URBAN GreenUP

D: Report on the Diagnosis of Izmir

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0 Executive summary

In the final analysis, URBAN GreenUP, aims to obtain a tailored methodology to support the co-development of Renaturing Urban Plans, focused on climate change mitigation and adaptation as well as efficient water management, and to effectively assist in the implementation of NBS in urban areas. Through the Project, NBS classification and parametrization will be addressed conclusively and resources to support decision making will be established as part of the project activities. A large scale and fully replicable set of demonstration actions related to NBS accompanied by innovative business models will provide evidence about the benefits of NBS contributing to the creation of new market opportunities for European companies, and fostering citizen insight and awareness about environmental problems.

Large scale demonstration actions in three cities; Valladolid (Spain), Liverpool (UK) and Izmir (Turkey), which are the front-runners of the Project, are at the core of URBAN GreenUP. WP4 is dedicated to the large-scale demonstration actions in the city of Izmir where a set of Deliverables address the initial state of play in the city, thus resulting in the present report,

D4.1 Diagnosis; a detailed assessment and prioritization of climate change related environmental and water challenges with a current background of urban issues framed by economic, social as well as physical factors.

The Report tackles the present state of play in the city of Izmir, summarizing the situation and supplying information in the following subsequent parts;

- Overall city description and geographical, socio-economical framing
- Climate, coastal resilience, water and green space management as well as air quality considerations
- Urban regeneration perspectives
- Participatory planning and governance
- Social justice and cohesion considerations
- Public health and well being
- Economic valuation via ecoservices opportunities

A discussion of various barriers to NBS adaptation as well as indicators pertaining to the diagnosis is also included in the Report.

In the report, Chapter 3, Section 1, is a detailed account of the physical, climatic and geographical attributes of the city of Izmir, with particular attention to urbanization and land use. The climate challenges it faces via coastal resilience and water management problems, present state of play regarding green space management and air quality aspects are summarized in sections 3.2 to 3.6. Each section includes a catalogue of issues as well as a pack of potential solutions vis a vis NBS actions that may be considered as appropriate.

Given that the various climate challenges and possible remedies are closely intermeshed with the current physical, social and urban economical dynamics, as summarized generically in the Barriers section (3.13), a careful analysis is carried out regarding the current planning culture, openings towards participative planning and governance dimensions for the city of Izmir in section 3.8.

URBAN GreenUP aims to significantly engage citizens in urban renaturing strategies as an important dimension of urban development actions. Thus, social justice and social cohesion aspects are analysed in a detailed fashion in section 3.9 of the report. The historical development of social organization as a determinant of the present planning culture overlaps in a major way with the potentials for positive social impacts and outputs regarding renaturing urban plans.

As is well known, some of the major negative impacts of global climate change in urban areas are public health related. The already important adverse public health issues arising from rapid and unplanned urbanization, especially typical of Turkish cities such as urban heat island effect, floods and landslides, pollution etc are particularly aggravated by heat waves, irregular and extreme rainfall patterns introduced by global warming. These negative impacts are accompanied by economical losses in agriculture and unaccounted-for health care costs. Very few direct studies relate urban public health issues to climate change in the Turkish urban context and it is consequently difficult to develop diagnostic baselines in this area.

As the economic benefits of renaturing are an essential part of the further sustainability of nature-based solutions, ecoservices valuation are an important dimension of potential NBS action in Izmir. Several initial approaches have been developed in this nascent field in section 3.11 of the Report, where very little numerical data may be found not only for the city of Izmir but also for Turkey.

1. Introduction

The conservation and sustainable development community considers **Nature-Based Solutions (NBS)** to be a strong method of addressing climate change and its associated challenges in urban environments. On the other hand, there is a widespread tendency to implement mainly traditional engineering solutions when cities act to implement renaturing actions. Normally, authorities promote changes in patterns of mobility, expansions of cities or major infrastructure projects to combat floods and other effects of climate change. However, tools and guidelines that are being developed in these topics emphasize saving emissions and adapting existing infrastructure to climate change.

Nature-Based Solutions are widely acknowledged to help improve air quality, minimize heatwaves, act as carbon stores, help mitigation of climate change in general, reduce floods and overall overcome barriers to adaptation to climate change.

Furthermore, they can also provide a multitude of benefits that impact on human health, life style and well-being. In line with those statements, EC launched in 2008 the Annual European Green Capital Award (EGCA), which recognizes and rewards cities efforts. EC is currently working on the definition of an urban environmental self-assessment tool that will be used by cities, as a basis for assessing their environmental performance and aiming to find innovative ways to meet urban environmental and sustainability policy targets[1].

Despite these initiatives, there is a lack of tools to associate the environmental problems of cities with natural-based solutions. Normally, plans and actions involving green areas of the city are kept separate from the urban development plans and the key issue is that the existing guidelines usually do not incorporate NBS to fight and adapt to climate change.

Accordingly, it is required (1) to enhance the evidence-base and rationale of NBS, (2) to work at larger scale integrating these actions in sustainable urban plans, and (3) to deploy them much faster. Moreover, there is the need to explore (4) how to maximize their potential benefits by working on a broader approach with full interaction of related environmental, economic and social improvements; restoring natural capital and cutting the costs in contrast with conventional solutions, (5) boosting new inclusive and social behaviour on cities communities. It is also necessary (6) to promote the market for NBS to encourage its implementation in the future. By enhancing NBS, Europe can deliver new products and services, increase resource efficiency and learn from nature. (7) Scaling these solutions up to the systemic level and creating access to markets and finance for SMEs, will strengthen their implementation and can give Europe a global competitive advantage.

Considering the significant points and concerns mentioned above, URBAN GreenUP aims to deploy a set of NBS in the lead cities of Valladolid, Liverpool and Izmir according to a holistic

[1] https://webgate.ec.europa.eu/greencitytool/home/

approach. The idea is to address specific challenges describe in Section 3 of this report, by means of several pilots in selected areas of the city. WP4 is dedicated this implementation, and D.4.1 is devoted to constructing a detailed diagnosis, specify potential interventions and most importantly, situate the interventions in their proper, historical, cultural, organizational, social and finally physical frameworks. The following table (Table 1-1) is a summary of Izmir URBAN GreenUP interventions as proposed by the Project.

	RE-NATURING URBANIZATION	WATER INTERVENTIONS	GREEN SINGULAR INFRASTRUCTURES	NON TECHNICAL INTERVENTIONS
SUB DEMO A	**IZAc6 - Shade and Cooling trees** (Planting 26 trees cooling sidewalks alongside Ege Park) **IZAc8 - Installation of 4 Parklet** in Ege Park Shopping Center's car parking area		**IZAc13 - Cool pavement** surrounding Ege Park Shopping Center **IZAc14 - Green Covering Shelter** **IZAc15 - Green Shady Structures** in Ege Park Shopping Center's car parking area	**IZAc18** - Community meeting facility for climate-smart urban farming **IZAc19** -Market Stalls for Organic Urban Farming **IZAc20** - Educational Path /Bio-boulevard **IZAc21** - Engagement Portal **IZAc22** - Municipality-enabled urban farming with Agricultural cooperatives (women) **IZAc23** - Bio-blitz Event **IZAc24** - Promotion of ecological reasoning (İzmir Bio-diversity Atlas API) **IZAc25** - City Mentoring Strategy (Staff Exchange)
SUB DEMO B			**IZAc4 - Smart soil production** in climate-smart urban farming precinct **Smart soil into green shady structures** **IZAc16 - Climate-smart Greenhouses** in Climate-smart Urban Farming Precinct **IZAc17 - Biofuel production unit**	
SUB DEMO C	**IZAc2 - New green corridor** supporting Izmir's green ways and cycle routes which also includes Industrial Heritage Route of Izmir (9.6 km) **IZAc1 - New green cycle lane** and re-naturing existing bike lane **IZAc5 - Planting 4000 trees** (New green corridor, 9.6 km).	**IZAc3 - Rain Garden** **IZAc11 - Urban Carbon Sink** (species to maximise carbon sequestration alongside with new green corridor) **IZAc12 - Green pavement** to re-naturing Peynircioğlu River (gabion walls).	**IZAc7 - Installation of 250 Natural pollinator's modules** **IZAc9 - Green fences/vertical** alongside Peynircioğlu River **IZAC10 - Installation of 4 Fruit walls** alongside Peynircioğlu River	

Table 1-1: Summary of Proposed Interventions of Izmir

The diagnosis and supporting catalogue of solutions are intended to support tendering processes and establish the monitoring programs also following WP5 guidelines. A rigorous supervision of the interventions will be carried out to safeguard a high-quality deployment of the solutions. More than 30 NBS will be implemented, as was explained in D1.1 NBS Catalogue and with strong participation of the city councils, stakeholders and citizens. As can be seen in the above table (Table 1-1), the non-technical actions in Izmir pertaining to engaging economic, social actors carry significant weight in the Project portfolio.

