Sürdürülebilir Çevre Dergisi

Dergi Sayfası: https://dergipark.org.tr/tr/pub/cevder

Araştırma Makalesi / Research Paper *Cilt 3 (2), sh. 52-64, 2023*

A Look at The Cities' Climate Change Adaptation Action Plans for Türkiye: Challenges and Opportunities†

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Arrival Date: 12.10.2023 / Accepted Date: 13.12.2023

Abstract

IPCC Sixth Assessment Report on Impacts, Adaptation and Vulnerability provides an in-depth assessment of Mediterranean Region where annual mean warming is projected to vary between 0.9 to 5.6°C under different emission scenarios by the end of the century while precipitation will decrease by 4% to 22% in most areas. Cities are hotspots of vulnerability to climate change impacts such as floods, drought and heatwaves, and need to adapt their operations in view of expected climate change impacts. On the other hand, cities are providing a unique ability to address those challenges as near-term measures implemented in urban infrastructure will determine global capacity for emission reductions and adaptation to climate change impacts. Urbanization influences climate change substantially and rapid urbanization may offer a unique potential for the creation of sustainable cities if decision-makers choose the right pathways and measures. Therefore, it is very important to make cities an integral part of the solution while combating climate change.

Cities have significant effects on climate change due to Greenhouse Gas (GHG) emissions occurring within their boundaries and urban heat island effect on temperatures. Meanwhile, they contain sensitive structures against the impacts of expected climate change. For this reason, a city action plan for climate change should consider actions both to reduce GHG emissions within the city and to increase the adaptation capacity of the city to the consequences of climate change. This study discusses the general approach adapted by the local governments, and evaluates adaptation measures. The study addresses economical, political, and social obstacles and opportunities in developing adaptation strategies and implementing adaptation measures. Furthermore, this study discusses in detail the following steps in developing cities' Climate Change Action Plan (CCAP): Determination of in-city GHG emission sources and emission factors, stakeholders' inclusion, preparation of GHG inventories, assessment of GHG emission reduction scenarios, sectors' vulnerability and risk assessments, identification of adaptation measures for the sectors, and finally preparation of the city's climate change action plan.

Keywords: Climate change, mitigation, adaptation, risk, vulnerability

† *This study was presented in the 6th International Symposium on the Environment and Morals.*

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Türkiye'deki Şehirlerin İklim Değişikliğine Uyum Eylem Planlarına Bakış: Zorluklar ve Fırsatlar

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Geliş Tarihi: 12.10.2023 / Kabul Tarihi: 13.12.2023

Öz

IPCC'nin Etkiler, Uyum ve Kırılganlık konulu 6. Değerlendirme Raporu Akdeniz Bölgesine ilişkin derinlemesine bir değerlendirme sunmakta olup; yüzyılın sonuna kadar farklı emisyon senaryoları altında yıllık ortalama ısınmanın 0,9 ila 5,6°C arasında değişeceği ve yağışların ise çoğu bölgede %4 ila %22 oranında azalacağı öngörülmektedir. Sel, kuraklık ve sıcak hava dalgaları gibi iklim değişikliğinin etkilerine karşı hassas noktalar olan şehirlerin operasyonlarını iklim değişikliğinin beklenen etkilerine göre uyarlamaları gerekmektedir. Öte yandan, kentsel altyapıda uygulanan kısa vadeli önlemler, emisyon azaltımı ve iklim değişikliği etkilerine uyum konusunda küresel kapasiteyi belirleyeceğinden, şehirler bu zorlukların üstesinden gelmek için benzersiz bir kabiliyete sahiptir. Kentleşme iklim değişikliğini önemli ölçüde etkilemekte olup, hızlı kentleşme, karar vericilerin doğru yolları ve önlemleri seçmesi halinde sürdürülebilir şehirlerin yaratılması için benzersiz bir potansiyel sunabilmektedir. Bu nedenle iklim değişikliğiyle mücadelede şehirlerin çözümün ayrılmaz bir parçası haline getirilmesi büyük önem taşımaktadır.

Şehirler, sınırları içinde meydana gelen Sera Gazı Emisyonları (SGE) nedeniyle iklim değişikliği üzerinde önemli etkilere sahiptir. Aynı zamanda beklenen iklim değişikliğinin etkilerine karşı da hassas yapılar içermektedir. Bu nedenle, şehrin iklim değişikliğine yönelik eylem planı, hem şehirdeki sera gazı emisyonlarını azaltacak hem de şehrin iklim değişikliğine uyum kapasitesini artıracak eylemleri dikkate almalıdır. Bu çalışmada yerel yönetimlerin benimsediği genel yaklaşım ele alınmakta ve uyum tedbirleri değerlendirilmektedir. Çalışma, uyum stratejilerinin geliştirilmesinde ve uyum önlemlerinin uygulanmasında ekonomik, politik ve sosyal engelleri ve fırsatları ele almaktadır. Ayrıca, çalışma şehirlerin İklim Değişikliği Eylem Planının (İDEP) hazırlanmasında gerekli olan; şehir içi sera gazı emisyon kaynaklarının ve faktörlerinin belirlenmesi, paydaşların katılımı, sera gazı envanterlerinin hazırlanması, sera gazı emisyon azaltım senaryolarının değerlendirilmesi, sektörlerin hassasiyet ve risk değerlendirmeleri, sektörlere yönelik uyum tedbirlerinin belirlenmesi ve son olarak şehrin iklim değişikliği eylem planının hazırlanması adımlarını ayrıntılı olarak tartışmaktadır.

