EXPLORING LOCAL CLIMATE CHANGE ADAPTATION PLANS INTO SPATIAL PLANNING INDICATORS: TURKEY

Developing a guideline of climate change adaptation for local spatial planning system

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ABSTRACT

Spatial planning (SP) plays a pivotal role in shaping urban and rural areas, encompassing interventions such as development, conservation, and spatial configuration, all of which significantly influence climate change adaptation (CCA) efforts. The incorporation of CCA policies within municipal SP has gained increasing importance in addressing the challenges posed by climate change impacts. This study aims to examine the interplay between CCA policies and municipal SP in Turkey. It proposes an assessment of selected cities representing diverse climate regions within Turkey at the local scale. The primary objectives encompass evaluating the current state of the CCA-SP relationship through a causal-comparative approach, considering assessment criteria derived from a comprehensive literature review, and formulating region-specific policies. Noteworthy advancements in local-level climate change mitigation policies are underscored, while concurrently identifying significant gaps in climate change adaptation, particularly concerning the built/green environment and governance/participation. The findings will enhance the integration of CCA policies into forthcoming spatial planning endeavors within Turkey.

Keywords: climate change adaptation (CCA), spatial planning (SP), local spatial planning (L-SP), Turkey.
Thematic clusters*:* 2. City and Environment
Topic: Environment, landscape, resilience and climate change

Introduction

The effective implementation of interventions such as development, conservation, redevelopment, and transformation of land management and spatial structure of cities, urban areas, and countryside, which are known to have a significant impact on climate change adaptation (CCA) policies, heavily relies on the proper execution of spatial planning (SP) (Caragliu et al., 2011, Costa et al., 2011). It can play an effective role in ensuring that international and national CC issues are included in the legal framework in the form of agreements and climate policies at the national, regional and local level (Kumar and Geneletti, 2015). Although local spatial policies may not be directly related to CC, they can become a valid policy tool for reducing and adapting to CC problems if effectively implemented (Birkmann et al., 2010; Chanthamas vd.,2017). It is emphasized that local spatial plans and legal implementation tools are also significant in preparing and implementing adaptation policies (UN-Habitat 2016; Siders, 2017).

The **main objective** of this study is **to demonstrate the relevance of the contents of CCA policies assuming CCA plans as an efficient input into the municipal SP (specifically into the design of master and development plans.** To achieve it, proposes to establish a guideline for the relationship between CCA (only) and SP, supported on performance indicators. The focus will be on evaluating selected cities in different climate regions in Turkey at the local level, using criteria gleaned from a literature review. The overarching objectives of this effort are:

Goal 1: To identify strategic Performance Indicators (PIs) related to CCA content, (assuming policies, strategies, and themes).

Goal 2: To assess the adequacy of CCA content in local plans in Turkey through the use of Performance Indicators (PIs).

Goal 3: To identify strategic Performance Indicators (PIs) related to CCA content, assuming policies, strategies, and themes, which will be utilized for the evaluation.

The main and sub-research questions which will contribute to the roadmap for future studies at local level to achieve these goals are as follows:

Main question: *"How can a guideline/public policy be developed to bring the contents of CCA into municipal SP in Turkey?"*

Sub-questions: *1) What performance indicators can be used to define the relationship between CCA and SP? 2) Which topics/subjects are being overlooked or given less attention in the CCA content at the local level? 3) What policies can be developed at the local level SP applications?*

1. State-of-art: literature review about climate change adaptation and spatial planning

Cities are considered as the field of application for policy tools to adapt to climate change. Ensuring adaptation to climate change and using spatial planning as a tool to minimize the negative impacts of climate change on cities and to make them more sustainable are among the prominent issues (Carter et al., 2015; Hurlimann et al., 2021). A literature search was first conducted on SCOPUS to reveal the relationship between CCA and SP, and the VosViewer was used to evaluate the obtained publications to understand which concepts/topics stand out in the literature as a whole. CCA was defined as "climate change adaptation" and SP was first defined as "spatial planning" and then as "urban planning". It was seen that all studies defined as "spatial planning" in the literature were included in the "urban planning" studies.

