CLIMATE CHANGE ADAPTATION POLICY: ISSUES IN LATVIA

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Abstract. Nowadays the tackling climate change is the greatest sustainability and environmental challenge for the world. The United Nations Framework Convention on Climate Change (UNFCCC) as the political forum, particularly the Paris meeting held in 2015, agreed the international actions on climate change. Climate change has already become significant in Europe, with the mean temperature increasing, and extreme weather events becoming more frequent. Europe (i.e. Latvia) is warming faster than many other parts of the world. The importance of adaptation in climate policy is now widely recognized. The transformation in policy has accelerated, especially since the European Climate Change Adaptation Strategy was adopted in April 2013. The main objective of the European Union (EU) Climate Change Adaptation Strategy is to promote adaptation in key vulnerable sectors (e.g., agriculture, fishery etc.). In the light of these climate impacts and vulnerabilities, adaptation measures need to be taken at the level of the EU as well as at national, regional and local levels. On the EU level it is stressed that integration of both climates concerns mitigation and adaptation into other development strategies and policies, as well as cross-sectoral planning instruments, is the most effective way tackling climate change. The principal materials used for the research are as follows: different sources of literature, legislative and programming documents (i.e. guidelines) of international (i.e. UN, OECD) and EU institutions, as well as Latvia's documents. Findings show that the climate change adaptation policies are being adopted by most of the EU countries, but several of them, including Latvia, have lagged for others. Moreover, the development and implementation of an integrated approach could require close collaboration among different stakeholders, for example, governmental institutions, municipalities, non-governmental institutions, the private sector and society.

Keywords: climate change, adaptation, mitigation, Latvia.

Introduction

Both mitigation of and adaptation to climate change have the same purpose: reducing its undesirable consequences. However, for historical reasons, the two have been separated both in science and in policy [1]. The EU strategy on adaptation to climate change [2] encourages all Member States to adopt comprehensive adaptation strategies. The strategy promotes action in cities and the mainstreaming of adaptation in relevant EU policies and programmes. In addition, it provides funding for actions, enhances research under the Horizon 2020 programme for environment and climate action [2], and promotes information sharing through the European Climate Adaptation Platform [3]. Adaptation policy will receive EU financial resources from the EU budget between 2014 and 2020. It is intended that 20 % of the budget should be used for climate-related actions (i.e. adaptation and climate change mitigation).

The Paris Agreement, adopted in December 2015, countries agreed to submit new or updated national climate plans by 2020 (known as nationally determined contributions) [4]. Every five years after that, countries agreed to submit new contributions, which have to go beyond previous efforts depending on the collective progress toward achieving the global long-term temperature goal [5]. Moreover, the Paris Agreement aims to limit "the increase in the global average temperature to well below 2 ºC above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 ºC above pre-industrial levels" [6]. Current Nationally Determined Contributions (NDCs) are insufficient to limit end-of-century warming to 1.5 ºC, the aspirational objective of the Paris Agreement, current mitigation efforts and existing future commitments are inadequate to accomplish the Paris Agreement temperature goals [5-6].

The Paris Agreement aims to strengthen the global climate change response by increasing the ability of all to adapt to adverse impacts of climate change and foster climate resilience. It defines a global goal on adaptation, which is: to enhance adaptive capacity and resilience; to reduce vulnerability, with a view to contributing to sustainable development; and ensuring an adequate adaptation response in the context of the goal of holding average global warming well below 2 ºC and pursuing efforts to hold it below 1.5 ºC [7]. The Agreement requires engaging in adaptation planning and implementation through, e.g., national adaptation plans, vulnerability assessments, monitoring and evaluation, and economic diversification. Moreover, all countries should, as appropriate, communicate their priorities, plans, actions, and support needs through adaptation communications, which should be recorded in a public registry.

Since mitigation alone is not enough to stave off the adverse effects of climate change, related adaptation is needed in complementarity with mitigation. Greater rates and magnitudes of climate change increase the likelihood of exceeding the limits to adaptation [8].

Adaptation to climate change is a response to actual or anticipated impacts from climate pressures, and reflects social efforts to minimize risk to assets of value [9].

