roadmap for Europe to be the first climate-neutral continent by 2050 (European Commission, 2021).

The Green Deal promotes the development and use of renewable energy, promotes a transition to a circular economy, outlines plans to both protect and restore natural areas and biodiversity, create cleaner transportation and other infrastructure, and build more sustainable agriculture systems. Additionally, it contains initiatives to improve both air and water quality, both of which have a significant impact on public health. As with most other documents discussed here, public health is not explicitly talked about and there are no specific commitments to meet health targets, but the other components of the Green Deal all contribute to significantly improved public health outcomes.

The European Green Deal as a whole is not legally binding but some components of it are, including the European Climate Law. Adopted in 2021, it sets the climate neutrality by 2050 target into EU law and sets out target steps along the way for reducing emissions.

*EU Adaptation Strategy*

The European Union Adaptation Strategy is a plan for countries within Europe to adapt to and mitigate the effects of climate change. Announced in 2019 and adopted in February 2021, the strategy is a part of the already mentioned European Green Deal. What sets it apart from the rest of the Green Deal or the Paris Agreement is that its focus is not on reducing, slowing, or stopping climate change, but solely on adapting to it and increasing climate resilience. The public health is not mentioned explicitly anywhere in the document, although there is an acknowledgement that the impacts of climate change can have 'significant health-related' outcomes.

As with the other treaties and agreements already mentioned, there are clear crossovers, some of the key points in the strategy, such as increasing education on climate change risks and better infrastructure for dealing with extreme heat events will bring major public health benefits. The Adaptation Strategy only touches on them implicitly though as the perspective is much more on the environment and infrastructure.

### 3.2. Assessment of climate change induced risks to public health in Lithuania

This subchapter will aim to analyse what was done to assess the situation of climate change induced risks to public health by answering the following questions: *Q 2 A. If and how the assessment of climate change induced risks to public health are being implemented in Lithuania? Q 2 B Are all specific vulnerable groups covered in those risks?*

Making a risk assessment it is important the evaluation of risk itself. The risk in many cases is considered bigger while making risk assessment if it considers the higher percentage of the population who faces the risk. But it could be argued that talking about climate change induced health risks or in general considering health risks it is not the case, because the results quite often are long term and hard to measure, there is a lot of uncertainty and unknows. The CFA Institute defines systemic risk as "the risk of failure of an entire system, not just the failure of individual parts" (CFA, 2023). This means that the risk can have impacts and consequences in different fields and sectors of society. Returning to uncertainty, it is based on numerous factors for example climate change, ageing populations, human activities, and policies directly contribute to the risk analysed in this thesis. This is followed by the spillover effect itself. A systemic risk is most likely to have a ripple effect. By ripple effect, we mean consequences that affect not only the health sector, but many different sectors (Klinke A and Renn O, 2006). Knowing that climate change induced risks to public health in Lithuania are systemic risk the risk assessment can be found in different fields, not just in public health.

In the Resolution approving the national strategy for climate change management policy, 2012 No XI-2375 point 96 was the assessment made that Lithuania does not have a separate programme for public health management and finances to carry out and coordinate activities in relation with climate change and well the note was made that there is a lack of studies to make an assessment of climate change impact to public health. This document was changed by another document valid from 3rd of July 2021 the National Climate Change Management Agenda Resolution XIV-490. This new document presented the assessment of strengths, weaknesses and what should be done in the public health in relation to climate change induced risks.

Studies identifying threats to human health induced by climate change were conducted and recommendations prepared in 2014 (UAB "Infraplanas", 2014). It was prepared the guidelines for climate change mitigation and adaptation to climate change for municipalities where the public health sector was mentioned as the one which is impacted by climate change in 2017 (VšĮ "Kaunas regional energy agency" 2017).

It was conducted a study which identified the vulnerability to climate change of the individual sectors, as well the risk assessment and opportunities how to adapt to climate change in 2018 (EC, 2018). This assessment was done to develop 'adaptation preparedness scoreboard' follow the EU's Strategy on adaptation to climate change (EC, 2018).

Ordered by Ministry of Environment of Republic of Lithuania 'Service report of the analysis of Lithuanian economic sectors for the period of implementation and renewal of the goals and objectives of the national climate change management policy strategy from 2021 onwards' was conducted in 2021. In this report assessment of main hazard and vulnerabilities by climate change to public health was made.

'Lithuanian's eight national communication and fifth biennial report under the United Nations Framework Convention on Climate Change' was published by the Ministry of Environment of the Republic of Lithuania Climate Policy Group in 2022. The vulnerability assessment was conducted, but public health sector as a vulnerable was not mentioned, see in the Figure 12. It is important to note that the following reports by the Ministry of Environment of the Republic of Lithuania already acknowledge climate change impacts on public health.

| Extreme phenomena | Vulnerable sectors |
|---|---|
| Air temperature rises, heatwaves | Energy, transport, industry, agriculture, landscape, spatial planning, ecosystems and biodiversity, forestry, tourism, groundwater resources, waste management |
| High water temperatures in summer | Energy, fisheries and aquaculture |
| Temperature rises during the cold season | Industry, agriculture, forestry, ecosystems and biodiversity, landscape |
| More frequent temperature fluctuations around 0°C | Transport |
| Storms and hurricane force winds, thunderstorms, hail | Energy, transport, agriculture, spatial planning, ecosystems and biodiversity, fisheries and aquaculture, forestry, tourism, waste management, landscape, industry |
| Heavy precipitation, increase in annual precipitation | Transport, industry, spatial planning, forestry, agriculture, groundwater resources, waste management, landscape, energy, industry, fisheries and aquaculture |
| Floods and flash floods, receding river water, water level fluctuations | Transport, industry, spatial planning, ecosystems and biodiversity, fisheries and aquaculture, forestry, tourism, waste management, landscape, groundwater resources |
| Droughts, declining river flows and extreme water level fluctuations | Energy, transport, industry, agriculture, landscape, spatial planning, ecosystems and biodiversity, fisheries and aquaculture, forestry, groundwater resources, waste management |

**Fig. 12.** Extreme climate events and which sector is the most vulnerable to them (source: the Ministry of Environment of the Republic of Lithuania Climate Policy Group, 2022)

On the behalf of the Ministry of the Environment of the Republic of Lithuania it was prepared the national studies on the preparation of climate change forecasts where it was prepared sensitivity and vulnerability of Lithuanian municipalities to climate change and climate change adaptation plan as well noted the most sensitive municipalities in November 2022. In the Phase I report it was suggested climate change forecasts scenarios for Lithuania up to 2100, based on data from the Global Climate Research Program's Coupled Model Intercomparison Project Phase 5. This assessment is important for public health because it shows the relationship between environmental climate change indicators and different sectors, of which public health is one and named (Ministry of Environment of the Republic of Lithuania, 2022).