In the first stage among a total of 298 studies related to CCA and SP are "spatial plan, participation and legislation", and "hazard (flood)" while in the second stage “planning, laws, cooperation, partnerships, governance, local people, drought and natural hazards” are emphasized (Figure 1).

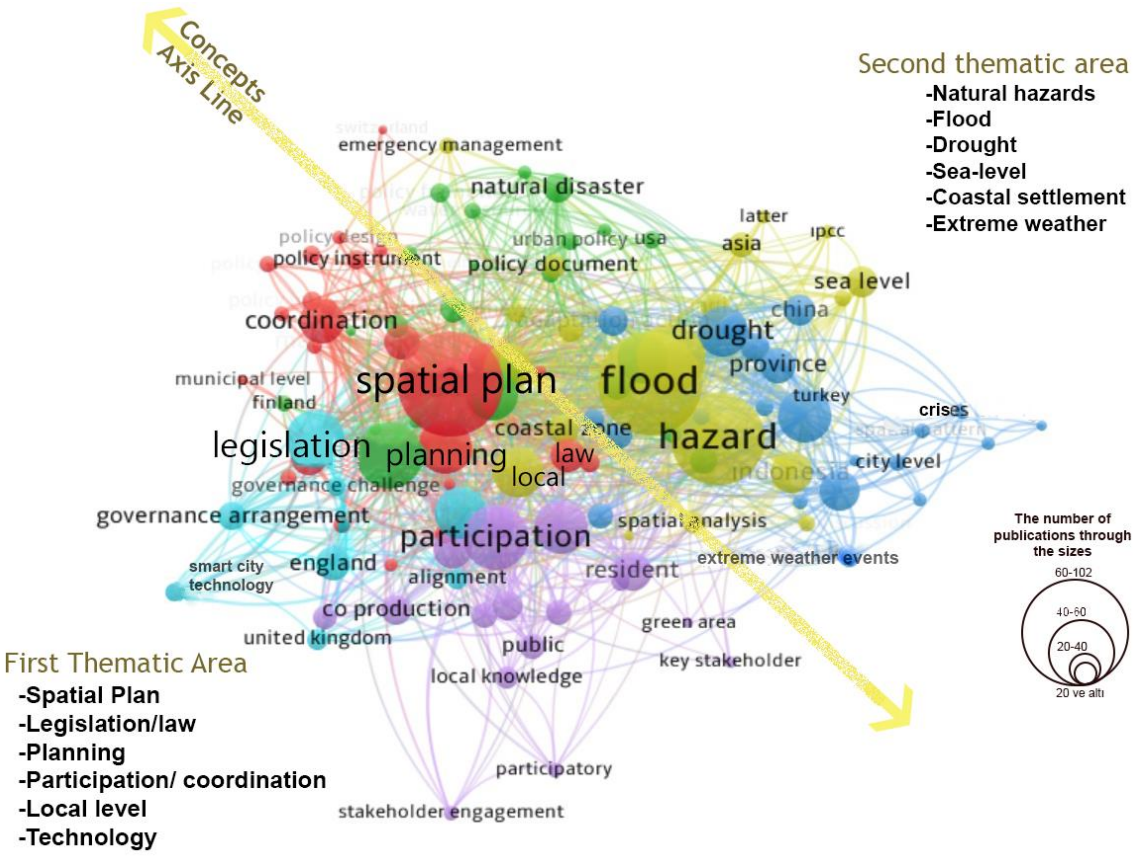

Fig. 01 Conceptual clusters that stand out in studies related to CCA and SP in the literature. Source: (reproduced from Kazancı & Tezer, 2021)

As can be seen in Figure 1, the studies are concentrated in two thematic areas. The first thematic area below the axis line where the concepts are divided shows the area where publications related to **spatial plans, legal framework and legislation, participation-cooperation-actors, local level** and **technology** are concentrated, while the second thematic area on the axis line focuses on natural hazards such as hazard and flood, drought, sea level, coastal settlements, extreme weather events related to climate change. Since the aim is to define spatial planning tools for CCA and to reveal the relationship of the subject **with legislation, the spatial plans, legal framework and legislation, participation and cooperation, and local level** parts of **the first thematic area** are focused on in the literature evaluation.