The implementations are in close contact with WP1 to support the development of the renaturing strategy and serve as validation test-bed as far as possible. WP2-Valladolid and WP3-Liverpool will work in parallel with Izmir implementations, allowing synergy and learning. To strengthen this collaboration, series of cross-cutting activities have been set up, common to the three city implementation WPs.

2. Predefinition of the city and area diagnosis

URBAN GreenUP project aims to create evidence about the NBSs impact in cities to fight climate change, improve wellbeing and build more sustainable livelihoods.

In URBAN GreenUP project WP1, WP5 and WP7 are dedicated i) to the construction of a methodology to set a city baseline, ii) to create a set of KPIs to measure NBSs performances, iii) to monitor NBSs performances and iv) to evaluate cost and benefits of NBSs. Each NBS generates several impacts; these may be assessed through a set of indicators by using specific types of methods. An objective method to evaluate the actions, impacts and performance is necessary. URBAN GreenUP will adopt several KPIs for the evaluation of NBSs impacts in front-runner cities. The EKLIPSE[2] framework will be used as starting point to elaborate a homogeneous framework for the evaluation of NBS and to compare results through cities. Other KPIs will be adopted in order to frame the project evaluation not just in the European context but also in an international one. This framework will take into consideration all NBS impacts at different scales. Initiatives that have been included are: European Green Capital Award, Sustainable Development Goals (SDGs), Convention on Biological Diversity - Aichi targets, The Economics of Ecosystem Services (TEEB) and Mapping and Assessment of Ecosystem Services (MAES).

The chapter is composed by three sections. The first one will describe the EKLIPSE framework and methodology used to evaluate NBSs. The second section will introduce the Ecosystem Services Assessment (ESA) methodology. The last one will describe i) the KPIs construction process adopted in URBAN GreenUP, ii) the results obtained and iii) the next steps needed to complete the process.

The European Commission requested the EKLIPSE H2020 project to help building up an evidence and knowledge base on the benefits and challenges of applying NBS. The aim of this EKLIPSE activity is to devise an impact evaluation framework that can guide the design, development, implementation and assessment of NBS demonstration projects in urban contexts. The framework takes into account insights from recent studies into the mapping and assessment of ecosystems and their services, ecosystem-based adaptation projects, and relevant information on climate adaptation, natural water retention, green infrastructure, greening cities and other European Commission based initiatives.

The result of the EKLIPSE activities is a methodology to evaluate NBSs based on 10 challenges:

1. Climate mitigation and adaptation;
2. Water management;
3. Coastal resilience;
4. Green space management (including enhancing/conserving urban biodiversity);
5. Air/ambient quality;
6. Urban regeneration;
7. Participatory planning and governance;
8. Social justice and social cohesion;

[2] www.eklipse-mechanism.eu

9. Public health and well-being;
10. Potential for new economic opportunities and green jobs.

For each challenge, a set of KPIs to measure NBSs impacts at different scales (micro-scale, meso-scale and macro-scale) has been individuated. URBAN GreenUP aims to integrate the EKLIPSE methodology with the Ecosystem Services Approach (ESA) in order to generate a homogeneous evaluation framework to be adopted by cities during the project. This framework is based on the ecosystem services produced or enhanced by NBSs and will take into consideration all NBSs impacts at different scales.

3. İzmir diagnosis

3.1. Overall city description

3.1.1. Population and Socio-Economic Structure

İzmir is a metropolitan city in the west coast of Anatolia and the third most populous city in Turkey, after İstanbul and Ankara. The city of İzmir is composed of several metropolitan districts. Population of İzmir which was around 530.000 in 1927 is slightly over 4.2 million today. İzmir constitutes 5.3% of the population of Turkey and 41% of that of the Aegean Region. Gender ratios in İzmir is slightly in favour of females. Percentage of the population engaged in agriculture is 15% of the total.

Considering the distribution of population according to location, percentage of those living in urban areas is 91% while those living in rural areas is 9%. Density of population is 333 per square km and İzmir is the third city in Turkey in terms population density. The biggest towns in terms of the number of inhabitants are Karabaglar, Buca, Bornova, Konak, Karşıyaka and Bayraklı respectively. The smallest town in terms of the number of inhabitants is Karaburun. Bergama is the largest town in terms of area while the smallest one is Balcova[3].

Figure 3-1: Izmir districts map (Source: Wikipedia)

İzmir's economy is essentially comprised of industry, commerce, transportation-communications and agricultural sectors. Oil and chemical products, metal, textile, machinery, food, tobacco and agro-industries stand out in İzmir's industrial profile. Main trading sectors are foodstuffs, construction materials, textiles/ready-made clothing, wood-furniture, chemical-plastic and agricultural products. Regarding the agricultural sector and animal husbandry, cotton, grapes, olive, figs, tobacco, vegetables and fruits, fish and animal by-products occupy the top places.

[3] TUİK. (2016). *Compiled from the data of the Turkish Statistics Institute*.

6.1% of Turkish exports and almost half of those of the Aegean Region were realized from İzmir in 2013. Trade in food products, building materials, textile products, wood products and furniture, chemical products provide İzmir's commerce particular boost[4].

3.1.2. Geographical and Climatic Structure

As mentioned before, İzmir is located in the west of Turkey and in the midway on the coastline of the Aegean Region. It is surrounded by the province of Balıkesir in the north, province of Manisa in the east and province of Aydın in the south. Area of İzmır is 1.201.477,55 ha (IPPA, 2013). İzmir's metropolitan area extends along the outlying waters of the gulf of İzmir and inland to the north across the delta of the Gediz river, to the east along an alluvial plain created by several small streams and to a slightly more rugged terrain in the south (Figure 3-2).

Figure 3-2: Location of Izmir and demo locations (Source: İzmir Mimarlar Odasi, 2017)

İzmir has a mild Mediterranean climate. Summers are hot and dry and winters mild and rainy. Temperatures rarely fall below zero degrees Celsius for more than 10 days per year. Temperatures above 30 degrees Celsius is experienced for approximately hundred days a year. Snowfall and frost are rarely seen. Annual precipitation is between 700–1.200 mm. Annual average sea water temperature is 18,5 °C[5].

The fact that mountains lie perpendicular to the sea and that plains penetrate as far as the Inner Western Anatolia threshold, makes it possible for marine effects to spread over inland areas. However, physical geographical differences such as altitude and distance from the coast further cause climatic differences which may be deemed significant in terms of precipitation, temperature and insolation.

[4] ICE. (2013). *İzmir Commodity Exchange Publishing*

[5] IDPFAL. (2013). *İzmir Directorate of Provincial Food Agriculture and Livestock*

The steepness of mountains in proximous to the Aegean cause valley systems to extend in the east-west direction and due to the complex geological structure, different parts of İzmir province have a structure very different from each other in terms of formation. Three of Turkey's water basins are located within the boundaries of İzmir province. These three water basins are between Kınık and Dikili towns at Bakırçay catchment in north of Izmir, direction of Emiralem Menemen-Çiğli west of Gediz catchment and the south of Izmir, Küçük Menderes catchment basin. These three catchment basins meet the Aegean in the west[6].