Because climate variability occurs over a wide range of timescales, there is often a historical record of previous efforts to manage and adapt to climate-related risk that is relevant to risk management under climate change. These efforts provide a basis for learning via the assessment of responses, interventions, and recovery from previous impacts. Although efforts to incorporate learning into the management of weather- and climate-related risks have not always succeeded, such adaptive approaches constitute a plausible model for longer-term efforts [10].

The interaction of gradual climate trends and extreme weather events since the turn of the century has triggered complex and, in some cases, catastrophic ecological responses [11]. Moreover, recent years increase of extreme climate events (i.e. heat events) - to anthropogenic warming particularly given both high- and low-frequency modes of internal climate variability, and their interaction with expected forced trends were detected [Horton]. These circumstances prove the necessity for development and implementation of more successful adaptation strategies and plans on all levels (i.e. world, regional, country and local).

Therefore, the aim of the study is twofold: 1) to assess the state and trends of development climate change mitigation and adaptation strategy and plan in Latvia; and 2) to provide some suggestions and proposals, which are based on latest evidence and findings, for development Latvia's adaptation strategy to climate change.

Materials and methods

The principal materials used in the studies are as follows: different sources of literature, e.g. scholars' articles, research papers and the reports of international institutions, EU institutions, as well as Latvia's institutions. The data were obtained from: Climat-ADAPT database [3], EEA database [12]. The various recent EEA reports on climate change, impacts and vulnerability and on adaptation are complemented by information in the European Climate Change Adaptation platform, 'Climate ADAPT' [3;12].

The Baltic Sea Region countries are eight EU Member States: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Sweden, as well as Norway and the north-western regions of Russia and Belarus [3]. In our research for evaluation and comparison of the state and trends among the countries in the Baltic Sea Region only EU Member States were chosen, which are indicated as the Baltic Sea countries.

The suitable qualitative and quantitative research methods (e.g., monographic; analysis and synthesis; logical and abstractive constructional, etc.) for certain tasks have been used in the process of study. Due to limited space, only the most important results of the research are set out in the paper.

Results and discussion

Although many activities can jointly contribute to the climate change strategies of adaptation and mitigation, climate policies have generally treated these strategies separately. In recent years, there has been a growing interest shown by practitioners in agriculture, forestry, and landscape management in the links between the two strategies [13]. Mitigation scenarios to limit global warming to 1.5 ºC or less in 2100 often rely on large amounts of carbon dioxide removal (CDR), which carry significant potential social, environmental, political and economic risks [5].

According to IPCC modelling results, future climatic conditions in northern Europe, including Latvia, will be warmer and wetter, and temperature increase will be higher in northern than in southern Europe [12]. Since the summer precipitation may increase only slightly, increasing temperature stress and early summer droughts, which are considered as one of the main causes of low crop yields, may become more common. Moreover, climate change also implies increasing frequency of rainy days and heavy rainfall events [14]. Projections suggest that there will be a larger than average temperature increase, in particular in winter, an increase in annual precipitation and river flows, less snow and greater damage by winter storms in this region. Climate change could offer some opportunities in northern Europe, including increased crop variety and yields, enhanced forest growth, higher potential for electricity from hydropower, lower energy consumption for heating and possibly more summer tourism. However, more frequent and intense extreme weather events are projected to have an adverse impact on the region, for example, by making crop yields more variable and by increasing the risk from forest pests and forest fires. Heavy precipitation events are projected to increase, leading to increased urban floods and associated impacts.

Projected impacts of climate change [12;15] in the Baltic Sea countries as European main biogeographical regions are presented in Fig. 1.

Northern Europe - Boreal region
Temperature rise much more than global average
Decrease in snow, lake and river ice cover
Increase in heavy precipitation events
Increase in precipitation and river flows
Northward movement of species
Increasing damage risk from winter storms

North-western Europe - Atlantic region
Increase in heavy precipitation events (esp. winter)
Increase in river flow
Northward movement of species
Increasing risk of river and coastal flooding

Central and eastern Europe - Continental region
Increase in heat extremes
Increasing risk of river floods
Decrease in summer precipitation
Increase in water temperature

Fig. 1. **Projected impacts of climate change in Baltic Sea countries as European regions**

However, more frequent and intense extreme weather events are projected to have an adverse impact on the region, for example, by making crop yields more variable and by increasing the risk from forest pests and forest fires. Heavy precipitation events are projected to increase, leading to increased urban floods and associated impacts [3].