Researchs on the topics of CCA and SP commenced in 2006. The integration of spatial planning into CCA was first discussed through the topics of participation & cooperation and technology. It has been emphasized that multi-stakeholder approaches should be adopted to understand the impacts of climate change and to include them in spatial planning, and experts on the subject should be included in the process (Carter et al., 2015; Wamsler et al., 2016; Lorenz et al., 2017). It has also been pointed out that technological tools play an important role in the integration of the two issues (Giffinger et al., 2007; Wamsler et al., 2016). Studies on the legal framework started in 2010 and it has been underlined that CCA policies need to be supported by laws/regulations at both the national and local levels in order to be included in spatial planning practices (Roy, 2009; Gil-Garcia et al., 2015). In addition to participation, technology and the legal framework, it has been argued that the integration of CCA and spatial planning can be done through spatial/ physical plans (Chanthamas et al., 2017; Donner et al., 2017; Dulal, 2019; Hurlimann et al., 2021; Mabon and Shih, 2021). The fact that studies on the use of spatial plans as a tool started in 2017 shows that this is a new topic that has recently started to be discussed differently in the CCA and SP literature. The increase in studies in the recent years on both the legal framework and legislation and on spatial plans in particular highlights the importance of the subject. However, the number of studies defining the legal framework for the integration of

CCA and SP and establishing a relationship on physical spatial plans is considerably low compared to other studies. This shows that there is a deficiency in the literature on the subject (Donner et al., 2017; Dulal, 2019; Hurlimann et al., 2021; Kazancı and Tezer, 2021).

In general, the studies have indicated that effective spatial planning measures such as *energy conservation* (Zanon and Verones, 2013), *reducing flood/flash flood impacts* (Fratini et al., 2012; Dabrowski et al., 2021), *water resource management* (Kundzewicz et al., 2019), *ensuring urban sustainability* (Kundzewicz et al., 2019; Jeong, 2018), *controlling resource consumption* (Pieterse et al., 2020), *identifying risks and vulnerabilities* (Roy, 2009, Donner et al., 2017, Dulal, 2019, Abarca-Alvarez et al., 2019), *creating alternative scenarios* (Abarca-Alvarez et al., 2019; Elagiry, 2019; Mabon and Shih, 2021), *controlling urban growth* (Chanthamas et al., 2017; Hurlimann et al., 2021; Yahia et al., 2019), and *creating effective land use policies supported by laws* (Wilson, 2006; Birkmann et al., 2010; Kumar and Geneletti, 2015; Gradinaru and Hersperger, 2019) have been effective in CCA (Table 1).

Table. 1 Prominent topics in climate change adaptation and spatial planning.

Main Themes	Researchers
-Preserving, improving, and increasing green spaces	(Wilson, 2006; Matthews, Lo ve Byrne, 2015; Carter vd., 2015)
-Consideration of public benefit and participation in land use decisions	(Giffinger vd., 2007; Blanco vd., 2009; Carter vd., 2015; Jeong, 2018)
-Recommendations for urban design	(Wardekker vd.,2010; UN-Habitat, 2011; Carter vd.,2015; Chanthamas vd.,2017)
-Consideration of protection-use balance, urban development decisions based on ecosystem-based green infrastructure planning	(Wamsler vd., 2016)
-Creating risk reduction and vulnerability plans based on sensitivity levels of settlements	(Roy, 2009, Donner vd., 2017; Dulal, 2019; Abarca-Alvarez vd., 2019; Dabrowski vd., 2021)
-Detection of changes in settlements through real-time data collection system	(Chanthamas vd., 2017; Jeong, 2018)
-Adoption of scenario development approach	(Abarca-Alvarez vd., 2019)
-Emphasis on legislation and legal framework	(Roy, 2009; Siders, 2017; Sánchez ve Ribalaygua, 2018)

Physical spatial plans produced at various levels are described as one of the tools used to provide integration (Wilson, 2006; UN-Habitat, 2011; Carter et al., 2015; Kumar and Geneletti, 2015; Donner et al.,2017; Hurlimann et al.,2021) in the reviewed publications. While significant progress has been made in integrating CCA goals into spatial plans through green infrastructure planning, it is emphasized that the literature on how this integration should be integrated with spatial planning is insufficient.