Anahtar kelimeler: İklim değişikliği, azaltım, uyum, risk, kırılganlık

1. Introduction

Climate change, as one of the key challenges that humankind facing within current century, is expected to increase the severity of hazardous phenomena such as heat waves, draughts, heavy precipitation and floods. Cities are estimated to account for 60% of the global greenhouse gases (GHG) emissions and can therefore contribute substantially to the global efforts of mitigating GHG emissions (UN, 2021). According to a model-based estimate of carbon footprint, there are 7 Turkish cities in a list of top 500 cities worldwide. Istanbul, as the largest city of Türkiye in terms of population, ranks 26th while Ankara follows it on 80th place (GGMCF, 2022).

In Türkiye, almost 70% of population lives in urban areas and an increase of this figure is expected in near future, which will challenge infrastructures in combination with the climate change related risks. Direct impacts of climate change such as increase in extreme weather events, sea level rise and change in precipitation patterns may result in food distress, water scarcity, poverty and health related concerns. IPCC Sixth Assessment Report on Impacts, Adaptation and Vulnerability classifies risk in urban areas into two categories, i.e. compound and cascading risks, where former implies events that can be initiated via climate hazards and latter occur when an extreme weather condition triggers secondary impacts on several areas such as health conditions of citizens, food security, key infrastructure systems, land-use, immigration (IPCC, 2022). Report also provides an in-depth assessment of Mediterranean Region where annual mean warming is projected to vary between 0.9 to 5.6°C under different emission scenarios by the end of the century while precipitation will decrease by 4% to 22% in most areas. IPCC Sixth Assessment Report on The Physical Science Basis underlines that without the implementation of intense mitigation measures, temperatures will exceed the threshold of 2°C between early 2040s and 2050s (IPCC, 2021). Report also highlights the importance of heatwaves resulting in enhanced urban heat islands and defines three factors that are amplifying the consequences of warming in urban areas, i.e. urban geometry absorbing and storing more heat, human activities providing heat and lack of vegetation and heat absorbing materials. 2021 Adaptation Gap Report prepared by UNEP to provide recent development and progress of global adaptation process in terms of planning, financing, and implementation, underlines that the estimated costs of adaptation could reach 280-500 billion USD per year by 2050 for developing countries while estimated adaptation costs and financing needs will be five to ten times greater than current international adaptation finance flows (UNEP, 2021).

Cities are hotspots of vulnerability to climate change impacts such as floods, drought and heatwaves, and need to adapt their operations in view of expected climate change impacts for their regions. The vital importance of cities and their roles in climate change adaptation have already been pointed out by global conventions. Paris Agreement, which mainly aims at limiting global greenhouse gas emissions and keeping global temperature increase below 1.5°C, was prepared at the 21st Conference of the Parties held in 2015 with the participation of 196 countries. The agreement was approved by the Grand National Assembly of Türkiye in October 2021. Although the negotiations for the implementation of the agreement are still ongoing, most of the countries have declared their contribution on reduction of global greenhouse gas emissions and will update their targets on a regular basis. The agreement also requires countries to carry out actions for the protection of GHG sinks and biodiversity and to provide support to the developing countries and the most vulnerable countries in terms of financing, technology transfer and capacity building. The goals of the Paris Agreement can only be realized through coordination in global, regional, national and local levels. Cities provide a unique ability to address those challenges as near-term measures implemented in urban infrastructure will determine global capacity for emission reductions and adaptation to climate change impacts. Urbanization influences climate change substantially and rapid urbanization may offer a unique potential for the creation of sustainable cities if decision-makers choose the right pathways and measures. For this reason, it is very important to make cities an integral part of the solution while combating climate change. The Urban Climate Change Research Network's Second Assessment Report on Climate Change in Cities (ARC3.2), provides a pathway constituting the following five steps; integration of mitigation and adaptation actions, coordination on disaster risk reduction, co-generation of risk information, special focus on vulnerable populations, advanced governance, finance, and knowledge networks. Report also states that

cities not following these steps may experience difficulties on realizing their potential in terms of climate change solutions (Rosenzweig et al., 2018).

Several projects have been built upon the importance of cities in the fight against climate change. The Cities and Climate Change Initiative as one of UN-Habitat's programmes on sustainable urbanization and climate change, providing support to cities in addressing the climate challenge by assessing vulnerabilities in a participatory framework, informing urban planning processes, developing climate change plans and strategies, bridging the climate financing gaps, and prioritizing and implementing mitigation and adaptation actions. The Global Covenant of Mayors (GCoM) for Climate and Energy brings together more than 13,000 cities and local governments voluntarily committed to achieve the goals of the Paris Climate Agreement in building a resilient and low-emission society. As of today, 68 municipalities from Türkiye are part of GCoM and they are required to develop a Sustainable Energy and Climate Action Plan (SECAP) outlining the key actions they plan to undertake (GCoM, 2023). Local Governments for Sustainability (ICLEI) is a global network working with more than 2,500 local and regional governments aiming at sustainable urban development, almost 20 municipalities from Türkiye are a member of ICLEI (ICLEI, 2023). Türkiye is currently working on a national law on climate change, under which local governments are expected to develop their climate change action plans (CCAP), therefore a guidance is needed for the local authorities on their cycle of CCAP preparation.