İzmir is under the effect of the Mediterranean climate in terms of vegetation. All types of Mediterranean flora and fauna are present here. In those places where forests have been removed due to overgrazing, fires and land clearing for many centuries, maquis flora appears. Maquis areas rise up to an altitude of 600 meters above the sea level. A large part of the mountainous areas is forested. Area covered by forests occupies 41% of the provincial terrain. There are Turkish red pine (*Pinus brutia*) forests up to an altitude of 600 m above the sea level and black pine (*Pinus nigra*) forests above this altitude.

There are indigenous stone pine (*Pinus pinea*) forests in the vicinity of Kozak region of Bergama, Guner village in Cumaovası and Helvacı village in Torbalı. Such broad-leaved trees as sycamore, chestnut, ash tree, willow, poplar, maple, elm and cornelian cherry spread in the secluded and damp river beds with favourable soil. Valonia oak is also one of the characteristic trees of the forests in our province[7].

Bornova lowland and the depression of İzmir bay were formed by faults trending E-W. Active faults nowadays are trending NE, NW, N-S and E-W in the west Anatolian Extension Province. İzmir bay is a lazy L-shaped superimposed basin that is topographically divided into an E-W-trending inner bay and a NW-trending outer bay[8]. İzmir is located on a seismically very active ground that makes the city susceptible to earthquake hazards[9]. History of İzmir area is full of very destructive earthquakes that resulted in many casualties and destruction of thousands of buildings over the course of history.

- **Slope Facets of Izmir Province**

The slope grades of the İzmir land have been examined according to the criteria of national land evaluation rules that has 6 slope facet groups. On the provincial lands, the largest surface area was found to have very steep slope (25.7%) and steep (18.8%) land slope groups. On the other hand, the area of lands with a slope of less than 6%, which is suitable for irrigated agriculture, covers 22.3% of total area (Table 3-1, Figure 3-3,Figure 3-4)[10].

[6] IPPA. (2013). *İzmir Land Assets, Izmir Provincial Private Administration Publishing.*

[7] IDPFAL. (2013). *İzmir Directorate of Provincial Food Agriculture and Livestock*

[8] Uzel, B., & Özkaymak, H. (2014). Neotectonic Evolution of an Actively Growing Superimposed Basin in Western Anatolia: The Inner Bay of İzmir, Turkey. *Turkish Journal of Earth Sciences, 21 (4)*, 439-471.

[9] Koçman, A. (1991). İzmir'in kentsel gelişimini etkileyen doğal çevre faktörleri ve bunlara ilişkin sorunlar. *Atatürk Kültür Dil ve Tarih Yüksek Kurumu Coğrafya Araştırmaları Dergisi, 3,*, 101-122

[10] IPPA. (2013). *İzmir Land Assets, Izmir Provincial Private Administration Publishing.*

Slope & Slope degree	Total (ha)
(1) Flat (0-2%)	201.037,69
(2) Gently slope (2-6%)	66.791,72
(3) Moderately slope (6-12%)	100.575,04
(4) Steep (12-20%)	227.042,41
(5) Very steep (20-30%)	308.578,84
(6) Extreme steep (30%+)	225.514,33
Coastal dune (CD)	174,64
River bed (RB)	3.407,29
Bare Rock (BR)	7.960,13
Water Body (WB)	4.288,56
Settlement (Se)	56.106,90
General total	1.201.477,55

Table 3-1: Distribution Slope Groups of Province Izmir lands (Source: IPPA, 2013)

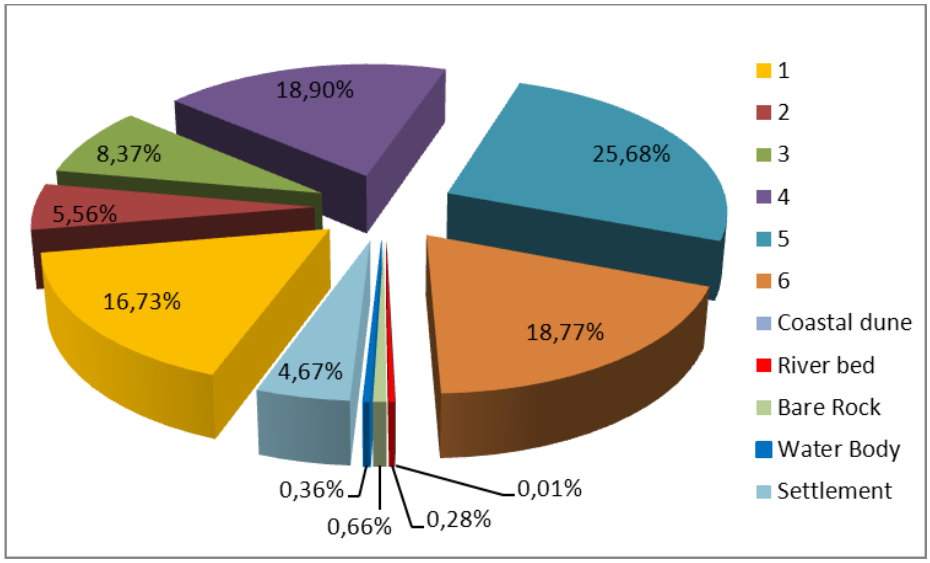

Figure 3-3: Distribution of province Izmir lands according to slope groups (Source: IPPA, 2013)

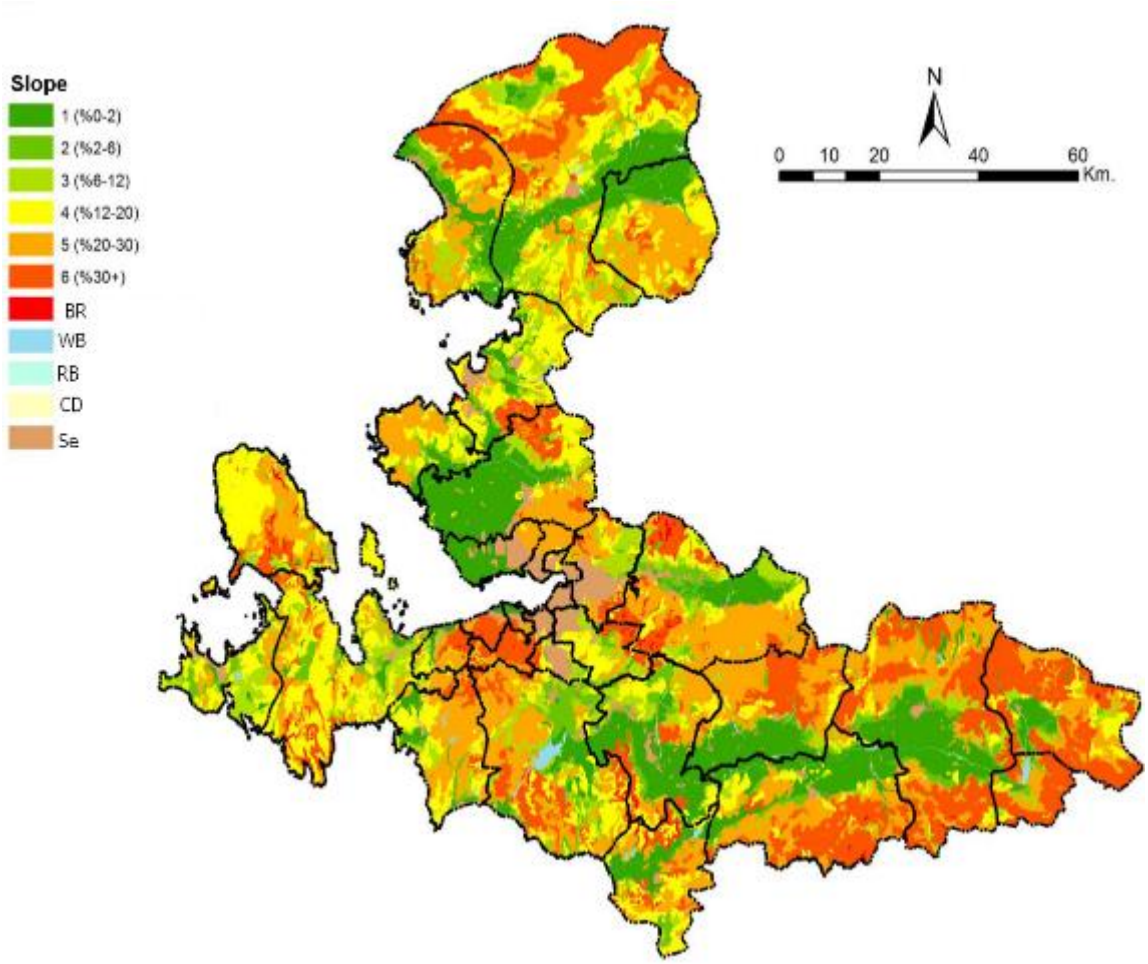

Figure 3-4: Slope map of Izmir province. (Source: IPPA, 2013)