Based on the literature review above, using the content analysis method (Vosviewer) the policies/strategies, PIs, and tools used to ensure the integration of CCA and SP. According to this: 1) In the **policies and strategies** for spatial adaptation to climate change*, the importance of regulating land use decisions, updating urban design practices related to the subject, designing open and green spaces within the city, preparing prioritized plans by identifying sensitive areas specific to the city, determining adaptation capacities for sectors, zoning and staging interventions, inter-scale studies, controlling resource consumption, identifying specific climate change impacts on the area (such as developing projects in the built environment to reduce the urban heat island effect, early warning systems to prevent flooding, etc.), developing alternative scenarios through the identification of problems and objectives for adaptation, and preparing the legal framework* has been determined through examples. 2) In the **Performance Indicators** framework, indicators that *define the scope of the effects, implementation of the participation mechanism, existence of legal bases, continuity of natural areas and resources, recommendations related to the built environment, adequacy of urban systems*

(such as transportation, education, health and services) related to the subject, forecasts for sectors (such as agriculture, industry), innovative/technological approaches, awareness-raising efforts, and questioning the adequacy of existing physical plans have been defined. 3) In the **main tools used in the integration of adaptation to climate change and spatial planning** are *spatial plans, legislation-legal framework, and participation/collaboration*. In addition, the results of the literature review indicate that spatial plans must be supported by a legal framework and both issues must be considered as a whole at the local level.

As a result, the PIs (Table 3) compiled from the international and national studies were simplified for use in the field study and were divided into 8 main themes: **key components of the plan(general), governance and participation, built- green environment, transportation, infrastructure, natural/conservation areas, energy/waste management and legal framework,** which will be detailed section 3 (case study)

2. Methodology

The novelty of this study lies in its potential contribution towards the integration of CCA policies into future SP in Turkey. The study methodology comprises two principal parts: *a literature review (state of art) conducted using content analysis*, which yields performance indicators by examining policies, strategies, tools, and themes. This study can be categorized as *quantitative research*, involving data collection and analysis. According to Cohen et al. (2017), quantitative research is a form of social research that employs empirical methods and empirical statements. An empirical statement refers to a descriptive statement about what "is" the case in the "real world" rather than what "ought" to be the case. Typically, empirical evaluations are applied in quantitative research. Empirical evaluations are defined as a form of evaluation that seeks to determine the degree to which a specific program or policy empirically fulfills or does not fulfill a particular standard or norm (Sukamolson, 2007).

The causal-comparative method is a quantitative research method that heavily relies on the factor of comparison. Its primary objective is to establish a cause-and-effect relationship between two or more variables, where one variable is dependent on the other independent variable in the second stage of the study. This method is not limited to the statistical analysis of two variables, but also encompasses the analysis of how different variables or groups change under the influence of the same changes (Schenker and Rumrill, 2004). In this study, *an analytical comparison table* is created to evaluate the performance indicators obtained from empirical evidence, including the Local CCA Plans and literature, using the +/- (plus & minus) under the *causal-comparative method*. The comparison is conducted using an *"IF-THEN" template* (Cohen et al., 2017), where the response is recorded as YES (+) if the local plan includes a defined input, and NO (-) if it does not include any related input, for general principles and other factors. To summarize, this study utilized the causal-comparative method to analyze local plans for adapting to climate change, and the performance indicators derived from the literature review were also incorporated as inputs in the analysis.

As the case study observation, the **first criteria** is that it is to evaluate a city that has at least one **Local Climate Action Plan** (LCAP) in Turkey. The **second criteria** is to choose them from **different climate regions**. According to the Köppen-Geiger climate classification, 11 sub-climate types have been identified within 4 main climate types in Turkey. The largest distribution is observed in the Steppe and Mediterranean climate types (Mızrak, 1983; Peel et al., 2007). Therefore, a total of 6 cities were selected, which not only have LCAPs, but also represent different climate regions, as shown in Figure 2.