2. Climate Change Action Planning for Cities

It is utmost important to develop a common methodology for a robust planning of actions to support local authorities while combatting the impacts of climate change. The SECAPs prepared within the GCoM were evaluated by the European Commission Joint Research Center and the results were reported to provide guidance on plans to be prepared in the following years (Bertoldi et al., 2020). On the other hand, there are various studies on the evaluation of local climate action plans prepared on a regional basis (Alexander, 2020; Pietrapertosaa et al, 2018; Reckien et al., 2018; Wheeler, 2018; Mendez, 2015; Walsh et al., 2011; Basset and Shandas, 2010; Tang et al., 2010).

There are several initiatives that are established to fill in knowledge gaps on adaptation planning such as EU's Climate-ADAPT, Stockholm Environment Institute's We-ADAPT, GIZ's Adaptation Community, World Adaptation Science Programme (WASP), UK Climate Impacts Programme etc. Several tools have been established to help local planning process on climate change adaptation such as; Urban Adaptation Support Tool (UAST) prepared by EEA, Climate-ADAPT and C40, Climate Action for Urban Sustainability (CURB) prepared by World Bank, Toolbox developed within the project "Reconciling Adaptation, Mitigation and Sustainable Development for Cities (RAMSES)", URBANPROOF toolkit developed within the Life project "Climate Proofing Urban Municipalities", Climate-Proof City tools created by ILKKA-project.

Co-benefits of the mitigation and adaptation actions are already evident, as investment to a low-carbon and resilient infrastructure comprise lower costs while providing many benefits. For example, implementation of sustainable transportation modes within the city may help in reducing traffic related concerns and improve local air quality together with the reduction of greenhouse gas emissions, while providing alternative means of transportation to reduce vulnerability of citizens in case of a disaster. Adaptation and Mitigation Interaction Assessment (AMIA) tool created by C40 aims to assist cities in maximizing synergies between adaptation and mitigation actions.

An evaluation of current local CCAPs in Türkiye have been performed with aim of assessing CCAPs based on several indicators determined under the following themes: development procedure, emission inventory,

goal setting, implementation of the plan, monitoring and evaluation. Nine local CCAPs that have been prepared by metropolitan municipalities were evaluated. All of them has prepared an emission inventory for a given base year and emission reduction targets were determined in a much broader term, while in few plans action-based information were provided. Not only many of the plans examined in this study did not cover adaptation to climate change but also, they contained limited information on the administrative structure, institutional arrangement and awareness raising in relation to the implementation of the plan. Sea level rise, urban heat islands, decrease in air quality, limited availability of water resources, damage to infrastructure due to extreme weather events and health effects are among the areas that are expected to be highly vulnerable to climate change at the urban scale. In this framework, 4 out of 9 CCAPs have prioritized the following sectors in terms of climate change related risks; public health, land use, forestry, agriculture, biodiversity, infrastructure and water resources management. In all plans, it is stated that vulnerability assessment and risk analysis have been carried out prior to the determination of actions. However, a variety of methodologies has been implemented where in many cases background is not clear. A common methodology needs to be developed to help the local actors and to the other stakeholders that will review the CCAPs (such as policy makers, research institutions).

3. Requirements for a Successful CCAP

The first step of the action plans is to define a realistic but ambitious vision that will clearly specify the source of motivation such as "low carbon development", "climate friendly city" and "sustainability". For the sake of the implementation and sustainability, multi-participant structure, usually through stakeholder workshops and survey studies must be formed in the process of the CCAP development. Sector experts, experts from different units within local governments, non-governmental organizations, academics and private sector representatives can be defined as stakeholders. The realization periods of the targets determined in the plans should be included in the planning processes as long, medium and short term.

Within the scope of the CCAP, the greenhouse gas inventory must be prepared for the cities. GHG emissions from all fixed and mobile sources operating within the boundaries of cities are evaluated as Scope 1 and GHG emissions from energy purchased outside the provincial borders are evaluated as Scope 2. Other sources of GHG emissions that occur outside the boundaries of cities due to the activities of cities are evaluated under Scope 3. Inventory studies are carried out for the residential, commercial and institutional buildings, transportation, manufacturing industries, energy production, treatment of waste and agriculture, livestock, forestry and land use. The sectors considered within the scope of the inventory should be evaluated and examined based on how much they represent the city. During the preparation of the inventory, the criteria determined by the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) can be taken into consideration. In addition to the methodology used in creation of greenhouse gas emission inventories, the data collection process, data sources and assumptions made in the calculation should be reported in detail in terms of both the continuity of the inventory update process and informing the stakeholders. GHG emission inventories prepared for cities in Türkiye mostly follow the GPC methodology. In addition, some inventories also include institutional GHG emission inventories that address categories such as transportation vehicles operated within the municipality, energy consumption in municipal buildings, street lighting and traffic lights.

Greenhouse gas inventories are a critical first step for CCAP as they are essential to monitor changes in GHG emissions while identifying mitigation opportunities. However, changes in GHG inventories over time cannot reveal the effects of policies or actions as they will not be sufficient to explain the causes of changes in emissions over time.