- **Soil Erosion**

Soil erosion is the displacement of upper layer of soil, one form of soil degradation. The erosion of soil is a naturally occurring process on all land. The agents of soil erosion are water and wind, each contributing a significant amount of soil loss each year. Soil erosion may be a slow process that continues relatively unnoticed, or it may occur at an alarming rate causing a serious loss of topsoil. The loss of top soil from farmland may be reflected in reduced crop production potential, fixed carbon losses and potential carbon emission, lower surface water quality and damaged drainage networks.

While erosion is a natural process, human activities have increased by 10–40 times the rate at which erosion is occurring globally. Excessive (or accelerated) erosion causes both "on-site" and "off-site" problems. On-site impacts include decreases in agricultural productivity and (on natural landscapes) ecological collapse, both because of loss of the nutrient-rich upper soil layers. In some cases, the eventual end result is desertification. Off-site effects include sedimentation of waterways and eutrophication of water bodies, as well as sediment-related damage to roads and houses. Water and wind erosion are the two primary causes of land degradation; combined, they

are responsible for about 84% of the global extent of degraded land, making excessive erosion one of the most significant environmental problems worldwide ([11];[12]).

Due to sloping topographic formation of Izmir province erosion is the biggest problem for sustainable agricultural production. Erosion affect could be a study title and according soil map of the Izmir province, some of the agricultural land (mostly olive field) located on sloping areas that are under the erosion threat. Due to sloping topographic formation of the İzmir lands, erosion is biggest problem in terms of sustainability. North and west part of Izmir province are affected from erosion mostly. Erosion effects separated into 4 groups. The land of İzmir province was examined and it was determined that 66% of total land is in severe and very severe erosion class (Table 3-2, Figure 3-5, Figure 3-6)[13].

Soil Erosion Degree	Total (ha)
1-Non- or less	204.643,70
2-Moderate	131.937,66
3-Strong	524.111,37
4-Very strong	268.847,30
Total Land	1.129.540,03

Table 3-2: Soil Erosion Classification of Land of Izmir (Except settlement, riverbed and water surface areas) (Source: IPPA, 2013)

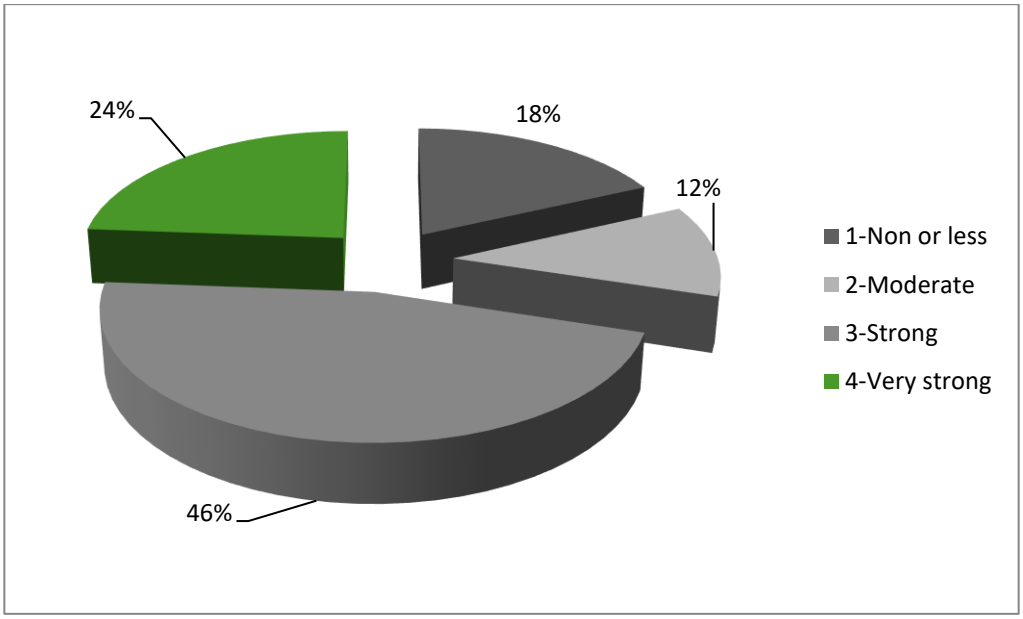

Figure 3-5: Proportional Representation of Erosion levels in Izmir Region (Source: IPPA, 2013)

[11] Blanco, H., & Lal, R. (2010). "Soil and water conservation". Principles of Soil Conservation and Management. Springer.

[12] Toy, Terrence J. et al. (2012). Soil Erosion: Processes, Prediction, Measurement, and Control. John Wiley & Sons.

[13] IPPA. (2013). *İzmir Land Assets, Izmir Provincial Private Administration Publishing.*