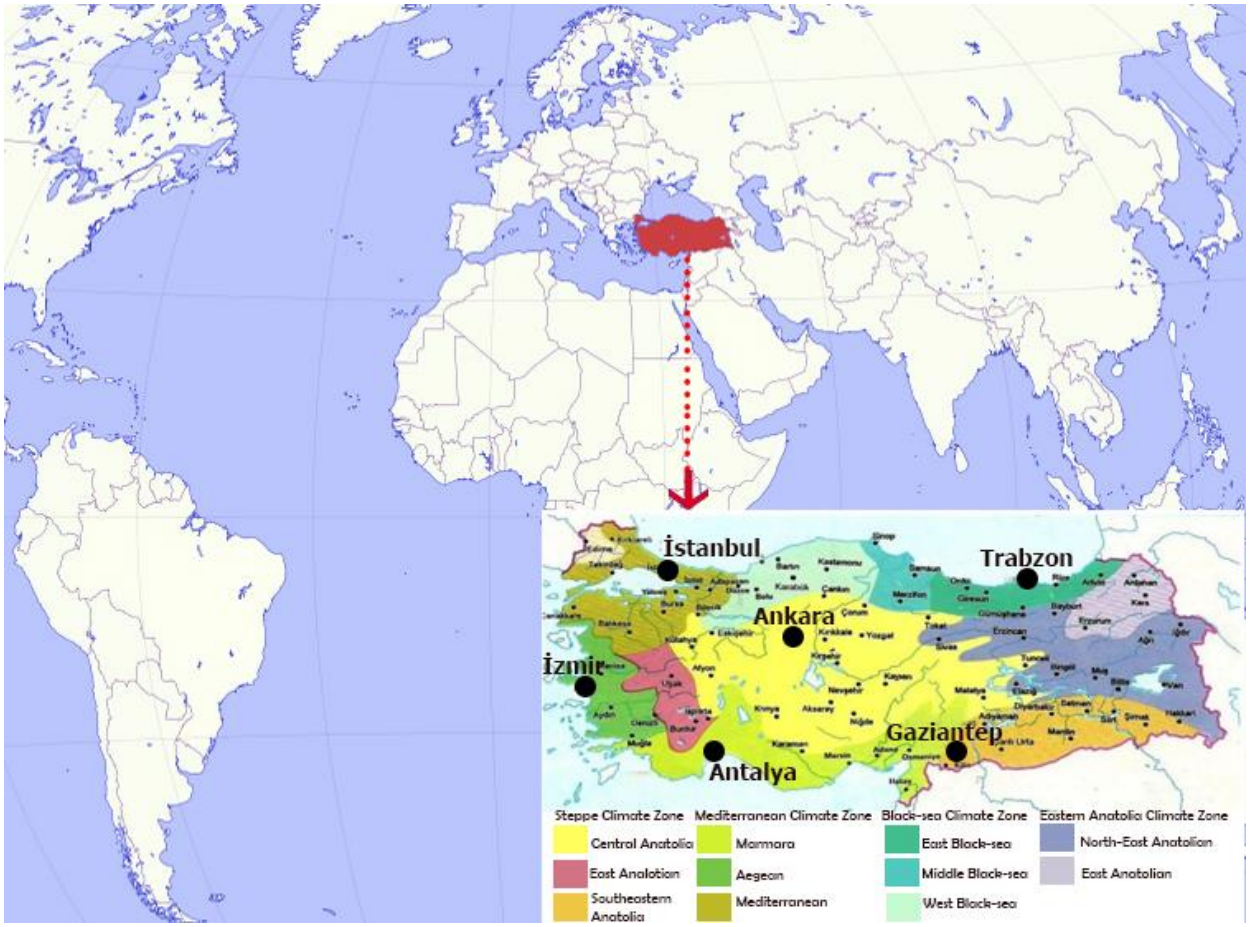

Fig. 02 Location of Turkey and selected cities. Source: (reproduced from Mızrak, 1983)

These cities are representing Mediterranean, Steppe, Black-sea and Eastern Anatolia climates as main climate zones with their sub-climate types. The reason for not selecting any city from the Eastern Anatolia climate or other sub-climate types is that there are no climate change themed plans made for cities yet. Spatial planning indicators were used to evaluate the adequacy and effectiveness of the CCA plans made for these 6 cities.