The Phase II report focused on the sensitivity and vulnerability of different sectors, including public health. Here it is mentioned that in order to ensure good governance and adaptation of the public health sector in relation to climate change, collaboration between public sector institutions and the scientific community is needed. In the report, the assessment of adaptation objectives was made, where the focus is on the assessment of policies and standards; infrastructure planning according to the impact of climate change on public health, especially in urban areas; improvement of monitoring and assessment system; improvement of public information system on the impact of climate change on public health (Ministry of Environment of the Republic of Lithuania, 2022).

It is important to note that the mentioned report identified the vulnerable groups and risk multipliers, which are elderly, babies and infants, people with chronic diseases (especially cardiovascular and respiratory diseases), people in the care facilities with minimal physical activity, people living in the urban areas. The assessment mainly considers heat waves. According to the projections in 2050 the most vulnerable municipality for climate change would be Klaipeda and in 2100 Kaunas. In the report it was not considered socioeconomic factors.

The IRGC risk governance framework suggests that to understand the situation of climate indued risks of climate change to public health in Lithuania is important to elucidate not just threats but as well assets, and vulnerabilities of the risk. This is as well the connection point between the IRGC framework and DPSIR framework. The threats, vulnerabilities and assets of climate change induced risks to public health in Lithuania are presented by author in Figure 13. Figure 13 has been completed based on Figure 10 of the DPSIR framework and the IRGC framework appraisal element where it is

threats, vulnerabilities assessed and can be used to see what can be used to prevent or mitigate the risk.

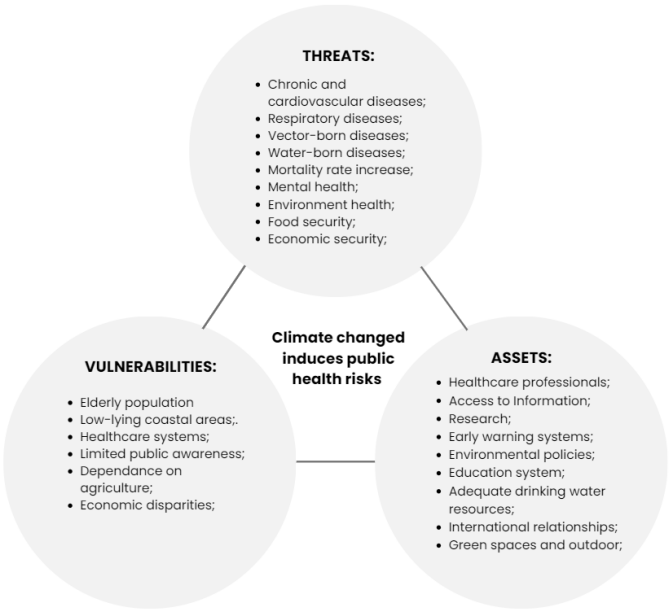


**Fig. 13.** The threats, assets and vulnerabilities of climate change induces risks to public health in Lithuania (made by author, 2023)

### 3.3. Indicators to assess climate change impact on public health

Climate change induced risks to public health as discussed in Chapter 1 are complex and there is a concern how this issue can be addressed and assessed by scientific and analytical tools and methods. In this subchapter the following question will be discussed: *Q 3 What are suggested indicators of climate change induced risks to public health assessment in Lithuania?*

The most common used tool is the count of deaths caused by climate change is heat related deaths, but there is no common and fully agreed system and approach to do so. Comparing the average daily deaths with the daily high temperature and the daily spike in deaths with the high temperature suggests that the deaths are caused by heat. In Climate change forecasting, national studies on the sensitivity and vulnerability of Lithuanian municipalities to climate change and the preparation of the climate change adaptation plan of the most sensitive municipality introductory report by Ministry of the Environment of the Republic of Lithuania some indicators are suggested, that can be used evaluating climate change induced risks to public health: tropical nights, duration of sudden cold snaps, cold days, perpendicular surface solar radiation (RSDS, further in the text), duration of sunshine, amount of precipitation, extreme rainfall, number of days without precipitation, number of days with snow cover, maximum snow cover thickness and biometeorological parameters (SAM, 2022). It is not just public health indicators it is in connection with environment, agriculture, transportation, energy sectors.

**Table 2.** Indicators for assessing climate change induced risks on public health (made by author in accordance with the document by SAM, 2022).

| **Indicators for climate change induced risks on public health evaluation** |
|---|
| Morbidity caused by climate change events (heat waves) |
| Morbidity caused by wildfires, floods, storms |

| |
|---|
| Number of tropical nights |
| Duration of sudden cold snaps |
| Number of cold days |
| The perpendicular surface solar radiation (RSDS) |
| The duration of sunshine |
| The amount of precipitation |
| The extreme rainfall |
| Number of days without precipitation |
| Number of days with snow cover |
| Maximum snow cover thickness |
| The biometeorological parameters |

The Institute of Hygiene under the Ministry of Health of the Republic of Lithuania is responsible for indicators of statistics of occupational diseases and causes of death, in this case morbidity caused by climate change events (heat waves). In the list of codes by cause of death TLK-10 of the National Health Insurance Fund under the Ministry of Health, there is no cause directly related to climate change, such as deaths due to heat waves, drowning because of floods, or any of indication of climate change related death cause. (http://ebook.vlk.lt/e.vadovas/index.jsp).