Global climate change predictions suggest new scenarios with larger arid areas and extreme climatologic events [16; 17]. As shown in Table 1, Kovats et al. [16] propose the potential for mitigation and adaptation to reduce the risks related to climate change.

Climate-related drivers of impacts are indicated by icons.

Taking into account that for Latvia two different agro-climatic areas are indicated – Boreal and Continental, the prognosis of risks and opportunities, based on [14] are provided in Table 2.

The Continental north region is another region, where the increase in the northern range of crops and a longer growing season offer the potential for increased crop and livestock production. However, water stress in summer and infertile soils may limit this potential. Flooding is also a serious risk. Priority needs to be given to manage water supplies to reduce the risk of flooding and to conserve water to increase availability for agriculture [14].

Climate impacts, however, are geographically diverse and sector specific, and no objective threshold defines when dangerous interference is reached [18]. Some changes may be delayed or irreversible, and some impacts could be beneficial. It is thus not possible to define a single critical objective threshold without value judgements and without assumptions on how to aggregate current and future costs and benefits [18;19].

Extreme weather and climate related events caused negative impact - economic losses [12], as shown in Fig. 2.

Table 1

Key risks from climate change, adaptation issues and prospects for Europe

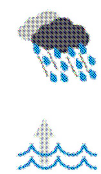
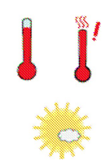
Key risk	Adaptation issues and prospects	Climatic drivers
Increased economic losses and people affected by flooding in river basins and coasts, driven by increasing urbanization, increasing sea levels, coastal erosion, and peak river discharges (**high confidence**)	• Significant experience in hard flood-protection technologies and increasing experience with restoring wetlands • High costs for increasing flood protection • Potential barriers to implementation: demand for land in Europe and environmental and landscape concerns	
Increased water restrictions - significant reduction in water availability from river abstraction and from groundwater resources (**high confidence**)	• Proven adaptation potential from adoption of more water-efficient technologies and of water-saving strategies (e.g., for irrigation, crop species, land cover, industries, domestic use) • Implementation of best practices and governance instruments in river basin management plans and integrated water management	
Increased economic losses and people affected by extreme heat events: impacts on health and well-being, labour productivity, crop production, air quality, and increasing risk of wildfires (**medium confidence**)	• Implementation of warning systems • Adaptation of dwellings and workplaces and of transport and energy infrastructure • Reductions in emissions to improve air quality • Improved wildfire management • Development of insurance products against weather-related yield variations	

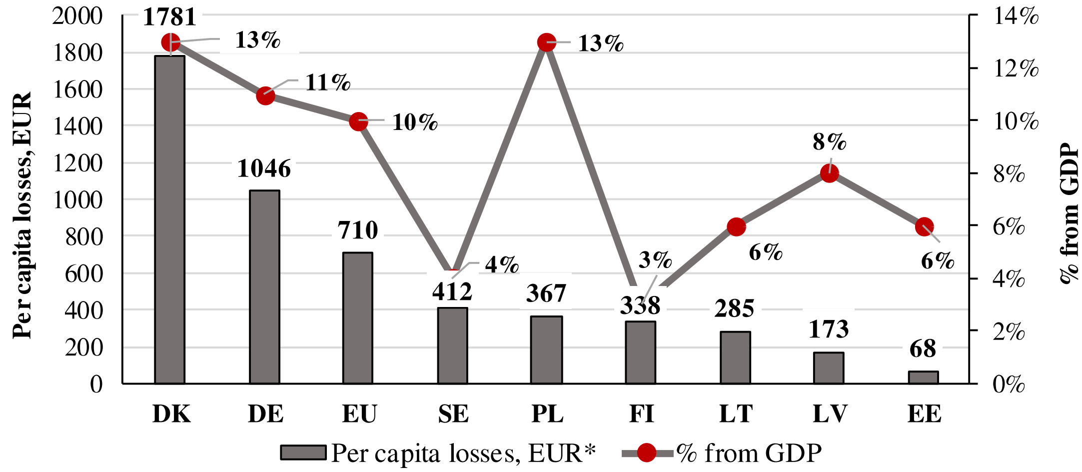
Table 2

Summary of risks and opportunities in the agro-climatic areas indicated for Latvia