3. Case study: cities in Turkey's three climate region

Based on the aim, a set of cities has been chosen from different climatic regions of Turkey that are illustrated on the map in the methodology section (Table 2).

Table. 2 Selected cities and their qualifications (on climate sub-region, population size, CCA related plan existance).

Main climate region	Sub-climate region	Name of the City	2020 Population (million)	Existence of Plans
Mediterranean	Marmara type	İstanbul	15.462.452 million	Local Climate Action Plan (LCAP)
	Aegean type	İzmir	4.425.789 million	LCAP & Sustainable Energy Action Plan (SEAP)
	Mediterranean type	Antalya	2.619.832 million	LCAP & SEAP
Steppe	Central Anatolia type	Ankara	5.747.325 million	LCAP
	Southeastern Anatolia	Gaziantep	2.130.432 million	LCAP

	transition type			
Black Sea	East Black Sea type	Trabzon	816.684	LCAP & SEAP& Climate Adaptation Plan (CAP)

Table 2 includes the cities selected according to main and sub-climate regions, their populations and the names of the plans. İstanbul, Ankara, and İzmir are among the most populous three metropolitan cities in Turkey. Antalya, Gaziantep, and Trabzon were selected for evaluation due to their location in different climatic zones and having at least one Local Climate Action Plan (LCAP).

PIs, derived from the literature review and consisting of a total of 59 criteria grouped into 8 main themes have been applied to the selected seven cities to assess the current status of the relationship between CCA and SP at the local level. The results of this evaluation is presented in Table 3.

Table. 3 Case study evaluation.

PERFORMANCE INDICATORS (PI)		CITIES					
		Gaziantep	Ankara	İzmir	İstanbul	Trabzon	Antalya
		LCAP	LCAP	LCAP& SEAP	LCAP	LCAP & SEAP & CAP	LCAP& SEAP
KEY COMPONENTS OF PLAN (GENERAL)	Has the year of preparation of the plan been specified?	2011	2021	2020	2021	2019	2022
	Have long-term objectives, goals, and impacts been defined for CCA?	-	+	+	+	+	+
	Has the budget allocated for CCA been stated?	-	-	-	-	-	-
	Does it cover the provisions of the Paris Agreement?	-	+	-	+	-	-
	Has an assessment been made of where and when the expected risk related to the priority issue will occur?	-	+	+	-	-	-
	Has the type and source of greenhouse gas emissions been classified?	+	+	+	+	+	+
	Is there an estimation of future emission trends? Have scenarios been developed?	+	+	+	+	+	+
	Has a cost estimation been made for the physical damage that may occur in a possible climate disaster?	-	-	+	-	-	-
	Is there a cost estimation for reducing greenhouse gas emissions and adaptation?	-	-	+	-	+	-
GOVERNANCE & PARTICIPATION	Has there been any participatory meetings?	+	+	+	+	+	+
	Are there any stakeholder selection criteria?	-	+	-	-	-	
	Has a participatory method been implemented at every stage?	NI	+	+	+	+	+
	Has public awareness been raised about climate change?	NI	+	+	+	+	+
	Is there a communication channel that enables local people and officials to take early action?	-	-	-	-	-	-
	Are monitoring and evaluation mechanisms used in practice?	+	+	+	+	+	+
BUILT-GREEN ENVIRONMENT	Do standards and corresponding guidelines for conformity exist in the field of planning?	-	-	-	-	-	-
	Are there any urban design applications related to the subject?	-	-	-	-	+	-
	Has the proportion of built-up areas been determined throughout the entire area?	+	+	-	-	+	+
	Has the ratio of building density been determined according to the population?	+	+	-	-	+	-
	Have changes in land use due to climate change been evaluated?	-	+	+	+	-	+
	Have risky areas been identified? - Have sensitive areas been shown in the plan?	-	-	-	-	-	+
	Has the type of material used in the built environment been determined?	-	-	-	-	-	-
	Are there any restrictions on building heights?	-	+	-	-	-	-
	Have green building and green infrastructure standards been followed?	-	+	+	+	+	+
	Have measures been taken for impermeable surfaces?	-	+	+	+	+	+
	Are there any suggestions or studies on roadside afforestation?	-	+	NI	+	+	+
	Are there any suggestions for green roof implementation?	-	+	+	-	+	+
	Have green areas been shown in the plans?	-	+	-	-	+	+
	Have selected plant species and their suitability been evaluated in green areas?	-	-	-	-	-	-