Lithuanian Hydrometeorological Service under the Ministry of Environment (www.meteo.lt) is responsible for variety of indicators related to weather conditions and these indicators: a number of tropical nights, a duration of sudden cold snaps, a number of cold days, the duration of sunshine, the amount of precipitation, the extreme rainfall, a number of days without precipitation, a maximum snow cover thickness, biometeorological parameters.

Radiation Protection Centre under Ministry of Health of the Republic of Lithuania is responsible to follow the indicator of RSDS.

The indicators presented are directly related to the environmental assessment and no specific public health indicator is mentioned for monitoring and statistically presenting climate change induced risks to public health. There is clear information on which governance body is responsible for monitoring specific indicators. For example, United States Environmental Protection Agency uses ICD-9 code E900: “excessive heat—hyperthermia”—specifically subpart E900.0: “due to weather conditions.”, it suggests that counting not the death numbers, but codes (EPA, n.d.).

### 3.4. The stakeholders and actors’ network

In the previous chapters it was noted that in the governance of climate change induced risks to public health there is the needed of cooperations between different actors at the different levels. This subchapter aims to answer the following question: *Q 4 Who are the stakeholders and what is the actors’ network in the governance of climate change induced risks to public health in Lithuania?*

Looking closely at the stakeholders/actors according to the IRGC risk governance framework there is horizontal and vertical stakeholders/actors in governance of climate change induced risks to public health. There are many actors working to address climate change induced risks to public health issue at all the levels in Lithuania and the world. The IRGC governance framework suggests considering several groups: governments, international organizations, businesses, science and academia civil society (IRGC, 2019).

Using the governance theories examined in Chapter 1, like Climate Governance, Smart Governance Theory, Network Governance Theory, Participatory Governance Theory, and the Good Governance model, a stakeholders/actors table has been analysed and developed to represent the horizontal and vertical governance of climate change induced risks to public health. Table 2 presents the stakeholders/actors. It is important to note that there is a wide network of actors, in this work is giving examples and the list is not finite and can be expanded.

**Table 3.** Table of Horizontal and Vertical governance of climate change induced risks to public health in Lithuania (made by author)

| | Governments/agencies | Industries | Science and academia | Civil society and NGOs |
|---|---|---|---|---|
| Local | Local government authorities, Health and Social Security Committee, Municipal Community Health Council, Municipality Public Health Bureau; Department of Land and Environmental Protection | Local businesses | Doctors; Public health workers | Civic society; Communities; Community-based organizations (CBOs) |
| Regional | District municipalities; Hospitals; Primary health care centres | Small and big scale farmers | Research and Innovation Parks, Regional Development Agencies | Media, Conferences, and events for general public |
| National | Ministry of Health of the Republic of Lithuania; National Public Health Centre; State Health Care Accreditation Agency; Institute of Hygiene; Health Emergency Situations Centre under the Ministry of the Ministry of Health; Environmental Protection Department under the Ministry of Environment; Radiation Protection Centre under Ministry of Health of the Republic of Lithuania; Ministry of Finance of the Republic of Lithuania, Committee of Health Affairs of Seimas; the Ministry of Education, Science and Sports. | Pharmaceutical companies; agriculture sector; energy, manufacturing, transportation, and waste management sectors companies like Grigeo Group; Klaipėda State Seaport Authority; Ignitis Group, Lithuanian Railways; UAB Ecoservice; Linas Agro | Vilnius University Faculty of Medicine; Lithuanian University of Health Sciences; Kaunas University of Technology, National Public Health Surveillance Laboratory | Lithuania Red cross, Lithuanian Green Movement, Lithuanian Green Building Council, Lithuanian Sustainable Business Association (LAVA) |
| Supra-national | The European Union (EU); The Organisation for Economic Co-operation and Development (OESD); | Orlen Lithuania; DHL; Lidl | European Public Health Association (EUPHA); universities and | European Environment Bureau; Baltic Environmental |

| | | | | |
|---|---|---|---|---|
| | European Center for Disease Prevention and Control (ECDC); European Environment Agency (EEA) | | research institutions across Europe conduct public health research | Forum; The Foundation for Environmental Education (FEE) |
| Global | World Health Organization (WHO), World Bank, The Food and Agriculture Organization of the UN (FAO); The United Nations Environment Program (UNEP) | Philips Morris International; Johnson & Johnson; Nestle; Coca-Cola; LTP Texdan | Academia of recearch institutes; International Healthcare Research Center (IHRC); International Centre for Energy and Environmental Sustainability Research | Health and Environment Alliance (HEAL); The Nature Conservancy |

The risk mitigation and adaptation governance should be considered and implemented at the different levels such as local, regional, national, and subnational and global, in this work the focus is at the national level, but all of them are connected so can't be left out.

Civil society's view of the health risks posed by climate change could be seen in the Eurobarometer survey of May 2023, when respondents were asked: Which of the following problems facing the world as a whole do you think is the most important? What other problems do you think are important (choose 4 answers)? 44 percent of the Lithuanian population chose poverty, hunger, and lack of drinking water (the EU average is 22 percent); the spread of communicable diseases was chosen by 29 percent of the Lithuanian population (EU average 22 percent); health problems due to pollution were mentioned by 22 percent of the Lithuanian population (EU average 21 percent) (Eurobarometer, 2023). As well in the same survey to the question who is responsible for the fight against climate change in the EU, respondents from Lithuania mentioned all the stakeholder levels like individual – civic society, regional, national, and international.

A representative survey of the Lithuanian population conducted by KTU researchers in 2022 showed that the Lithuanian population considers health care (34%), the economy (24.7%) and poverty (14.8%) to be the most important problems. Only 4 percent cited environmental protection as the most important problem. However, when asked about different environmental problems, Lithuanians cited climate change as the most important (21.3%) (Telešienė et al. 2023).

In order to implement and manage the responses, as discussed in the previous parts, it is important that all stakeholders/actors work together towards the same main goals, sharing responsibilities and areas of responsibility between them. Coming back to the idea "mitigation is global, adaptation is local", Lithuania, as a part of EU, WHO and UN, adopts the international key policies and strategies into its own national policies and strategies at the national level. However, implementation and adaptation are carried out by smaller territorial units, mainly by district municipalities. As the future brings many new challenges for occupational safety and health, it is important that governments, employers, workers and other stakeholders take full advantage of the opportunities to create a safe and healthy future of work for all (International Labour organization, 2019). Law on Safety and Health at Work of the Republic of Lithuania (2022) requires the employer to take active role to ensure employee health, risk reduction, risk breeding, health training and health prevention (Seimas, 2022).