Risks	**Boreal**	**Continental**
Increased risk of floods	Medium risk	High risk
Alteration of permafrost	Medium risk	Medium risk
Increased risk of agricultural pests, diseases and weeds	Medium risk	Medium risk
Increased risk of drought and water scarcity		High risk
Increased need of supplemental irrigation		High risk
Deterioration of water quality		High risk
Deterioration of soil quality and desertification		Medium risk
Deterioration of livestock conditions		Medium risk
Opportunities		
Increased optimal farming conditions and crop productivity	High opportunity	
Improvement of livestock productivity	High opportunity	
Improvement of energy efficiency in glasshouses	Medium opportunity	Medium opportunity

Legend:

High risk | Medium risk | Not relevant/ not significant | Medium opportunity | High opportunity



** 2013 EUR value*

Fig. 2. **Impacts of extreme weather and climate related events in Baltic Sea countries, 1980-2017**

Several new attribution studies have found a detectable anthropogenic influence in the observed increased frequency of climate extreme warm days and nights and decreased frequency of cold days and nights. There is, however, a need to make explicit the tensions between adaptation policies and actions aimed at proximate causes of vulnerability (i.e. supporting decision making within prevailing governance arrangements), and those seeking broader and systemic change to social and political regimes – in other words, transformation [20]. The need to adapt to climate change is now widely recognised as evidence of its impacts on social and natural systems growth and greenhouse gas emissions continue unabated [20]. Moreover, the implemented actions have been mostly incremental and focused on proximate causes; there are far fewer reports of more systemic or transformative actions [20]. However, to date, such "adaptation pathways" approaches have mostly focused on contexts with clearly identified decision-makers and unambiguous goals; as a result, they generally assume prevailing governance regimes are conducive for adaptation and hence constrain responses to proximate causes of vulnerability [20].

The emerging field of climate-change adaptation has experienced a dramatic increase in attention, as the impacts of climate change on biodiversity and ecosystems have become more evident. Major advances in the development of climate-adaptation principles, strategies, and planning processes have occurred over the past few years, although implementation of adaptation plans continues to lag [21].

The understanding that climate is indeed changing is widely received and policy makers discussed both mitigation and adaptation strategies on national and international levels [22]. Adaptation, however, has received more attention only recently, because it has emerged as an essential strategy to reduce adverse effects of climate change that cannot be avoided anymore, as well as to exploit beneficial socioeconomic opportunities, since no mitigation effort can prevent climate change impacts in the next few decades [22].

The EC evaluated implementation of the EU strategy and published the results in a report on 12 November 2018 [23;24]. The report included an adaptation scoreboard, with key process-based indicators that measured the EU MSs' levels of readiness. The evaluation concluded, *inter alia*, that the EU strategy succeeded in promoting adaptation planning (including strategies) in the Member States at all levels, but was less effective on carrying out and monitoring of the planning [23; 24].

National Adaptation Strategies (NASs) usually address overarching issues that allow them to position adaptation on the policy agenda. These strategies recognise the importance of expected climate change impacts and the need to adapt, and they facilitate the process of coordinating the adaptation response, increasing awareness of adaptation and stakeholder involvement, assessing risks and vulnerabilities, and identifying knowledge gaps [23; 24]. National Adaptation Plans (NAPs) usually aim to implement NASs and to organise activities for achieving their objectives, typically through sectoral implementation. Although adaptation implementation at national level is still at an early stage, adaptation planning work is under way in most countries [23; 24].

Totally 25 of the EU MSs have adopted a NASs. Finland among the Baltic Sea countries had adopted NAS in 2005 and had updated it in 2014. Only three EU countries Bulgaria, Croatia and Latvia have not yet adopted NASs [25]. Latvia reported that NAS are drafted and likely to be adopted in 2018. Table 3 provides an overview regarding NASs and NAPs development in the Baltic Sea countries [26].