TRANSPORTATION	Are there pedestrian and bicycle-friendly projects, and projects that support public transportation?	+	+	+	+	+	+
	Are there bike paths?	+	+	+	+	+	+
INFRASTRUCTURE	Has temperature measurement been carried out in the neighborhoods?	-	+	+	+	+	+
	Is rainwater being utilized?	+	+	+	+	+	+
	Have changes in floodplains and areas expected to be affected by rising sea levels been identified?	-	+	+	-	+	+
	Has an urban drainage system been built?	-	+	+	+	+	+
	Has poverty resulting from climate change been assessed?	-	+	-	-	-	-
	Have projections been made for displacement and forced migration due to climate change?	-	+	-	-	-	-
	Has the employment and livelihood structure been evaluated to identify vulnerable groups?	-	+	-	-	-	-
NATURAL& PROTECTED AREAS	Are there any restrictions on water usage?	+	+	+	+	+	+
	Are there any efforts to ensure water efficiency?	+	+	+	+	+	+
	Are there any special regulations for agricultural and forest areas?	+	+	+	+	+	+
	Are there any decisions regarding the preservation of the natural environment and landscape?	-	-	+	+	+	+
	Have natural resources been indicated on the plans?	-	-	-	+	-	+
	Have wind corridors been incorporated into the plans?	-	-	+	-	-	-
	Has an inventory of species been created?	-	-	+	-	-	+
	Have the current stream corridors been included in the plan?	-	-	+	+	+	+
ENERGY& WASTE MANAGEMENT	Has the use of renewable energy and solar energy been encouraged?	+	+	+	+	+	+
	Have waste management and greenhouse gas reduction technologies been utilized?	+	+	+	+	+	+
	Are there any recommendations for wastewater control and treatment?	+	+	+	+	+	+
LEGAL FRAMEWORK	Are scenarios supported by laws?	-	+	+	-	+	-
	Has a legal framework been defined for protected areas?	-	-		-	-	-

In Table 3, red color and a (-) sign have been used to indicate when spatial planning indicators are not included in the local climate action plans. If the defined PIs are present in the local climate action plans, a green color and a (+) sign have been used to show their inclusion. When necessary information cannot be accessed in the plans, NI (no information) has been used.

The Gaziantep climate action plan incorporates principles aimed at energy efficiency and greenhouse gas reduction, rather than adaptation. However, the climate action plan for the capital city of Turkey, Ankara, appears to be more comprehensive compared to Gaziantep's plan. While adaptation to climate change is addressed as a separate topic, it has been found that adaptation measures are not based on spatial references. Similarly, the climate action plan for Izmir has detailed headings, but there are shortcomings in spatial representation. The climate action plan for Istanbul, where a large portion of the country's income is generated, does not appear to contain spatial strategies that are as adaptive to climate change as Ankara and Izmir. Likewise, while risks and effects are addressed in the Trabzon climate action plan, interventions about the specific spaces are lacking. However, spatial mapping has been carried out for climate risks, particularly in the coastal area of Trabzon. Additionally, the local climate action plan in Trabzon covers both adaptation and sustainable energy action plans. Unlike other cities, structures have been identified at the neighborhood scale as high-risk, medium-risk, and low-risk in Antalya.