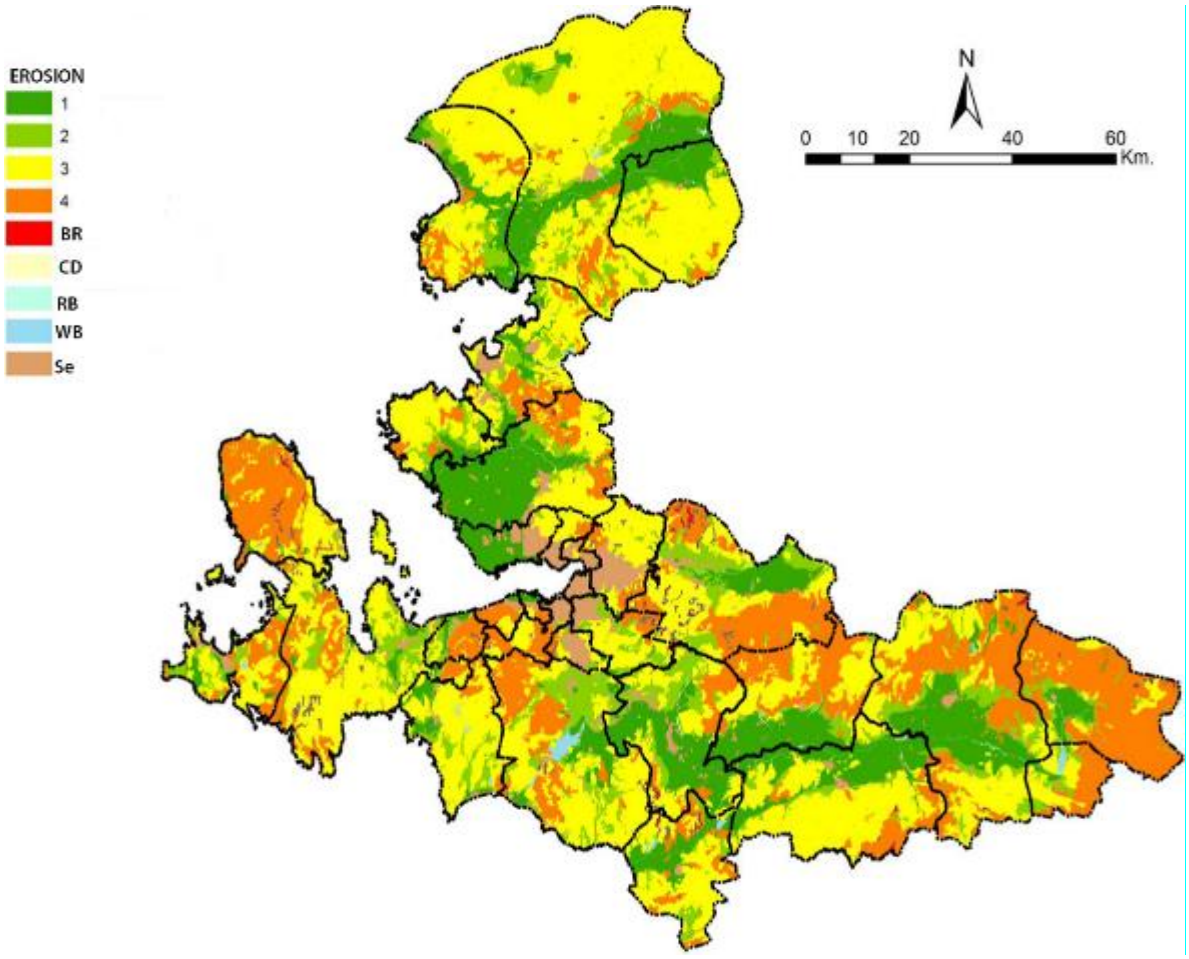

Figure 3-6: Erosion map of Izmir province (Source: IPPA, 2013)

- **The problems of Izmir Lands**

Soils of Izmir province have some limits for agricultural production and nature plant life. These limits were examined under 4 groups that named as soil subclasses. These subclasses indicate soils deepness, stoniness, salinity, alkalinity, excessively heavy or coarse soil texture, slope facets, drainage condition and lands under excessive climate condition. Symbols of these classes are given below:

- "e" erodibility – where susceptibility to erosion is the dominant limitation.
- "w" wetness– where a highwater table level, slow internal drainage, and/or flooding constitutes the dominant limitation.
- "s" soil – where the dominant limitation is within the rooting zone. This can be due to shallow soil profiles, subsurface pans, stoniness, rock outcrops, low soil water holding capacity, low fertility (where this is difficult to correct), salinity, alkalinity or toxicity.
- "c" climate – where the climate is the dominant limitation. This can be summer drought, excessive rainfall, unseasonal or frequent frost and/or snow, and exposure to strong winds or salt spray.

The problems of the soils are given as subclass characteristics in soil map of Izmir district. Izmir provincial territory was examined according to the subclass characteristics of the lands. According to results, soil insufficiency and erosion (se/es) are the biggest (71.6%) problem of soils of Izmir District. This suggests that soil conservation efforts should be carried out effectively in the region. (Table 3-3, Figure 3-7,Figure 3-8)[14].

Limitations Class	Area (ha)
No Limitation	108712.42
e	68617.36
es	746571.55
s	9953.26
se	113313.43
sw	14486.28
w	53842.44
ws	14043.29
Coastal Dune (CD)	174.64
River Bed (RB)	3407.29
Bare Rock (BR)	7960.13
Water Body (WB)	4288.56
Settlement (Se)	56106.9
Total	1.201.477,55

Table 3-3: Areas of Izmir Province soil subclasses (Source: IPPA, 2013)

[14] IPPA. (2013). *İzmir Land Assets, Izmir Provincial Private Administration Publishing.*

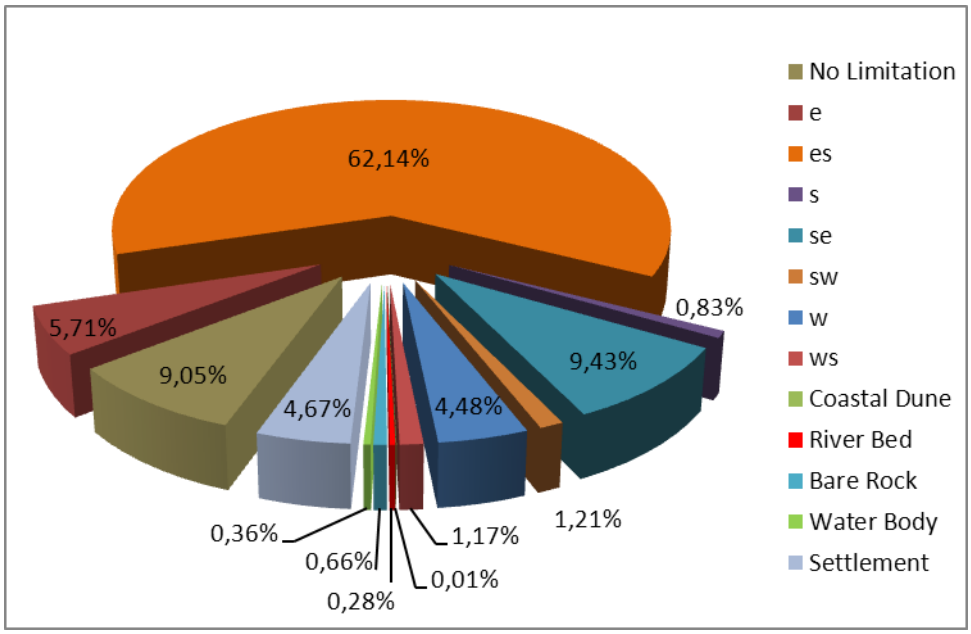

Figure 3-7: Distribution of LUC subclasses (Source: IPPA, 2013)