The following text will explain the roles of stakeholders/actors according to literature review and analysis using the DPSIR framework response element (Figure 11). There are four directions of governance of climate change induced risk to public health in Lithuania selected by the author: public health policy; climate change mitigation and adaptation strategies, public health infrastructure resilience; awareness and education.

The main national body responsible for the public health policies in Lithuania is Ministry of Health of the Republic of Lithuania. It is a central government institution to oversee all health related affairs, it works mainly in two directions development of public health policies and implementation of public health policies. Development includes not just policies and regulations, but short and long term plans and strategies aiming to improve general health of the population.

When making decisions, the Ministry of Health of the Republic of Lithuania relies on international policies, recommendations, data from international organisations such as WHO, UN, ECDC, OESD, as well as national level agencies. The National Public Health Centre plays an important role by providing data, conducting public health surveillance, monitoring and analysis. It provides evidence-based information to support the development of public health policies. The National Public Health Centre does not collect all the data itself, there are other public agencies involved in the process, for example the Institute of Hygiene.

The process of awareness and education of climate change induced public health risks involves a wide stakeholders/actors network at the different level. The Ministry of Education, Science and Sports aim to involve pupils to social-civic activities to encourage students to take an active part in solving current social problems in community and public life, and to develop citizenship, social, emotional, and healthy lifestyles and other skills by reflecting on their experiences. Through social-civic activities, students can get involved in the activities of various non-governmental organisations and contribute to solving problems they care about, for example, raising public awareness of climate change issues (The Ministry of Education, Science and Sports, 2023). Municipality Public Health Bureaus perform public health functions for all age groups based on priorities: preventing infectious and non-infectious diseases, injuries and reducing addictions (smoking, alcohol, drugs), promoting healthy lifestyles (physical activity, proper nutrition), improving mental health, preventing disorders, supporting healthy ageing and reducing health inequalities; conduct public health monitoring, analysing data on health and risk factors, focusing on municipal areas for detailed information on population health; plans and implements measures to strengthen public health on the basis of approved indicators set by the Minister of Health Protection of the Republic of Lithuania (SAM, n.d.). The Ministry of the Environment's Klimato Kaita website offers educational guides on low-emission travel, guides for businesses on how to reduce emissions, and a general guide explaining climate change (Klimato kaita, n.d.)

There is one main document for climate change mitigation and adaptation is passed by the Seimas National Climate Change Management Agenda and the coordinator to follow the agenda is the Ministry of the Environment of the Republic of Lithuania. The implementation if followed and implemented according to the competence by ministries: Ministry of the Environment, the Ministry of Economy and Innovation, the Ministry of Energy, the Ministry of Finance, the Ministry of National Defense, the Ministry of Culture, the Ministry of Social Security and Labor, the Ministry of Communications, the Ministry of Health, the Ministry of Education, Science and Sports, the Ministry

of Foreign Affairs, the Ministry of Internal Affairs, and the Ministry of Agriculture. In connection with climate change mitigation and adaptation strategies the focus by Ministry of Health of the Republic of Lithuania is the public health infrastructure resilience (Seimas, 2021).

There are agencies under the Ministry of Health and Ministry of Environment which are specializing in special health and environmental situations like Health Emergency Situations Centre under the Ministry of the Ministry of Health; Environmental Protection Department under the Ministry of Environment; Radiation Protection Centre under Ministry of Health of the Republic of Lithuania.

### 3.5. Cooperation and public communication

This subchapter examines, by answering the question, whether there is evidence of cooperation, transparency and participation among stakeholders in the area of public health governance: *Q 5 Is there dialogue, transparency, and involvement between horizontal governance stakeholders in Lithuania?*

The government of Lithuania sets ambitious targets for openness and communication with stakeholders including the private sector and the public in their government programme, but interestingly it does not mention explicitly communication between government agencies (Seimas of The Republic of Lithuania, 2020).

Although individual agencies are publishing policies and strategies on the issue, there is little clear evidence of collaboration, for example, there is a National Climate Change and Health Agenda document developed by the Ministry of Health (Ministry of Health of the Republic of Lithuania, 2021), and there are also multiple policies and initiatives created by the Ministry of Environment that aim to reduce the health impacts of climate change including research and monitoring programs on respiratory diseases, heat stress, and allergies, public awareness campaigns that encourage behavioural change to reduce personal and collective risks, and support for investments in healthcare services to increase preparedness for climate change related health emergencies **(** Lithuania's Eight National Communication and Fifth Biennial Report Under The UNFCCC, 2023)**.** However, the Ministry of Health and the Ministry of Environment do not appear to collaborate on any overall policy documents, and there is no mention of working together with one another.

There are systems in place for dialogue between stakeholders on climate and energy issues – Multilevel Climate and Energy Dialogues (MLCEDs further in the text), which were set out in governance regulations by the European Parliament with countries required to report for the first time in 2023, yet again these do not explicitly include public health. In an EU wide study Lithuania self-reported that it was one of only two countries in the EU to have both existing and new dialogue structures in place between stakeholders regarding MCLEDs and that they are multi-stakeholder (Faber et al, 2023).

The Ministry of Finance reports that it has created an Inter-Institutional Group on Sustainable Finance, which involves many agencies including the Ministry of Energy, Ministry of Transport, Ministry of Agriculture, and the Bank of Lithuania (Lithuanian Strategy and Action Plan on Sustainable finance, 2021), but again this group does include the Ministry of Health (European Bank for Reconstruction and Development, 2021).

The fact that no such mechanism of inter-institutional cooperation between the Ministries of Health and the Environment has been created, like the MLCEDs and the Inter-Institutional Group on Sustainable Finance, is a significant barrier to progress on risk management and mitigation of climate change related health issues. It would be highly recommended for such a framework to be established, which would make progress on these issues much easier to monitor and also aid in strategy development going forward.