The construction of mitigation scenarios and the assessment of greenhouse gas impacts should be carried out as a complement to developing a GHG inventory. The first step in the process of determining the targets in the action plan is to estimate the change that the city will undergo during the inventory preparation period in the light of socioeconomic indicators. For this purpose, projections of greenhouse gas emissions for a base year should be calculated, taking into account of various factors such as expected changes for the country and social transformations that may occur in the province. In action plans, alternative emission projections can be created taking into account different parameters such as growth rate. There are two main methods used to set GHG emission reduction targets: absolute reduction and reduction compared to the reference scenario (GPC, 2014). In general, emerging economies set reduction targets according to the reference scenario, taking into account of their growth status. Two methods are generally preferred in action plans for digitizing the reduction targets: determining the sectoral reduction ratios by distributing the total reduction target to the sectors (top-down) and calculating the reduction amount for each action that can be quantified (bottom-up) and specifying these amounts as performance indicators.

It is anticipated that the increase in the frequency and severity of extreme weather events will cause great hazards in the province and pose significant threats to the urban infrastructure. Access to basic resources such as water and food is expected to be restricted as floods, frosts, hail and sea level rise will also affect agriculture. For these reasons, public health, land use, forestry, agriculture, food safety, biodiversity, infrastructure and water resources management should be among the priority areas in climate change adaptation plans prepared for cities. Determining actions to increase the city's capacity to adapt to climate change is important for CCAP. Before determining the actions in the plans, vulnerability assessment and risk analysis studies should be carried out. Actions determined on a sectoral basis are prioritized with the participation of stakeholders, CCAP include information on the relevant institution/organization, the realization time of the action, performance indicators and estimated costs. Evaluations of the measures set forth in the preparation of CCAP are carried out using methods such as cost analysis and multi-criteria analysis. CCAPs are intended to consist of actions to build capacity building and support management systems, such as the establishment of compliance options and supportive institutional frameworks. The difference in emissions between the mitigation scenarios and the baseline scenario will represent the impact of the policy or action on GHG emission reduction. In addition to evaluating the effects of the policies and actions according to GHG emissions mitigation potential, the broader social, economic, and environmental impacts such as contribution to air quality, public health and job creation are also examined in a general framework.

According to the guidelines published by the European Commission Joint Research Center for the CCAP documents being prepared within the CoM, the CCAP strategy should be formed under three pillars; emissions inventory, climate change risk and vulnerability assessment and finally mitigation and adaptation actions. Within same guide, the basic elements defined in order to create a successful action plan are as follows (Bertoldi, 2018):

- Formal acceptance of the planning process by the city council (or equivalent decision-making body)
- Clearly setting mitigation and adaptation targets
- Scientific assessment of the local situation (emissions inventory, risk and vulnerability analysis)
- Dealing in detail with the main sectors that profile the city
- Clearly defining the strategies and actions to be completed by 2030
- Mobilization of all relevant units of the municipality
- Involvement of the public and other

stakeholders in the process
- Identification of financial resources
- Establishing the framework for monitoring and evaluation of the plan

4. Risk Analyses: Hazards, Exposure and Vulnerability

Researches on the regards of the impact analyses of climate change in Türkiye mainly follow the "top-down" approach at which climate risks are evaluated based on the results of simulations of regional climate models dynamically downscaled using initial and boundary conditions taking from the global climate model projections, historical records and past events. In order to assess and anticipate climate-related risks, and appraise adaption options, it is imperative to understand the physical aspects of climate change, uncertainties in global climate models and regional impacts. Three methodologies namely "top-down", "bottom-up", and "storylines or narratives" are extensively used for risk assessments and adaptation appraisal.