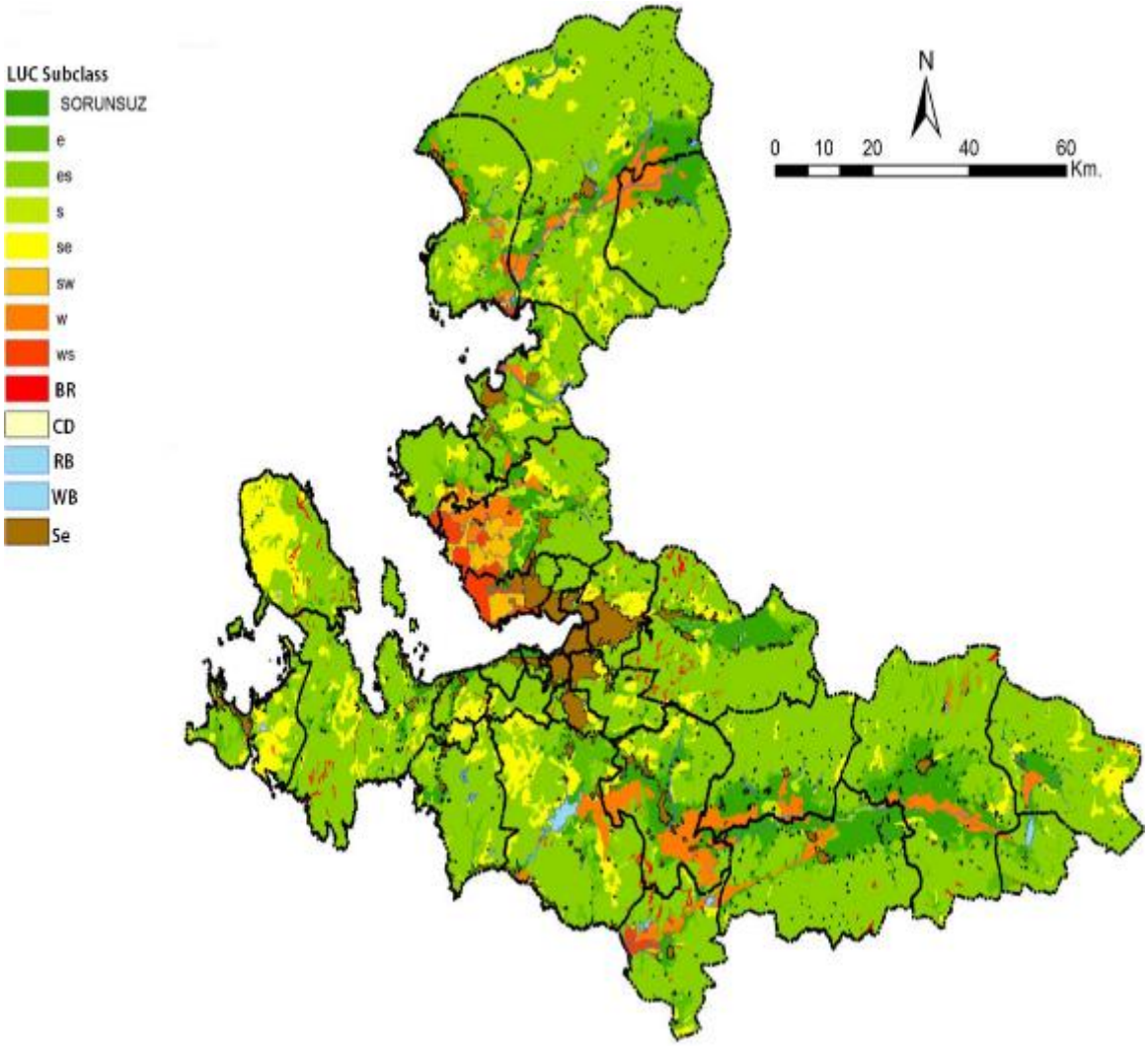

Figure 3-8: Map of LUC subclass and soil problems (Source: IPPA, 2013)

3.1.3. Urbanization and Land Use

Urban development has followed a significantly different path in Turkey compared to Europe, due to economic, demographic, cultural and historical reasons. Local administrative capacities, authority, priorities and vision, has been naturally marked by these developments.

It is possible to say quite easily that Turkish cities have very different demographic, physical and infrastructural attributes and needs, compared to typical European cities. These differences are compounded in Turkish megacities with populations in excess of many European countries. This typological difference brings particular problems as well as opportunities to urban responses to energy-climate issues.

According to Bilsel (2009) and Kaya (2002), the Danger and Prost Plan (1925) was the first comprehensive attempt for a citywide planning approach in İzmir[15]. Dangers proposed a regular layout for the burnt-out district, with a system of large open spaces and diagonal avenues that formed visual axes converging on the sea or on important monuments such as the Citadel (Kadifekale). The avenues intersected at plazas, the most monumental being the Plaza of the Republic by the sea. At the centre of the axis connecting the Plaza of the Republic to the central railway station, a public park was designed. Seymen (1993) and Serçe et al. (2003) stated that during the implementation of the park, this green area was enlarged to 40 ha by the municipality and was modelled in 1936 on Moscow's Gorki Park as Culture Park (Kültürpark), and since that time, has been the home of İzmir's International Fair[16]. Kültürpark, as a multifunctional public space that has served as a stage for recreational, cultural, and social activities, has become an important component of urban life and İzmir's identity.

As models for climate resilient and inclusive urban development unfold through smart city projects in Europe, the participation of İzmir is particularly important. Conveying EU theory and practice to local administrations in Turkey is important in itself but, the enhancing and enriching the experience and global reach of European urban regeneration models by lessons from İzmir which is experiencing problems and stresses more similar to the fast urbanizing world that is outside the borders of Europe, is imperative. As the migration crisis has tragically shown, problems as well as solutions are clearly global and we stand to gain from a better understanding of the dynamics of global urban processes.

İzmir is fast growing city under the threat of air pollution, heat island effect, heavy traffic and loss of natural areas. The city maintained its urban identity as a typical Mediterranean coastal town until the 1950s, when it started to undergo rapid urban development and sprawl due to rural to urban migration. Since the 1980s, İzmir has experienced an accelerated process of urban expansion. Like other metropolitan cities in Turkey, it has expanded its borders and has added new urban expansion sites along the roadways and coastline. There are significant changes in land cover and urban fabric during the period from 1963 to 2005. The built-up area increased from 8.2

[15] Can, I. (2010). Urban Design and Planning System in İzmir, Journal of Landscape Studies Vol.3, pp.181-189

[16] Martinidis, V. (2011). Urban aesthetics and national identity: the refashioning of Eastern Mediterranean cities between 1900 and 1940. *Plan Perspect 26:*, 153–182

% to 28.9 %, primarily at the expense of agricultural land. Agricultural land declined from 13.65 % to 5.19 % of the total area[17]. Therefore, there is strong need for integrating peri-urban and urban farming practices to save the fertile agricultural lands which produces 5.4 % Gross Value Added (GVA) of the city (highest among the most developed cities in Turkey) (Figure 3-9).

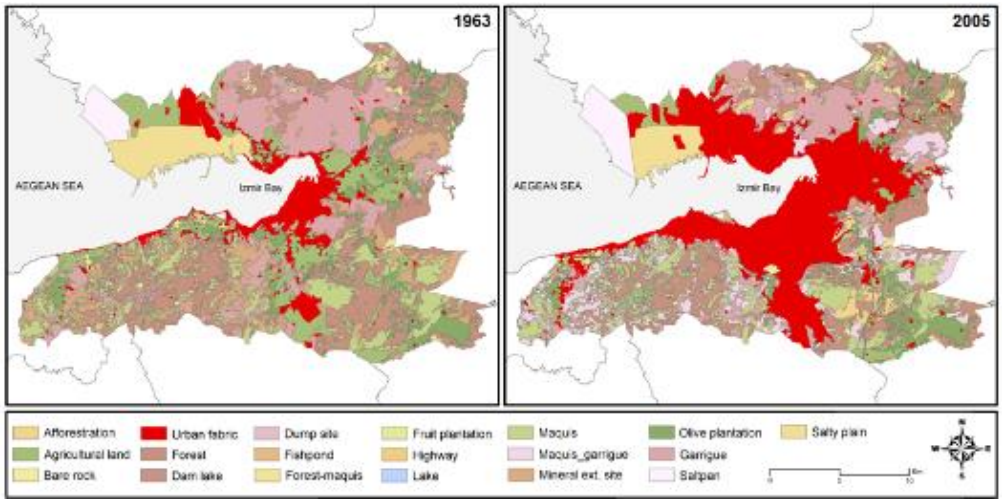

Figure 3-9: Land use and land cover change between 1963 and 2005 in İzmir (Source: Hepcan, et al., 2013)

Figure 3-10: A view from urban landscape of İzmir that includes natural vegetation and urban fabric surrounding İzmir bay (Source: Hepcan Ş., 2013)

Dense and fast urbanization pattern of Izmir has also created the heat island effect (Figure 3-10). A study illustrates the heat island effect distributed all over the city of İzmir (Figure 3-11). It was produced by image processing of a LANDSAT scene captured in 2013. Red circles seen in the figure

[17] Hepcan, Ş., Coşkun Hepcan, Ç., Kılıçaslan, Ç., Özkan, M., Koçan, N., & s. (2013). Analyzing Landscape Change and Urban Sprawl of a Mediterranean Coastal Landscape: A Case of İzmir. *Turkey Journal of Coastal Research, 29, Issue 2,* 301 – 310.

are 500-meter buffer zones for distributed heat for a specific region in İzmir including the sub-demo sites[18].