Table 3

Development of the National Adaptation Strategy (NAS) and the National Adaptation Plan (NAP) in the Baltic Sea countries

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
DK		[dark green]	[dark green]	[dark green]	[dark green]	[light green]	[light green]	[light green]	[light green]	[light green]	[light green]	[light green]
EE											[dark green]	[dark green]
FI	[dark green]	[light green]	[light green]	[light green]	[light green]	[light green]	[light green]	[light green] *	[light green]	[light green]	[light green]	[light green]
DE		[dark green]	[dark green]	[dark green]	[light green]	[light green]	[light green]	[light green]	[light green]	[light green]	[light green]	[light green]
LV												
LT						[dark green]	[light green]	[light green]	[light green]	[light green]	[light green]	[light green]
PL							[dark green]	[dark green]	[dark green]	[dark green]	[dark green]	[dark green]
SE												[dark green]

Legend:

[white]	No policy
[dark green]	NAS has adopted
[light green]	NAS and NAP in place
*	NAS has updated

The EC [24] indicated that there is limited quantitative information available (and in only a few countries) on the effectiveness of adaptation strategies and plans regarding enhanced resilience and reduced vulnerabilities and risks. This indicator is therefore not yet able to show the effectiveness of these strategies and plans in making Europe more climate resilient. More information on this is expected to become available in future, when more countries implement monitoring, reporting and evaluation adaptation schemes [26].

Consistent funding is available for the implementation of adaptation actions to increase climate resilience in vulnerable sectors and in cross-cutting ways (e.g., national scenarios and climate services, capacity building, website) in only nine EU countries (DE, DK, EE, ES, FR, LT, PT, RO, SE), but adaptation is financed in at least some sectors in all of the other countries, with one exception. The lack of funding that is specifically labelled for adaptation is also reflected in the fact that only 14 MSs include budget allocations in their NAS or NAP [27]. Adaptation policy will receive EU financial resources from the EU budget between 2014 and 2020. It is intended that 20 % of the budget should be used for climate-related actions (i.e. adaptation and climate change mitigation) [27]. Besides, climate change adaptation is mainstreamed (integrated) throughout the EU sectoral policies, using, on the one hand, the five European Structural and Investment Funds (ESI Funds): the European Regional Development Fund (ERDF), European Social Fund (ESF), and Cohesion Fund (CF), European Agricultural Fund for Rural Development (EAFRD), and the European Maritime and Fisheries Fund (EMFF).

A limited number of countries have started to monitor and report on adaptation policies and actions at national level [24]. So far, even fewer countries are evaluating adaptation policies at national level; there are various reasons for this, including the fact that implementation of adaptation has only just begun [26]. National Adaptation Plans (NAPs) usually aim to implement NASs and to organise activities for achieving their objectives, typically through sectoral implementation. Although adaptation implementation at national level is still at an early stage, adaptation planning work is under way in most countries [24].

Although in Latvia a systemic approach to climate adaptation was initiated in 2008 by approval of the Government Report on Adaptation to Climate Change, Latvia has not yet adopted its National Adaptation Strategy (NAS) on climate change [25]. The National Environment Policy Guidelines 2014-2020, adopted by the government on 18 March 2014, cover adaptation to some extent - there was a dedicated chapter on climate change covering mitigation and adaptation policy objectives [25]. Among the Baltic Sea countries only Latvia has not fulfilled its commitments and has neither developed NAS nor a NAP (Fig. 3).

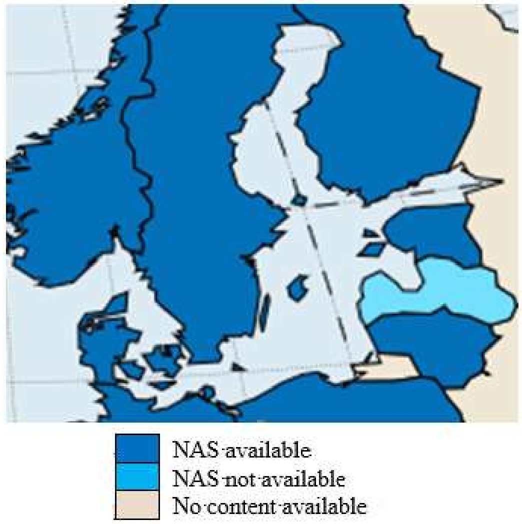


Fig. 3. **Availability of National adaptation strategy (NAS) in Baltic Sea countries, 2018**

Moreover, Latvia's climate change mitigation strategies and some developed sectoral adaptation strategies are created without complying with the EU, UNCCF and UNEP guidelines.