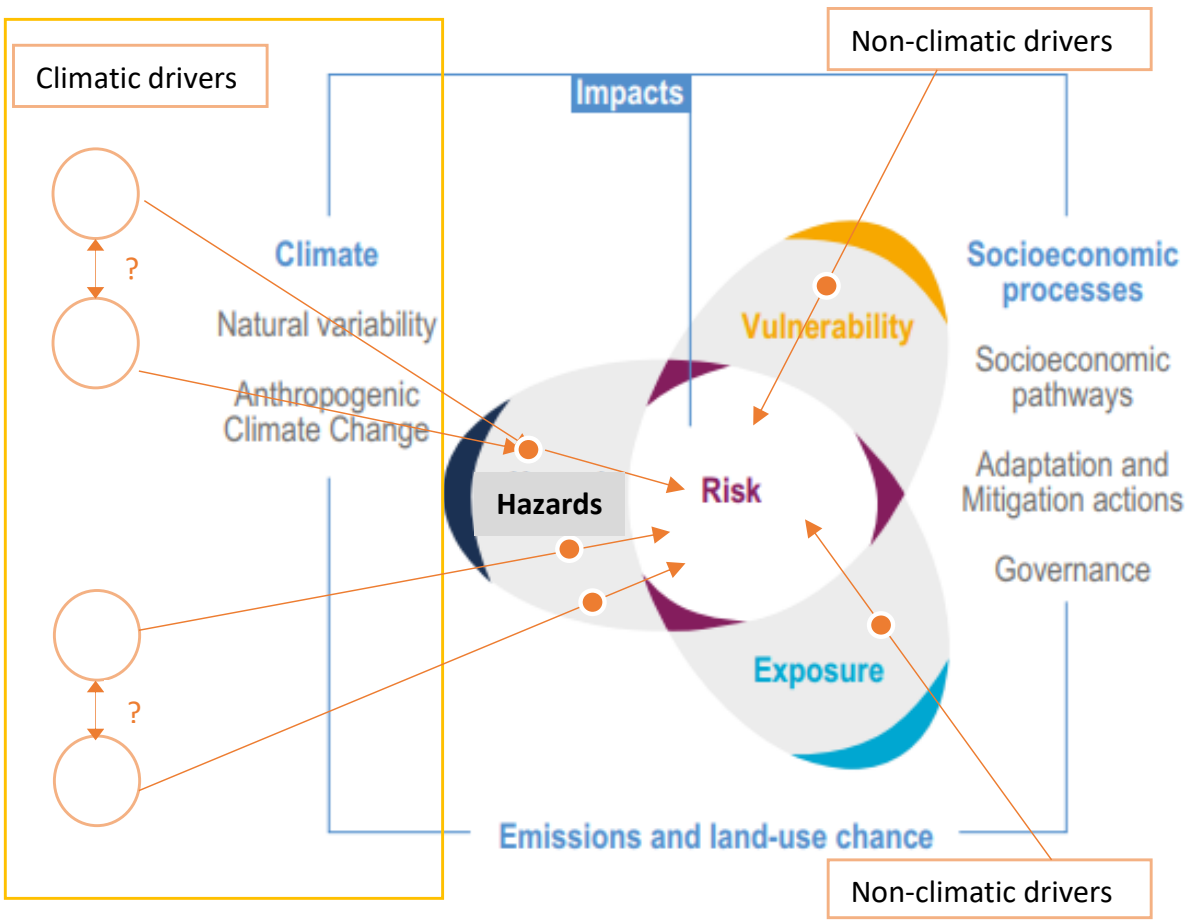

Figure 4.1. Risk Framework (adapted from Zscheischler et al. (2018) and IPCC (2014) WGII AR5. Multiple climatic drivers cause one or multiple hazards leading to societal and environmental risk. The Climate drivers and/or hazards may be mutually dependent. Non-climatic drivers related to vulnerability and exposure may also contribute to risk

Figure 4.1 adapted from Zscheischler et al. (2018) and WGII AR5 of IPCC (2014) depicts the relationships among the hazard, vulnerability, exposure, and climatic and non-climatic drivers. Exposure, as described by the IPCC, is the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected. Vulnerability, on the other hand, is the propensity or predisposition to be adversely affected.

Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2014). The term hazard refers to climate-related physical events (e.g., floods, heatwaves, wildfire) or their physical impacts. Therefore, risks are the combination and/or function of hazards (events), vulnerability, and exposure. Climatic drivers including climate and weather processes, variables, and phenomena cause climate-related hazards while non-climatic drivers will have impact on vulnerability, exposure, and risks. Climatic drivers could interact with each other, trigger one another leading to compound or cascading hazards which increase the impact and risks, and make the estimation of events even more difficult due to the complexity of their interaction (Zscheischler et al., 2018).

In order to evaluate risk assessments and appraise adaptation options for a specific sector, reliable and thorough scientific information with known uncertainties about the impacts of changing climate, and sector's vulnerability as well as exposure to a single or combined impacts of events need to be known as detailed and accurate as possible. For the water sector for instance, The General Directorate of Water Management of the Republic of Türkiye, Ministry of Agriculture and Forestry implemented and studied climate impacts on water resources at basin scale (GDWM, 2016). In that study, climate projections using several RCP scenarios at 10 km spatial resolution were obtained using a regional climate model taking initial and boundary conditions from three different global climate models. The sectorial risk analyses will then be followed based on hydrological modelling scenarios, in-depth analyses of the past events and statistical behavior of the historical meteorological variables, and determining the capacity of the regions' social and economic conditions. The above approach more or less describes the "top-down" methodology. Many studies conducted in worldwide including in Türkiye fall into this category. As Zscheischler et al. (2018) argue that the top-down approaches unlikely represent the real risks since they are dependent on climate change scenarios which possess great uncertainties and don't provide the whole spectrum of possible future conditions. In top-down approaches, an individual hazard or an impact has been estimated based on individual or combination of meteorological or climatic drivers, creating doubts on its capability on predicting impacts associated with multiple interacting drivers or hazards (i.e., cascading or compound events).

The bottom-up approaches as described by Culley et al. (2016) are an alternative to the top-down procedure, and have been designed to identify performance thresholds without considerations of climate models' projections. Instead of focusing on how the system performs under scenario-based global model projections, the approach is rather interested in identifying the exposures under which a particular system performs satisfactorily (Lempert and Collins, 2017). To implement the approach, climate exposures are generated for a range of plausible changes in climate, including range of changes not projected by the global climate models, and system response is assessed against each climate exposure (Lempert et al., 2004, Prudhomme et al., 2010, Brown et al., 2012, Brown and Wilby, 2012). The approach takes the system of interest (e.g., river management) to the center, and starts with exploring and understanding the vulnerability or sensitivity of the whole system to the climatic drivers. The bottom-up approach which is used by many sectors to explore system resilience to the climate impacts, especially for the compound events, is more ideal for vulnerability assessments since it focuses on the combined effects of individual drivers and/or hazards that could cause system failure; this in turn results in invaluable information for the assessment of vulnerability analyses.