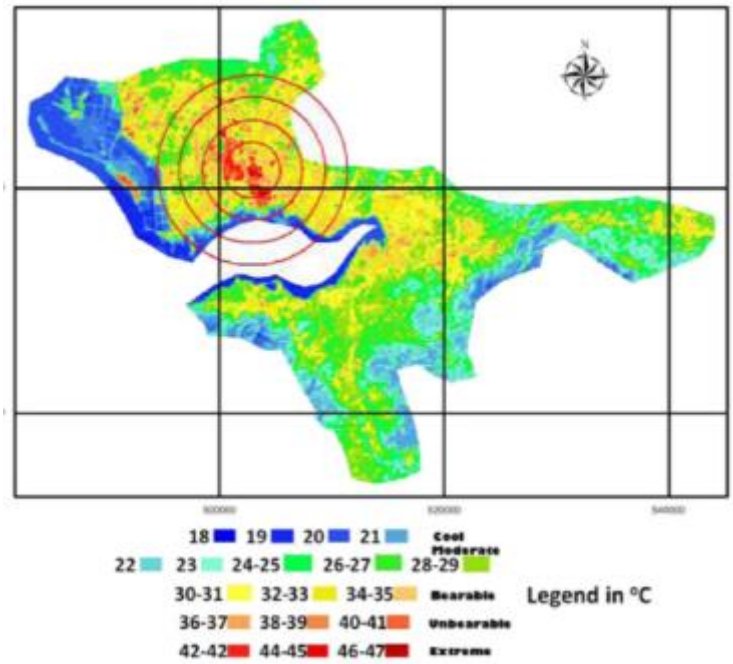

Figure 3-11: Distributed heat island effect in the city of Izmir (Source: Asri & Çorumluoğlu, 2015)

İzmir's 1/25.000 scaled Urban Structure Plan indicates greenbelt around the city's highly urbanized coastal districts. The intention of constructing the greenbelt is still endangered due to the uncontrolled urban sprawl including the demo sites. This also creates greater pressures for in-situ nature protection sites. For instance, the coastal marshes on the eastern part of the Gediz delta decreased by more than 40% during the 42 years period and were reclaimed by built-up areas where the Karşıyaka and Mavişehir districts are located today[19](Figure 3-12). Therefore, wetland protection (except from Ramsar Area) should be vital for the future of the Sasalı region.

[18] Asri, İ., & Çorumluoğlu, Ö. (2015). The effect of urban heat island on İzmir's city ecosystem and climate. *Environ Sci Pollut Res 22:*, 3202–3211.

[19] Hepcan, Ş., Coşkun Hepcan, Ç., Kılıçaslan, Ç., Özkan, M., Koçan, N., & s. (2013). Analyzing Landscape Change and Urban Sprawl of a Mediterranean Coastal Landscape: A Case of İzmir. *Turkey Journal of Coastal Research, 29, Issue 2,*, 301 – 310.

Figure 3-12: Need for renaturing: First nature vs second nature (Source: Atlas Magazine, 2013)

A study illustrating the changes in central parts of the Karşıyaka district (including sub-demo I) indicates that in the year of 1995, while built-up areas was covering 60.50 % of the urban development zone, natural urban green areas and designated or man-made urban green areas occupied 31.03 % and 8.46 % respectively. Within a 19-year period, built-up area increased up to 78.85 % at the expanse of natural green areas in the urban development zone. What was experienced was mostly an infill development. In this period, natural green areas showed a dramatic change and decreased up to 11.07 %. Some parts of the coastal marshes of Gediz delta in the western part of the district were converted into built-up areas[20] (Figure 3-13).

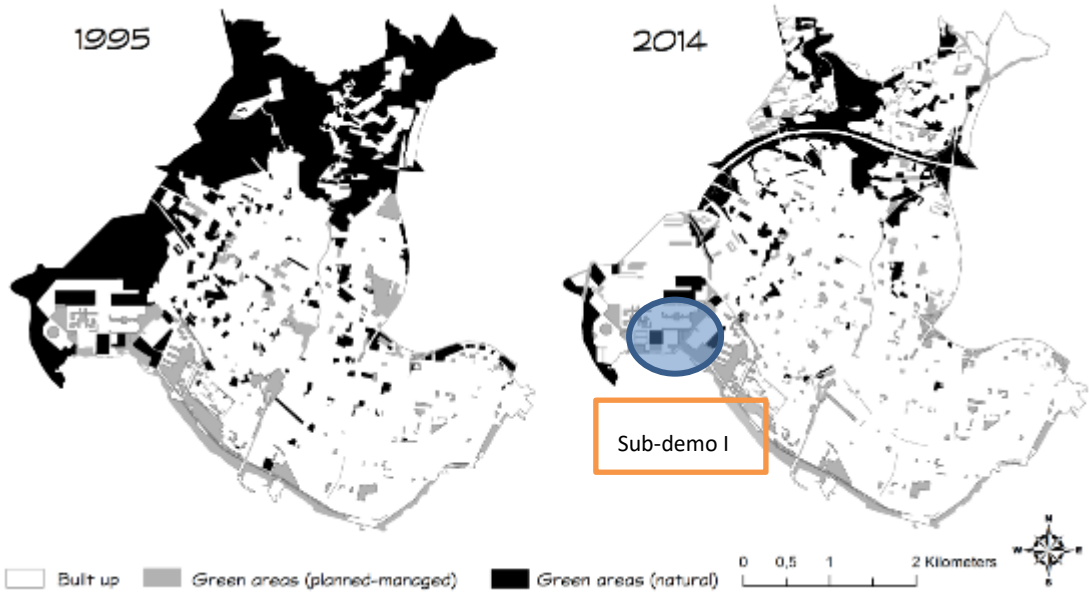

Figure 3-13: Changes of urban green spaces between 1995 and 2014 including sub-demo I (Source: Coskun Hepcan & Hepcan Ş., 2016)

[20] Coskun Hepcan, C., & Hepcan, Ş. (2016). Structural Analysis of Urban Green Spaces in The Karşıyaka District. *Peyzaj Analizi Çalıştayı* . Adana.

Losing coastal marshes and destruction of natural stream systems in particular cripple the storm water retention capacity. That results in a lot of flooding and contamination of aquatic systems. İzmir is surrounded by largely barren hills and mountains with high atmospheric activity and highly mobile depression systems. Although a decrease in yearly rainfall has been seen, the irregular nature of this fall has created grave consequences in İzmir as can be seen in the floods of 1995 in Karşıyaka district, with 63 fatalities.

Another negative impact of dense urbanization path of the central city is increasing air pollution problems. Findings of a recent academic study illustrating air pollution covering Çiğli district stated that the presence of the industrial zone, the form of fossil fuels (coal or natural gas) used in heating, and topography are the strong determinants urban air pollution[21].

- **Agricultural Sector in İzmir**

Share of agricultural sector in İzmir Province's economy is relatively low as compared to the other sectors. Share of agriculture in the Gross Domestic Product (GDP) also displays some reduction by years in the province of İzmir as well as in Turkey in general. İzmir Province alone constitutes approximately 50% of the GDP of the Aegean region and 7% of that of Turkey[22].

In this section, all the figures and percentages quoted for Izmir represents the values calculated for the jurisdiction area of Izmir City, which is one of the eight cities in Aegean Region of Turkey (Figure 3-14).

Figure 3-14: Map of the Aegean Region showing the eight included provinces

When it is examined in terms of Gross Value Added (GVA), the Aegean Region made a contribution of added value of 13.7% to the national economy in 2011. In the same year, İzmir Province's share in the Aegean Region's GVA was 48.3% while it was 6.6% in Turkey's total GVA. According to these

[21] Ozcan, N., & Cubukcu, K. (2014). Evaluation of Air Pollution Effects on Asthma Disease: The case of İzmir. *Procedia - Social and Behavioral Sciences 202*, 448 – 455.

[22] OECD. (2006). *Competitive Cities in the Global Economy, OECD Publishing.*

results, İzmir occupies the third place next to İstanbul and Ankara in terms of the added value created. Of the total GVA generated in İzmir Province in 2011, 67.7% was achieved by the industry, 26.9% by the service and 5.4% in the agricultural sectors. Seven percent of the industrial GVA achieved in our country, 6.5% of the service sector GVA and 4% of the agricultural sector GVA was achieved in İzmir Province.