Climate change has complex effects on the biophysical processes that underpin agricultural systems, with both negative and positive consequences in different EU regions. Rising atmospheric CO_2 concentration, higher temperatures, changes in precipitation patterns and in frequency of extreme events both affect the natural environment as well as the quantity, quality and stability of food production. Climatic variations affect water resources, soils, pests and diseases, leading to significant changes in agriculture and livestock production. Farmers have to adapt to challenges stemming from climate change, and have to pursue mitigation and adaptation actions [3].

Management interventions will increasingly need to be decided on quickly and with full understanding of the ecological and evolutionary consequences. Focused consideration and planning, cross-disciplinary dialogues and the involvement of management practitioners and policymakers are all needed for successful mitigation strategies [11].

Climate change related adaptation is needed in complementarity with mitigation, since mitigation alone is not enough to stave off the adverse effects of climate change. Greater rates and magnitudes of climate change increase the likelihood of exceeding the limits to adaptation. Also the opportunities to take advantage of positive synergies between adaptation and mitigation may decrease with time, particularly if adaptation limits are exceeded [22]. The methodology for identifying and evaluating adaptation measures has three main components: identification of adaptation measures, review of national adaptation frameworks, and stakeholder consultations [14].

Stein et al. [21] propose some categories and approaches, which could be useful for adaptation strategies (Table 4).

There are a number of factors that determine the timescale or urgency with which an adaptation action is considered. Adaptations that can be addressed in a short timescale are those that can be rapidly implemented at a low cost. In addition, where there is a high level of uncertainty surrounding an impact or potential adaptation, further research may be needed as soon as possible to build greater knowledge, so that an informed decision may be made about the nature and urgency of appropriate adaptation [14].

Landscape management can also help adapt to climate variations. In addition, adaptation measures can be implemented to reduce the vulnerability of agriculture to climate change. However, trade-offs between adaptation and mitigation can occur (e.g., when gains in carbon sequestration lead to an increase in the vulnerability of humans or ecosystems) [13]. From a broader perspective, the goals of adaptation policy would be well-served through public investments in ecosystem management, which aims to protect, restore, and manage it [28]. Governments can play a key role in protecting these valuable "ecosystem services". In areas where climate change threatens to subject areas public funds may be needed [28].

Table 4

Examples of categories and approaches of adaptation strategies

Categories	Approaches
Improve current conditions	• Reduce non-climate related threats; • Restore flood plains; • Remove dams; • Reduce forest-fire fuels.
Protect and manage large landscapes	• Increase connectivity for species and ecological processes; • Create additional protected areas; • Enlarge protected areas; • Protect enduring features (geophysical); • Protect climate refugees; • Increase redundancy of protection provided by reserves.
Species- and site-specific approaches	• Relocate organisms (managed translocation); • Manage for heat-tolerant phenotypes; • Increase genetic diversity; • Re-establish ecosystem engineering.

Berger and Troost [29] argue that several requirements are necessary for development of a new modelling approach: microeconomic footing (i.e. whole-farm planning approach); farmer learning (i.e. technology adoption, risk-management strategies, and spatial interaction;) farmer interaction; spatial explicitness (e.g., soil erosion in sloping landscapes); environmental feedback, where socioeconomic and biophysical processes are captured; dynamic analysis, where land-use change and related landscape functions and agro-ecosystem services can be projected; empirical data, where connection to existing databases and model repositories is assured [30]. In turn, Jones [31] proposes importance of next generation agricultural system models taking into consideration: (i) technological advances; (ii) open, harmonized data (i.e. metadata, standards and protocols as well as data that are now mostly lost after collection and primary use); (iii) transdisciplinarity (i.e. broaden the collaboration among biophysical and economic modelers, in particular to include plant and animal breeders, insect and disease researchers and modelers, etc.); (iv) modularity and interoperability (i.e. research community can access and use the same sources of data "in the cloud" from multiple sources and to operate multiple models, knowledge products, and decision support systems). Moreover, modules can be integrated into holistic biophysical and economic models to address more comprehensive problems, as well as ensure model longevity and maintainability; (v) user-driven data and model development (i.e. models can be "user unfriendly", as well as be more effectively utilized through various kinds of "knowledge products").