There is no such mechanism of inter-institutional cooperation between the Ministries of Health and the Environment has been created like MLCEDs and Inter-Institutional Group on Sustainable Finance, which would be recommended to establish.

There is some degree of communication between horizontal governance stakeholders on reporting and mitigation strategies for climate change induced public health risks in Lithuania. As an example of this there is no formal system currently in place for stakeholders to share information and work on collaborative solutions to climate change and health issues, which leads to duplication of work and slower research progress.

The Ministry of Health runs consultations with public, has open phone line to the public. The Ministry of Health conducted 29 consultations between 1 January 2021 and 19 December 2023 (Mano vyriausybė, 2023). There are press releases for other institutions and the information to the public available in different sources. The transparency is through performances reports, financial reports. Any public agency under the follows the same transparency model – performance reports, financial reports, press releases, available information to the public. As an exception could be Radiation Protection Centre.

Radiation Protection Centre under Ministry of Health of the Republic of Lithuania (RSC, n.d.) has listed in their website cooperation with state institutions, institutions and associations, international organizations. There is transparency evidence such as performances reports, financial reports. There is press releases for institutions and the information to the public. As well, Radiation Protection Centre under Ministry of Health of the Republic of Lithuania, is publicly presenting the public notification information. It pays a lot of attention to informing the civic society to related to the organisation topics in different forms like informative reports on radiation safety issues, organize seminars, introduce schoolchildren and students to their activities, have community events, communicate with journalists and participate in various television and radio programs. From 2020 the institution introduced the social media "Facebook" profile in order to strengthening communicative messages with civic society. As a result, the communication and transparency are increasing not just with civic society, but as well with ministries, municipalities, municipalities public health offices and schools. It is important to note that social media report is al well available to the public.

Municipalities have Health and Social Security Committees and Municipal Community Health Council in connection with public health, which works according to the former Health Education and Disease Prevention Centre, now the Health Promotion Centre of the Institute of Hygiene, prepared recommendations based on the Lithuanian Health Programme 2014-2025 (Health Education and Disease Prevention Centre, 2015). The Health and Social Security Committees are formed by Council members while Municipal Community Health Councils involves representatives from the different

sectors like non-governmental organisations, communities, municipality administration, educational institutions, districts local activity groups and Council members. If coming back again to the " mitigation is global, adaptation is local" these two groups are the most close governance organs to the civic society. Each of meeting of these two units is formal and the information discussed, the decisions are available to the public.

Civic society engagement in connection with public health is encouraged by financing of health projects by the district municipality's public health support special program the applicants can be NGOs, communities, educational and public agencies. An each municipality sets up the main goal which could be generalised as to finance health projects through tenders, the implementation of which will increase the health literacy and quality of the environment of the residents of district, help to form responsible public behaviours, and reduce the morbidity, disability and mortality of the residents. There are each year the objectives according public health monitoring indicators which varies the each year. There was no object directly mentioning climate change and health, but there are 2022 or 2023 year, but there was considering the environment - health of living environment (bathing water monitoring, noise prevention).

A good example set by Kėdainiai district municipality in 2023 an open event covering dialogue, transparency, and involvement between horizontal governance stakeholders in the district. The main hosts of event were Municipal Community Health Council and Municipality Public Health Office which showed interinstitutional cooperation. The actors involved: local politics, NGOs, community-based organisations (CBOs further in the text), civic society, public agencies, public health workers, business. The aim of event to share good practices, to empower civic society to participate writing projects, to present the challenges and the most common mistakes writing the projects, to introduce to the most recent public health monitoring indicators. The form of event different public health sector presentations and open dialog/ discussion. Municipal Community Health Council as well presented it's activities, the financial report to the public to be more transparent and reachable (Kėdainiai municipality, 2023).

Despite the public's active involvement in efforts to support Ukraine, Lithuania's Civic Empowerment Index declined in 2022, falling to 35.9 points out of 100, the lowest score since 2017, reflecting a decline in the public's perceived and actual engagement, influence, and assessment of risks related to civic participation. Only 38.6 per cent had participated in environmental clean-ups, while 30.7 per cent had participated in local community activities (The Civil Society Institute, 2022).

The OECD's Infrastructure Governance Index (IGI, further in the text) looks at stakeholder participation, provides a comprehensive assessment of countries' progress in developing national policies for involving stakeholders, facilitating their active participation and ensuring their oversight in infrastructure projects. Lithuania stands out with a score of 0.60 on a scale of 0-1, which is higer than the OECD average of 0.52 in the IGI on Stakeholder Participation. Lithuania performs well in all three dimensions of the index, demonstrating excellence in stakeholder oversight, scoring 0.24 out of a maximum of 0.33 (OECD, 2023), results presented in Figure 14.

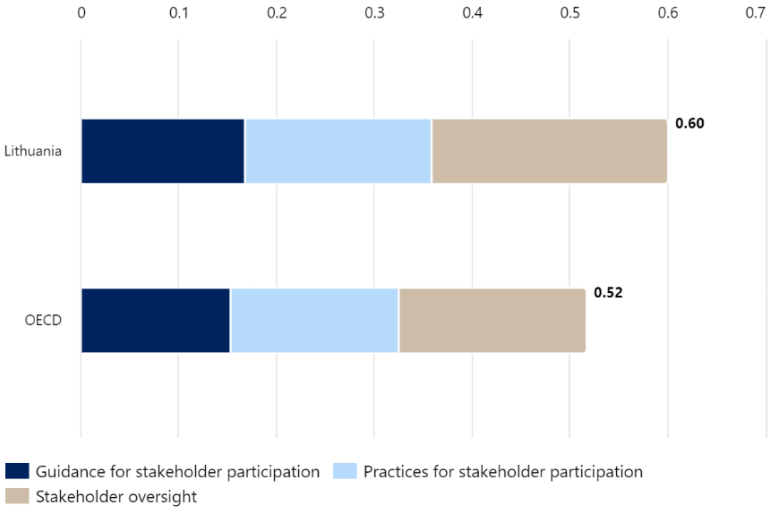


**Fig. 14.** Index on stakeholder participation in infrastructure decision making from 0 (lowest) to 1 (highest), 2022 (source: OECD, 2023)

## 3.6. Risk coverage by policy documents

This subchapter, based on the systematic analysis of key national policies and strategies, aims to answer the following question: *Q 6 How diverse climate change induced risks to public health are covered by policy documents in Lithuania?* The focus of the analysis was on content, not on quality or processes. The coverage of risks in policy documents is shown in Table 5.