Frequently observed, low-impact atmospheric phenomena could cause high-impact extreme events if they occur concurrently or at the same time. Thus, understanding the physical aspects of these phenomena (e.g., planetary scale systems like waves, jet streams, large/synoptic scale atmospheric systems like fronts and low-high pressure systems, and

mesoscale processes like land-sea interactions and topographical effects) is a critical key for the assessment of reliable risks. It would be useful and very beneficial to take into account of extreme events as being a compound event and study and understand each of its' integral parts (multi-drivers causes). Studies on the hazard projections concentrate on extreme climate computed using spread of univariate quantities like the number of coldest days, magnitudes of heat waves or precipitation. Nevertheless, impacts are, many times, associated with multiple climatic/atmospheric drivers. In addition, studies on the extreme events don't give desirable information about the spatial and temporal resolution in order to make reliable risk assessments. Furthermore, extreme/catastrophic events occur in the lower end of the probability distributions and may not be quantifiable. Therefore, the climate model projections come with great and unknown uncertainties. These necessities the use of storyline (stories as short for storylines/narratives/storytelling) approaches which have recently been extensively used in energy and climate change research, and can create a linkage between the physical aspects of climate change and its' human dimension. At the intersection of multiple interpretations, stories can be useful to provide a different perspective and serve as a complementary source of information the above mentioned approaches. Moezzi et al. (2017) provides a different way of explaining stories and explains that stories offer alternative perspectives looking through "lenses" from social sciences, humanities, and practitioners. As stated in the study, stories are used to 'zoom out' and see the bigger picture, 'zoom in' to better understand micro-dynamics, local scale, and refine models of how things work, 'zoom through' by looking what's behind the surface. The method can help connect diverse stakeholders and create an environment for collaborative and cooperative actions.

5. Suggestions and Final Comments

Cities are responsible for about 60% GHG emissions globally and therefore, have significant effects on climate change. At the same time, they are hot spots of exposure and vulnerability to the adverse impacts of climate change. Therefore, it is imperative for cities to develop strategic plans and climate actions for both reducing GHG emissions and improving adaptation capacities. With the Draft Climate Law prepared by the Directorate of Climate Change of the Ministry of Environment, Urbanization and Climate Change, it is aimed to prepare Local Climate Change Action Plans in 81 provinces of Türkiye. It is considered that there is a need for capacity building on climate change in all municipalities, especially metropolitan municipalities, and in this context, through the Climate Portal, which is also planned to be commissioned by the Directorate of Climate Change, an infrastructure will be established where both the studies carried out in the field of climate change will be shared and local stakeholders will carry out monitoring studies on action plans. Moreover, the preparation of guidance documents and calculation tools that will contribute to the preparation of greenhouse gas emission inventories by municipalities is also underway.

In order for CCAPs to be successful and actionable, a few criteria are listed below:

1. For a successful and sustainable CCAP, local governments or municipalities should accept their responsibilities and take ownership of prepared CCAPs. The willingness and ambitions of local governments on the issue of climate change are important keys for sustainability. Action plans should be ambitious but have realistic goals, clearly specifying the source of motivation such as "low carbon", "climate friendly city" and "sustainability".
2. The CCAPs must follow scientifically established standards and certain international protocols so that they can be monitored and evaluated easily, and compared with other CCAPs.
3. Mitigation targets and adaptation options must be identifiable, applicable, actionable, implementable. The short, medium and long term-realization periods of the targets should be included in the planning process.

5. Strategies and actions defined in CCAPs should be aligned with and, even further, should support and contribute to the national climate action plan, national strategies and climate goals.
6. For each mitigation or adaptation action, the main responsible parties or branches within the local governments or municipalities should clearly be identified and determined. The contributing actors such as provincial directorates and stakeholders should also be assigned in CCAPs.
7. Each action defined in CCAPs comprises multiple measures associated or attributed to clearly defined performance criteria. It is essential and a requirement to continuously monitor, update, and improve CCAPs, and therefore, policy consistency and long-term devotion are critical aspects, and consortiums within municipalities are recommended. All relevant branches within the municipalities (e.g., Depts. of the Environment Protection and Control, Transportation, Zoning and Urbanization, and the Climate Change and Zero-Waste) must be fully engaged and contribute to the cause.
8. High engagement of the stakeholders is the key to success. Public awareness on the impacts of climate change is crucial. Therefore, municipalities must keep organizing systematic and effective awareness raising activities on climate change. Local actors such as NGOs, union of chambers, private sectors must be included in planning from the start. It is important for the sake of the implementation and sustainability of the plan to create a multi-participant structure, usually through stakeholder workshops and survey studies. Typical stakeholders for city CCAPs are the sectorial experts, experts from different units within the local government, non-governmental organizations, academicians and private sector representatives.
9. Financial resources and funding mechanisms should be planned ahead, and actions should be prioritized accordingly. To give an example; one of the criteria for the sake of prioritization would be the low-cost and high benefit criterion (e.g., the actions with low-cost, high impact providing co-benefits). Certain funds received from the Central government can be allocated in fulfilling both the main responsibilities of the municipality and climate actions at the same time.

In most of the action plans of cities evaluated within the scope of this study, actions for adaptation to climate change were not determined. This situation can be explained by factors such as the issue of adaptation to climate change has come to the fore in recent years compared to mitigation, adaptation actions can be considered in a much broader framework, and the results of adaptation actions provide benefits at the regional level. Although it is seen that stakeholder participation in the preparation of action plans is generally provided through survey studies, workshops and focus group meetings, it has been determined that the targets/activities for public participation and awareness raising are missing, especially at the point of disseminating the results of the action plan. While information on the prioritization methodology used to transform mitigation targets into actions is provided in a limited number of plans, for those plans that do not include numerical targets on action basis, there is a significant deficiency for monitoring and evaluation of the plan.