Turner et al. [32] propose a generic climate change adaptation process (Fig. 4), which helps assess the risks and vulnerabilities, as well as adaptation options.

Increases in atmospheric CO_2 concentration will also impact on crop growth by increasing the resource (radiation, water and nitrogen) efficiency. As a consequence, for most crops grown in northern Europe (i.e. in Latvia), future warmer temperatures and elevated CO_2 levels are expected to result in more favourable growing conditions, although there will also be some negative consequences.

The interacting effects of climate trends and extreme events suggest that management approaches will need to adapt in the future. Many interventions involve practices that remain controversial and for which there are few policy guidelines [11]. Considering the impact of extreme events in the context of climate change trends can help identify when and where management intervention might be necessary and most likely to succeed. In some cases, proactive intervention after an extreme event may prevent system collapse or mitigate the impact of the next extreme event [11]. The opportunities to take advantage of positive synergies between adaptation and mitigation may decrease with time, particularly if adaptation limits are exceeded [8]. The IPCC provides a systematic typology of barriers (called constraints), including knowledge, awareness, and technology; the physical environment; biological tolerances; economic factors; financial factors; human resources; social and cultural factors; and governance and institutional processes [19]. They note that underlying many of these issues are competing values, which necessitate trade-offs in prioritizing adaptation actions.

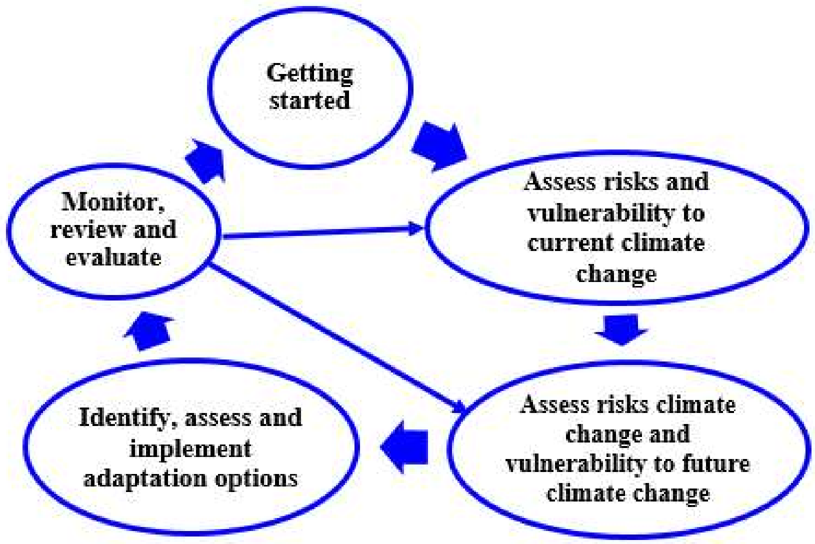


Fig. 4. **Generic climate change adaptation process**

Conclusions

1. Despite the deadline for the EU countries for development of the adaptation strategy to climate change was 2018, among the EU Member States only three countries, including Latvia, have not developed and submitted the National Adaptation Strategies (NASs). Moreover, among the Baltic Sea Region EU countries only Latvia has not fulfilled its commitments and has neither developed the National Adaptation Strategy (NAS) nor the National Adaptation Plan (NAP).
2. Besides, Latvia's climate change mitigation strategies and some developed sectoral adaptation strategies are created without complying with the EU, UNCCF and UNEP guidelines, and are based on simple forecasting models, which are criticised by experts and scholars on the EU and international level.
3. Considering the impact of extreme events in the context of climate change trends can help identify when and where management intervention might be necessary and most likely to succeed. In some cases, proactive intervention after an extreme event may prevent system collapse or mitigate the impact of the next extreme event.

Acknowledgements

This research was supported by the project "INTERFRAME-LV" (No VPP-IZM-2018/1-0005) within the National Research Program "Challenges and Solutions of the Latvian State and Public in the International Context".

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