**Table 4**. Table of policy documents in relationship with climate change induced risks to public health in Lithuania (made by author, sources: https://e-seimas.lrs.lt/portal/documentSearch/en and Climate-ADAPT, 2023)

| Risk | Documents |
|---|---|
| Extreme heat events | • National Strategy for Climate Change Management Policy (2012)<br>• National Climate Change Management Agenda (2021)<br>• Lithuanian Health Strategy (2014-2025)<br>• National Adaptation Strategy (NAS, 2012)<br>• National Energy and Climate Action Plan (NAP) 2021-2030<br>• National Public Health and Heat Prevention Action Plan for 2016-2020 (2015)<br>• Assessment of the Health Impacts of Climate Change in Lithuania (2019)<br>• Eighth National Communication and Fifth Biennial Report on Climate Change (2022)<br>• Climate change projections to 2100 |
| Wildfires | • National Adaptation Strategy (NAS, 2012)<br>• Eighth National Communication and Fifth Biennial Report on Climate Change (2022)<br>• Assessment of Climate Change Impacts on Forests and Adaptation to Climate Change in the Forestry Sector of Lithuania (2015)<br>• National Forest Fire Prevention and Control Plan (2016-2020)<br>• Climate change projections to 2100 |
| Flooding | • Lithuanian Health Strategy (2014-2025)<br>• National Adaptation Strategy (NAS, 2012)<br>• Eighth National Communication and Fifth Biennial Report on Climate Change (2022)<br>• National Flood Risk Management Plan (FRMP) (2018)<br>• Climate change projections to 2100<br>• National Energy and Climate Action Plan (NAP) 2021-2030 |
| Air pollution | • National Strategy For Climate Change Management Policy (2012)<br>• National Climate Change Management Agenda (2021)<br>• Lithuanian Health Strategy (2014-2025)<br>• National Adaptation Strategy (NAS, 2012) |

| | |
|---|---|
| | • Assessment of the Health Impacts of Climate Change in Lithuania (2019)<br>• Eighth National Communication and Fifth Biennial Report on Climate Change (2022)<br>• Climate change projections to 2100 |
| Allergens and pollen | • National Strategy For Climate Change Management Policy (2012)<br>• National Climate Change Management Agenda (2021) |
| Airborne pathogens | • Assessment of the Health Impacts of Climate Change in Lithuania (2019)<br>• National Climate Change Management Agenda (2021)<br>• Lithuanian Health Strategy (2014-2025) |
| Infectious diseases | • National Strategy For Climate Change Management Policy (2012)<br>• National Climate Change Management Agenda (2021)<br>• Lithuanian Health Strategy (2014-2025) |
| Vector-borne pathogens | • National Strategy For Climate Change Management Policy (2012)<br>• Lithuanian Health Strategy (2014-2025)<br>• Assessment of the Health Impacts of Climate Change in Lithuania (2019)<br>• Eighth National Communication and Fifth Biennial Report on Climate Change (2022) |
| Waterborne pathogens | • Lithuanian Health Strategy (2014-2025) |
| Food insecurity | • National Climate Change Management Agenda (2021)<br>• Lithuanian Health Strategy (2014-2025)<br>• National Adaptation Strategy (NAS, 2012)<br>• Assessment of the Health Impacts of Climate Change in Lithuania (2019)<br>• Eighth National Communication and Fifth Biennial Report on Climate Change (2022)<br>• National Energy and Climate Action Plan (NAP) 2021-2030<br>• Voluntary National Review on the Implementation of the 2030 Agenda for Sustainable Development |
| Mental health issues | • National Strategy for Climate Change Management Policy (2012)<br>• National Climate Change Management Agenda (2021)<br>• Lithuanian Health Strategy (2014-2025)<br>• Assessment of the Health Impacts of Climate Change in Lithuania (2019)<br>• Eighth National Communication and Fifth Biennial Report on Climate Change (2022) |
| Health infrastructure stress | • Lithuanian Health Strategy (2014-2025)<br>• Vilnius City Council Climate Change Adaptation Plan<br>• National Energy and Climate Action Plan (NAP) 2021-2030<br>• Eighth National Communication and Fifth Biennial Report on Climate Change (2022)<br>• National Action Plan for Public Health and Heat Prevention 2016-2020<br>• National Public Healthcare Development Programme for 2016-2023 |

The increase in summer temperatures generally, and an increased number of extreme heat events is the single most documented effect of climate change in Lithuanian government policies, being directly pointed out in the Eighth National Communication on Climate Change and Fifth Biennial Report on Climate Change (2022), the National Energy and Climate Action Plan (2021-2030), the National Climate Change Management Agenda (2021), among others, there is a clear understanding of the potential effects on health as well as on the economy, agr iculture, and infrastructure, and of the need to mitigate these effects. The effects on public health are clear and are backed up by mortality and morbidity statistics from recent heatwaves, still an interesting question would be whether this particular issue is so clearly documented by the government because it is seen as the most important or because it is the most publicly visible.

Despite the understanding of the dangers from extreme heat, there are not many specific measures set out to tackle the problem. Article 35.1.5. of the National Climate Change Management Agenda (2021) identifies the need for changes and for increased levels of green infrastructure, and access to cool

areas. The need for access to available health care is also understood (Eighth National Communication, 2022). As Lithuania becomes more urbanised and the number of high temperature days increases there is also a need for changes in urban planning to help mitigate the formation of urban heat islands, as well as installation of cooling and heat recovery systems in public and private buildings.

In comparison to other climate change induced risks, for example flooding, there is both a high level of acknowledgement of the effects of climate change on increasing forest fire risks, and robust strategies and policies in place for prevention and mitigation. The forestry design and management systems that are currently in place are designed to reduce the risk of fire breakouts and to make it possible to contain those that do occur, and these systems do take the increased risk from hotter and drier summer weather into account (Assessment of Climate Change Impacts on Forests and Adaptation to Climate Change in the Forestry Sector of Lithuania, 2015). While there are strategies to reduce the risk and scale of fires themselves, there is no explicit strategy to deal with the increased risks posed to public health.