In general, although the first step towards a solution is taken with the action plans prepared for climate change, the failure to clearly set out the responsibilities and performance indicators for the actions determined, the failure to address the other benefits and impacts of the actions, and the failure to establish a timetable for the implementation and financing of the actions are considered as important problems that may hinder the success of the process. In the coming period, when climate action plans will gain importance, it will be useful to create guidance documents/tools on a national basis regarding the planning process

and minimum requirements, both for new plans and for updating existing plans. Increasing the sharing of experience and knowledge among local governments in the planning process will also increase the consensus on the planning process and contribute to raising the level in terms of scope and quality.

As preparing and implementing mitigation and adaption measures, varying degree of challenges and certain opportunities arise; these difficulties and opportunities appear and manifest themselves differently from nations to nations, and even among cities.

Some of the challenges and opportunities obtained through studies of CCAPs can be listed as the followings;

1. Risk assessments rely on known uncertainties and reliable climate change information. One of the biggest problems is uncertainties in climate model projections, their inability to produce past climate and even seasonal variations. Use of dynamically downscaled "Regional Climate Modelling" approach can provide scenario-based projections for risk assessments, and could reduce uncertainties, improve forecast skills due to higher spatial and temporal resolutions, high resolution of digital elevation mapping and land use / land cover, and better representations of physical aspects of land-sea interaction (Shepherd et al., 2018; Meredith et al., 2015).
2. Lack of financial mechanisms to support developing and underdeveloped countries has vital consequences. This has been one of the key issues since the Paris Agreement which is to establish financing mechanisms both mitigation and adaptation actions. Developing or underdeveloped nations don't have enough expertise and technological resources.
3. Lack of necessary funding that municipalities need to carry out adaptation actions which can be solved in part by prioritizing co-beneficial actions, low-cost and high-impact choices. For instance, as for adaptation options against flooding, one measure would be to create artificial wetlands, structures to hold water with permeable surfaces. This allows water to infiltrate and reach groundwater reservoir enhancing water resources and biodiversity. As for mitigation actions, implementation of sustainable transportation modes within the city reduces GHG emissions, and at the same time reduces traffic related problems, improves local air quality and public health, creates alternative means of transportation to reduce vulnerability.
4. Lack of institutional capacity and understaffing within local governments and municipalities may result in an inapplicable CCAP. Sharing experience and knowledge between local governments during planning process would increase the consensus on CCAPs and contribute to raising their scope and quality.
5. Economic and political instabilities around the world pose serious threats. Crises due to wars, economic bans, worldwide refugee problems and such will bring additional obstacles to fight against climate change and better climate resilient communities.
6. Limited understanding of risks for adaptation and lack of acceptance of risks are another issue for sustainability reasons. Choosing a right language is important for the public even for politicians to understand the climate and climate change, and its potential impacts. Utilizing conventional and social media coverages are critical to inform the public, and to provide science-base evidence.
7. In some parts of the world, supportive policies, standards, and regulations on the mitigation of and adaptation to climate change do not exist. Especially, underdeveloped countries have understandably different and legitimate priorities such as accessing quality of drinkable water, electricity, nutrition and food safety, and water scarcity and education, and many more.
8. Climate change and its adverse impacts are now recognized and accepted by the

public, and it is considered to pose great threats. Majority of people and sectors representatives believe that climate change is real and its adverse impacts will be great. This could leverage climate actions plans, cause more community support, and provide an opportunity to tackle climate related problems; turning obstacles into opportunities.

9. Lack of confidence in measures could play a negative role. Scientific results (science-base evidence) should be translated using clear, understandable, appropriate languages and or mechanisms. Important questions about feasibility, efficacy, acceptability and sustainability of actions must be answered satisfactorily, providing information about the cost-benefit and timescale information, and showing robustness of the actions within the uncertainty. Action plans must consider, and take equity and fairness seriously, and flexible enough.
10. To date, no studies conducted in Türkiye on the sectorial risk assessments and or vulnerability analyses using bottom-up or storyline approaches have been appeared in the literature. These methods have certain advantages as discussed previously and can bring relevant actors, improve risk awareness by framing risk in an event-oriented rather than a probabilistic manner. Storylines can strengthen decision-making by reliving and learning from the past events and combining local impacts of climate change including compound risks. In addition, storylines can be used to explore probable range of extreme events by utilizing improved regional climate model scenarios where multi-divers can be employed.

Co-beneficial features of the mitigation and adaptation actions are already evident, as investment to a low-carbon and resilient infrastructure comprise lower costs while providing many benefits. Adaptation actions to climate change create multiple benefits such as cleaner air and greener cities as mentioned earlier. Studies on the preparations of CCAPs will contribute to awareness raising about climate change and help better resilient society. These studies will reveal the current situation in terms of GHG emissions and climate risks. If and when the mitigation and adaptation measures are well integrated in the CCAPs, it will also serve to contribute to some of the sustainable development goals mentioned by the United Nations.