4. Discussion

In the assessment conducted through eight main themes, **key components of the plan** were first addressed. In this section, it is observed that greenhouse gas trends and the type and source of greenhouse gas emissions are classified in all cities. The fact that addressing the effects and priorities of greenhouse gases serves as the basis for climate change mitigation shows that local level adaptation activities have not yet fully begun, and cities are still in the preparation stage to adaptation (Costa, 2011). Although long-term objectives, goals, and impacts for CCA have been defined, budget and physical damage have not been taken into account in most cities. In terms of **governance & participation**, participatory meetings have been organized in the plans prepared in the cities, and studies have been carried out regarding monitoring and evaluation mechanisms. However, there is almost no mention of selection criteria for how participants are chosen in almost all cities (except Ankara). Additionally, it can be observed that no study has been conducted to establish a communication channel that enables local people and officials to take early action in any city. Gaziantep city has the most deficiencies, possibly due to the age of its planning, while the most work has been done in Ankara, Trabzon, and Antalya cities respectively in terms of **built-green environment**. It is observed that no urban design guidelines have been developed in any of the selected cities and there is no

identification of appropriate plant species and materials used in the built environment. Moreover, it is seen that there are no restrictions on building heights and no identification of risky areas in most cities. In comparison to other themes, the **transportation** theme contains the most work and projects in all cities. This is due to the fact that transportation is generally one of the sectors associated with greenhouse gas reduction (Dulal, 2019). However, in all cities, pedestrian and bicycle-friendly projects and supporting public transportation are seen to support adaptation. In the context of **infrastructure**, all PIs evaluated in Ankara have been carried out. Studies have been conducted on the subject in İzmir, Trabzon, and Antalya after Ankara. For example, it is observed that studies have been carried out in all cities regarding the utilization of rainwater. However, no studies have been conducted in any city except Ankara on poverty, migration/displacement, and vulnerable groups resulting from climate change. In terms of **natural & protected areas**, it is observed that there are restrictions on water usage, ensuring water efficiency and special regulations for agricultural and forest areas in all cities. However, in most cities, natural resources were not indicated on the plan (except for Antalya and Istanbul). In addition, wind corridors were not incorporated into the plans in any city except for Izmir. As in the transportation theme, studies have been carried out on the use of renewable energy, waste management, and wastewater control and treatment in all selected cities in the **energy & waste management** theme. In conclusion, in terms of **legal framework**, scenarios supported by laws have been developed in Ankara, Izmir, and Trabzon, but no legal framework has been defined for protected areas in any of the selected cities.

According to the evaluation, recent local climate action plans of the cities investigated (such as Antalya and Ankara) appear to give more consideration to governance & participation, built-green environment, transportation, infrastructure, natural & protected areas, energy & waste management and legal framework as the main spatial planning principles for climate adaptation compared to plans developed in cities with older planning years (such as Gaziantep). This may be attributed to technological advancements over the years and increasing awareness at the local level (Gradinaru and Hersperger, 2019). However, while planning year is an important criterion for evaluation, it is not a decisive one. For example, in the plan developed in İstanbul in 2021, there appears to be less emphasis on spatial planning indicators compared to older plans (such as Trabzon in 2019 or İzmir in 2020). Hence, it is crucial to take a broad perspective on CCA contents when examining plans.

5. Conclusion

In conclusion, local climate action plans generally focus on recommendations for the current state and reduction of greenhouse gases (in transportation and energy & waste management themes). However, deficiencies still exist in the areas of *built & green environment* and *governance& participation*. It was also found that *infrastructure*, *natural & protected areas*, and *legal framework* issues require further development. These findings can be considered as the answer to the second research question. Moreover, the lack of full budget and cost estimations for climate adaptation and the absence of a complete legal framework at the local level indicate a centralized approach. The strategies and projects developed for the CCA can be interpreted as top-down. Therefore, it can be argued that spatial representation is quite weak, site-specific projects couldn't be developed, and urban design is not prioritized at local level in Turkey.

In the local level, the current status of CCA content will be communicated to the relevant units of each municipality and recommendations will be made to create a roadmap for the future. This roadmap is expected to have an impact on both climate-themed plans and entry criteria for local spatial plans. In particular, it is necessary to develop projects using SP in the CCA content areas where deficiencies are emphasized (built & green environment and governance & participation). The identification of changes in land use, the identification of risky and sensitive areas, the implementation of green building standards, especially in public buildings, and prioritizing urban design projects are essential. For governance & participation content, it is important to develop digital applications that increase public awareness and activate early warning systems in cities. Details of other measures/projects that can be developed in other areas are expected to be elaborated upon completion of the study.

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