There is a National Flood Risk Management plan (2018) in place, which does set out 10 objectives directly related to reducing the effects of floods on human health (National Flood Risk Management Plan, 2018), but it only makes brief mention of climate change, noting that in some models inland flooding could decrease due to warmer winters but there is an increased risk in spring flooding, while coastal flooding is expected to increase. Other documents that are related to flood risks either do not mention or very briefly acknowledge public health risks.

Coastal flooding seems to be a more pressing concern than inland and urban flooding and there is a resolution to decrease both flood events and health effects from them. Many of the flood risk mitigation measures that are planned or in place do partially address climate change related risks but there are no specific measures planned to mitigate climate change related effects.

The relationship between climate change and growing levels of allergic diseases is acknowledged in both the National Strategy for Climate change management policy and most recently in the Eighth National Communication and Fifth Biennial Report on Climate Change. It is important to note that most of the documented plans are for the improvement of diagnosis and prevention of allergic diseases rather than treatment.

The government aims to improve the monitoring and forecasting of high airborne pollen counts along with other health risk indicators as set out in article 35.1.2 of the National Climate Change Management Agenda, while universities in Lithuania are being encouraged to continue to do research on the impact of the rising levels of pollen and other airborne particles on health including people suffering from hay fever and other respiratory issues (National Strategy for Climate change management policy, 2012). Both Siauliai Academy and Vilnius University are actively involved in research on the topic, and Vilnius University will host the 2024 world symposium on Aerobiology (EAS Aerobiology, 2023).

The projection is that climate change will increase the rate of infectious diseases, with increased effects on those with existing health conditions and the elderly, and the increase in weather variation and extreme weather events plays a part in this.

The National Strategy for Climate change management policy (2012) includes a resolution to prevent the ''emergence and spread'' of climate change induced diseases although there is little detail on how this is planned to be implemented with the National Health Strategy (2014-2025) specifically making little or no connection between climate change and increased infectious disease levels.

Airborne pathogens and waterborne pathogens. A link is made between levels of air and water pollution and a potential increase in levels of both infectious and non-communicable diseases with a stated aim to reduce the levels of both of these and also soil pollution. The focus here is on agricultural and industrial practices much more than on climate change effects.

The most noticeable rise in climate change related diseases in Lithuania is from parasitic diseases, which accounted for 1.5% of deaths in Lithuania in 2012 and there has been a sharp increase in both the number of ticks and tick-borne diseases, both encephalitis and Lyme disease, in the period since then. Many scientific projections are that increasing temperatures mean that this spread will continue although this is not evident in any government documents of projections. Although mosquito, and similar vector, borne diseases are not a major issue in Lithuania, it is interesting to note that the Lithuanian National Risk Analysis (2018) updated in 2018 also identified epizootic diseases including African Swine Fever as posing a potentially high health risk in Lithuania.

Although Lithuania does have monitoring and public information programs in place currently to address this issue, for example the public website erkes.lt, there are no specific plans outlined for further preventative or treatment measures.

The link between higher CO2 levels, increasing global temperatures and more extreme weather events and food security is clearly acknowledged both for national agriculture and food production, and also the risks of availability and price fluctuations from internationally produced food products which was first identified in the National Strategy for Climate change management policy (2012), and remains as a known issue in later government communications. The possible damage to the agriculture sector within Lithuania from increased levels of air, soil, and water pollution is also a factor for concern.

There is continuing research by national institutions and universities on sustainable food systems and climate-smart agriculture, and there are resolutions in place to conform with the EU Farm to Fork Strategy and updated Common Agricultural Policy with the Lithuanian CAP Strategic Plan approved by the European Commission in 2022 (European Commission, 2022), as well as national resolutions to increase food security by localising food supply chains and to reduce food waste.

Mental health issues, along with social deprivation and inequality in access to health services are highlighted as issues within the Lithuanian health system in the Lithuanian Health Strategy (2014-2025) and there are many targets to reduce the incidences of mental health problems. Although the link between climate change induced natural disasters and extreme weather events and negative mental health effects is clearly accepted in the National Climate Change Management Agenda (2021) and the Eighth National Communication on Climate Change and Fifth Biennial Report on Climate Change (2022), it is not listed as one of the primary areas of concern or action, with other factors like alcohol and narcotics use being seen as more urgent to address.

It is noted in both the National Strategy for Climate Change Management Policy

(2012) and the more recent National Climate Change Management Agenda (2021) that Lithuania does not have a specific programme for public health management and financing to take actions to prevent the spread of diseases and other health issues that are caused by climate change, and that there is also a lack of both studies and training on the extent and specific actions needed to mitigate these risks. While it is in these documents and in the Eighth National Communication on Climate Change and Fifth Biennial Report on Climate Change (2022), published in 2022, accepted that there will be additional stress on the healthcare system in both short and long terms from climate change, the focus on improving and expanding the healthcare infrastructure in the country is much more general, with the only exception being some measures to mitigate the increase in needed capacity during extreme heat events