References

Alexander S. (2020). Harnessing the opportunities and understanding the limits of state level climate action plans in the United States, *Cities*, 99, 2020.

Bassett E., Shandas V. (2010). Innovation and Climate Action Planning Perspectives from Municipal Plans, *Journal of the American Planning Association*, 76 (4), 435-450.

Bertoldi P. (2018). Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP)', Publications Office of the European Union, Luxembourg.

Bertoldi P., Rivas Calvete S., Kona A., Hernandez Gonzalez Y., Marinho Ferreira Barbosa P., Palermo V., Baldi M., Lo Vullo E., Muntean M. (2020). Covenant of Mayors: 2019 Assessment, *Publications Office of the European Union,* Luxembourg.

Brown C., Ghile Y., Laverty M., Li K. (2012). Decision scaling: Linking bottom-up vulnerability analysis with climate projections in the water sector, *Water Resources Research,* 48, W09537, doi:10.1029/2011WR011212.

Brown C., Wilby RL. (2012). An alternate approach to assessing climate risks, EOS, *Transactions American Geophysical Union*, 93 (41), 401–402.

Culley S., Noble S., Yates A., Timbs M. Westre S., Maier HR., Giuliani M., Castelletti A. (2016). A bottom-up approach to identifying the maximum operational adaptive capacity of water resource systems to a changing climate, *Water Resources Research*, 52, 6751-6768, doi:10.1002/2015WR018253.

GCoM (2023). Global Covenant of Mayors for Climate and Energy, *https://www.globalcovenantofmayors.org/*, (Access Date: 4.12 2023).

GDWM (2016). İklim Değişikliğinin Su Kaynaklarına Etkisi Projesi Nihai Raporu. https://www.tarimorman.gov.tr/SYGM/Belgeler/iklim%20de%C4%9Fi%C5%9Fikli%C4%9Finin%20su%20kaynaklar%C4%B1na%20etkisi/Iklim_NihaiRapor.pdf, (Access Date: 10.11 2022).

GGMCF (2022). Global Gridded Model of Carbon Footprints, https://www.citycarbonfootprints.info/, (Access Date: 4.12 2023).

GPC (2014). Global Protocol for Community-Scale Greenhouse Gas Emission Inventories An Accounting and Reporting Standard for Cities, C40, ICLEI, WRI.

ICLEI (2023). Local Governments for Sustainability, https://iclei.org/, (Access Date: 03.12 2023).

IPCC (2014), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Working Group II, 5th Assessment Report, Intergovernmental Panel on Climate Change.

IPCC (2021). Climate Change 2021: The Physical Science Basis, IPCC Sixth Assessment Report, Working Group I, Intergovernmental Panel on Climate Change.

IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability, IPCC Sixth Assessment Report, Working Group II, Intergovernmental Panel on Climate Change.

Lempert R., Collins MT. (2007). Managing the risk of uncertain threshold responses: Comparison of robust, optimum, and precautionary approaches, *Risk Analysis*, 27 (4), 1009-1026.

Lempert R., Nakicenovic N., Sarewitz D., Schlesinger M. (2004). Characterizing climate-change uncertainties for decision-makers. An editorial essay, Climatic Change, 65, (1), 1-9.

Mendez M. (2015). Assessing local climate action plans for public health co-benefits in environmental justice communities, *Local Environment,* 20 (6), 637-663.

Meredith EP., Maraun D., Semenov VA., Park W. (2015). Evidence for added value of convection-permitting models for studying changes in extreme precipitation, *Journal of Geophysical Research: Atmospheres,* 120 (24), 12500–12513.

Pietrapertosaa F., Khokhlov V., Salvia M., Cosmi C. (2018). Climate change adaptation policies and plans: A survey in 11 South East European countries, *Renewable and Sustainable Energy Reviews,* 81, 3041–3050.

Prudhomme C., Wilby RL., Crooks S., Kay AL., Reynard NS. (2010). Scenario-neutral approach to climate change impact studies: Application to flood risk, *Journal of Hydrology*, 390 (3-4), 198-209.

Reckien D., et al. (2018). How are cities planning to respond to climate change? Assessment of local climate plans from 885 cities in the EU-28, *Journal of Cleaner Production*, 191, 207-219.

Rosenzweig C., et al. (2018). Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network, Cambridge University Press.

Shepherd TG., et al. (2018). Storylines: an alternative approach to representing uncertainty in physical aspects of climate change, *Climatic Change*, 151, 555-571.

Tang Z., Brody SD., Quinn C., Chang L., Wei T. (2010). Moving from agenda to action: Evaluating local climate change action plans, *Journal of Environmental Planning and Management*, 53 (1), 41-62.

UN (2021). Cities and Pollution. United Nations, https://www.un.org/en/climatechange/climate-solutions/cities-pollution, (Access Date: 4.12 2023).

UNEP (2021). Adaptation Gap Report 2021: The gathering storm – Adapting to climate change in a post-pandemic world, United Nations Environment Programme.

Walsh CL., et al., (2011). Assessment of climate change mitigation and adaptation in cities, *Urban Design and Planning*, 164, 75-84.

Wheeler S. (2008). State and Municipal Climate Change Plans: The First Generation, *Journal of the American Planning Association,* 74(4), 481-496.

Zscheischler J., et al. (2018). Future climate risk from compound events, *Nature Climate Change*, 8, 469–477, https://doi.org/10.1038/s41558-018-0156-3.