## Conclusions

1. The literature from several scientific fields - climate change governance, risk governance theories, and insights from the field of public health governance research - can be combined in a meaningful way to assess the governance of climate change induced risks to public health. A critical review of the main theories in these fields has shown that there are three major dimensions, that are important while assessing the country level governance of climate change induced risks to public health: international context, key national policies and strategies, and main stakeholders/actors. When analysing the international context, it is important to look at the legally binding regulations from the EU, guidelines or international agreements administered by the UN and other organizations, as well as regional and other relevant policy documents. When analysing the national policies, it is important to look at different sectoral policies from the domains of public health, environment, and climate change. Analysing cross-cutting policies, especially those related to public health are also important. When analysing stakeholders and actors at a national level, it is important to look at four different types: governments/agencies, science and academia, businesses and industry, and civil society and NGOs.
2. Climate change poses several immediate risks to public health in Lithuania and across Europe. These risks, which are directly attributable to or exacerbated by climate change, include a range of challenges such as intense heat waves, forest fires, floods, air pollution, allergens and pollen, airborne pathogens, infectious diseases, waterborne pathogens, vector-borne diseases, food insecurity, mental health problems and various other indirect risk factors, as well as factors that amplify these risks.
3. Methods of secondary data, statistical data and document analysis are applicable to the assessment of governance of climate change induced risks to public health in Lithuania builds on several analytical blocks. The most important in climate change induced risks to public health governance is to analyse: international context; whether there is an assessment of climate change induced risks in Lithuania; whether there is an assessment of vulnerable groups; name indicators for assessing climate change induced risks to public health; what are the stakeholders; the dialogue, transparency and involvement between actors; risks coverage by policy documents.
4. The empirical analysis of various international documents allowed identifying the legal-regulatory landscape for governing climate change induced risks to public health in Lithuania. There are a number of international agreements and treaties that cover climate change and Lithuania is a signatory, either as a single nation or as part of the European Union bloc, to many of them, with the biggest potential issue being that many of these agreements are not legally binding or have a lack of enforcement mechanisms in cases where they are. Some of the most publicly widely recognised agreements, such as the Paris Agreement and the European Green Deal, do not have any explicit focus on the risks to public health, however they do have implicit effects on the public health landscape. Both the United Nations SDGs and the Alliance for Transformative Action on Climate and Health (ATACH) do have explicit goals in mitigating the effects of climate change on public health, with ATACH being the most important initiative to date related to public health and climate change, however Lithuania is not yet a signatory of the ATACH agreement.
5. Lithuania currently has a comprehensive approach to the assessment and management of climate change induced public health risks. The plans and strategies have evolved significantly over the past decade, from recognition in 2012 that there was a lack of specific programs and funding to the creation of a National Climate Change Management Agenda in 2021. Studies in 2014, guideline implementation in 2017, and vulnerability assessments in 2018 and 2022 show that

there is a growing level of awareness of the connections between climate change and public health. Recent reports continue to highlight both the vulnerability of the public health sector, and the importance of collaboration between public institutions and scientific research bodies, while also making steps forward in delivering deeper insights by identifying vulnerable groups and making projections for specific municipalities as well as more general national projections. There are identified the vulnerable groups and risk multipliers: elderly, babies and infants, people with chronic diseases like cardiovascular and respiratory diseases, people in the care facilities with minimal physical activity, people living in the urban areas.

6. Making assessments of the impact of climate change on public health is a complicated and challenging task which is made more difficult by the lack of standardised approaches. The principal tool used in assessment is the count of deaths caused by climate change but there is an absence of a commonly agreed on system for doing so. Suggested indicators include a range of meteorological and biometeorological parameters, and various institutions including the Institute of Hygiene and the Lithuanian Hydrometeorological Service are responsible for monitoring specific indicators in different fields, i.e. health, weather patterns. These indicators are highly interconnected, which shows that the approach which is needed to tackle the impacts on public health form climate change has to be holistic, looking at agricultural, environmental, transport, and energy factors along with the public health sector.
7. Collaboration between various stakeholders and actors at different levels is essential for effective governance of climate change related public health risks in Lithuania. According to the IRGC framework these can be divided into the government, international organizations, private sector businesses, and civil society. Using the other discussed governance theories allows a comprehensive list of local, regional, national, supra-national, and global stakeholders to be complied, including government agencies, industry, academic institutions, and civil society organisations, with actors at all levels being able to be considered as responsible for climate change.
8. Looking at the levels of cooperation, involvement, and transparency between horizontal stakeholders in Lithuania's public health governance shows a mixed landscape. The government sets some ambitious targets for communication and cooperation between stakeholders, but there is limited evidence of collaboration on many principal issues, including overall policy documents covering climate change and health, between key agencies, e.g. the Ministry of Health and the Ministry of Environment. Many existing dialogue systems, i.e. the Multilevel Climate and Energy Dialogues, are multi-stakeholder but do not explicitly include public health. There are some good examples, including the Radiation Protection Centre, which has extensive cooperation, transparency, and communication, with other state institutions, international organisations, and the public. Local municipalities have an important role to play in engaging civic society, promoting dialogue and supporting health related projects.
9. Analysis of the official policy documents in Lithuania shows that there is an uneven approach to addressing the public health risks that come from climate change, with widely varying levels of preparedness. Some risks, like extreme heat events and wildfires, are clearly recognised and have robust policies and clear preventative and mitigation measures in place. Other health risks like flooding, increased levels of allergens and pollen, infectious diseases, food insecurity, mental health issues, and health infrastructure stress have less detailed policies in place and limited mitigation plans. In particular, mental health issues related to climate change and increased levels of health infrastructure stress lack specific programs and solutions.

## Recommendations

For the Ministry of Health of the Republic of Lithuania:

1. Join the Alliance for Transformative Action on Climate and Health to strengthen national and multinational cooperation in addressing climate change induced health risks, to promote global cooperation for sustainable solutions for resilient public health system in Lithuania, to promote health benefits of climate change mitigation in other sectors through contribution and use of collective resources, knowledge sharing, monitoring, access to financing, advocacy.

2. Prepare a strategy to adapt the Lithuanian emergency alert system for public health risk warnings by introducing heat wave and air pollution emergency alerts.
3. To join and take active part in dialogue with other government agencies and stakeholders in the Multilevel Climate and Energy Dialogues, the Inter-Institutional Group on Sustainable Finance, and any other already existing formal dialogue and governance structures.

For the Ministry of Health of the Republic of Lithuania and the Ministry of Environment of the Republic of Lithuania:

1. In cooperation between ministries, conduct an assessment specifically on the impact of climate change on public health, including an assessment how key national policies related to climate induced risks to public health are implemented.
2. Implement the Health in All Policies approach in future public health and environment policy making. These are the documents to consider where implementation can take place: National Climate Change Policy Strategy; National Climate Change Agenda; National Adaptation Strategy; National Public Health Development Programme; Lithuanian Health Strategy.
3. To create and ensure proper use of a formal mechanism for communication, information sharing, joint research, and forward strategizing between the ministries.

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