In İzmir Province, agricultural sector made a contribution of 4% to the total agricultural GVA and a contribution of 22,2% to the Aegean Region's agricultural GVA in 2011. Aegean Region has a share of 18% in the total agricultural GVA of Turkey. The fact that the agricultural production capacity of the Aegean Region is high also makes some contribution to the fact that İzmir City, which is the exports centre of the region further becomes an agricultural trading and exporting centre[23].

- **Structure of agricultural businesses**

The general structure of agricultural businesses is unfortunately small-sized family businesses at the brink of subsistence and semi-subsistence. While the average size of an agricultural business is 6,1 hectares in our country, this average is 16,7 hectares in the EU and is 2,7 times higher than Turkey's average. And this value is lower than Turkey's average and is 3,7 hectares in İzmir Province.

- **Land Assets of Izmir Province**

Total area of Izmir province is 1.201.478 hectares. The city divided into 30 sub-regions. Besides its fertile agricultural areas, hills and mountainous areas cover 60% of Izmir province[24].

In the distribution of land use, a share of 59.9% is covered by agricultural areas, 30.5% by forested and wooded areas, 0.6% by pastures, 0.4% water body and the remaining 8.6 % by settlement areas (Table 3-4, Figure 3-15Figure 3-16).

A Usage Form of Land	Area (ha)
Settlement	103666.57
Pasture	7380.73
Waterbody	4288.56
Forest	366,245.64
Agricultural Lands	719896.05
Total	1,201,477.55

Table 3-4: Distribution of the land use types of Izmir Province (Source: IPPA, 2013)

[23] ICE. (2013). *İzmir Commodity Exchange Publishing.*

[24] IPPA. (2013). *İzmir Land Assets, Izmir Provincial Private Administration Publishing.*

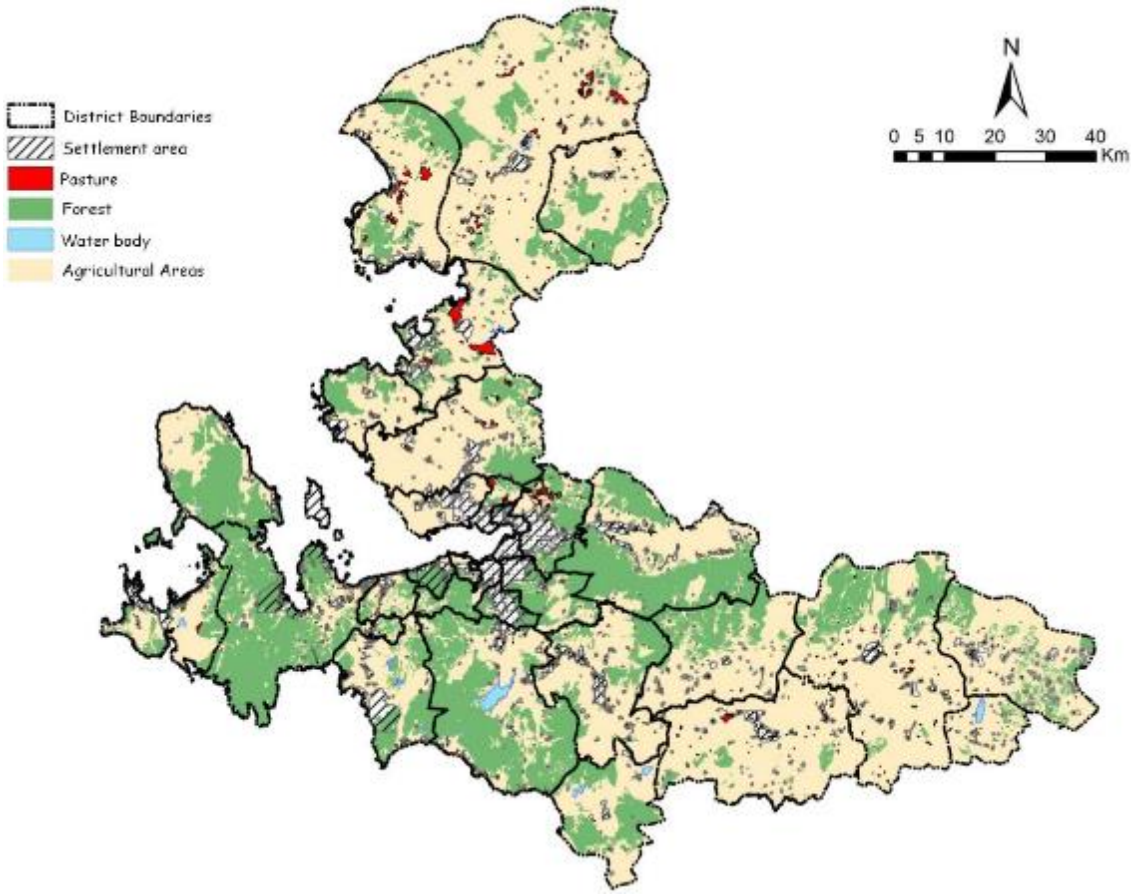

Figure 3-15: Land use types of Izmir Province (Source: IPPA, 2013)

İzmir province has 352.148 hectares fertile agricultural lands that cover only 29.3% percent of total lands. These lands except for forest, water body, pasture and residential areas were classified under four groups according to the criteria specified in Land Use and Protection Law (Table 3-5, Figure 3-16, Figure 3-17).

Land Use Type	Area (ha)
High Grade Agricultural Lands	172.651
Moderated Agricultural Lands	14.940
Marginal Agricultural Lands	365.686
Orchards + Vineyard + Olive grove	164.557
Total	717.835

Table 3-5: Classes of agricultural lands of Izmir Province (Source: IPPA, 2013)

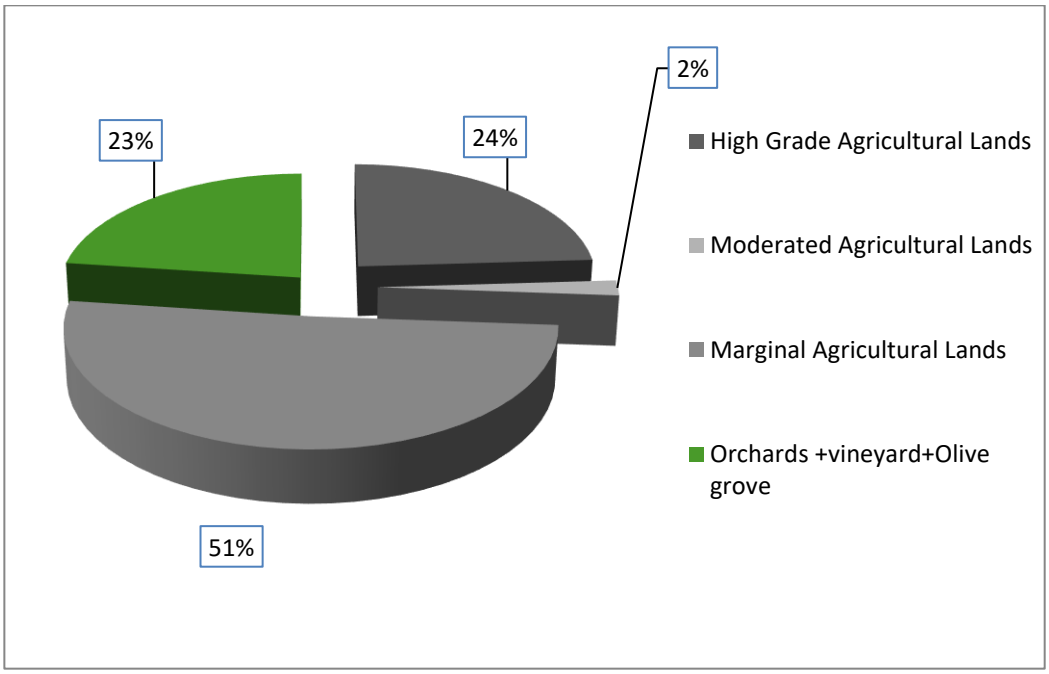

Figure 3-16: Proportional representation of agricultural land in Izmir Province (Source: IPPA, 2013)

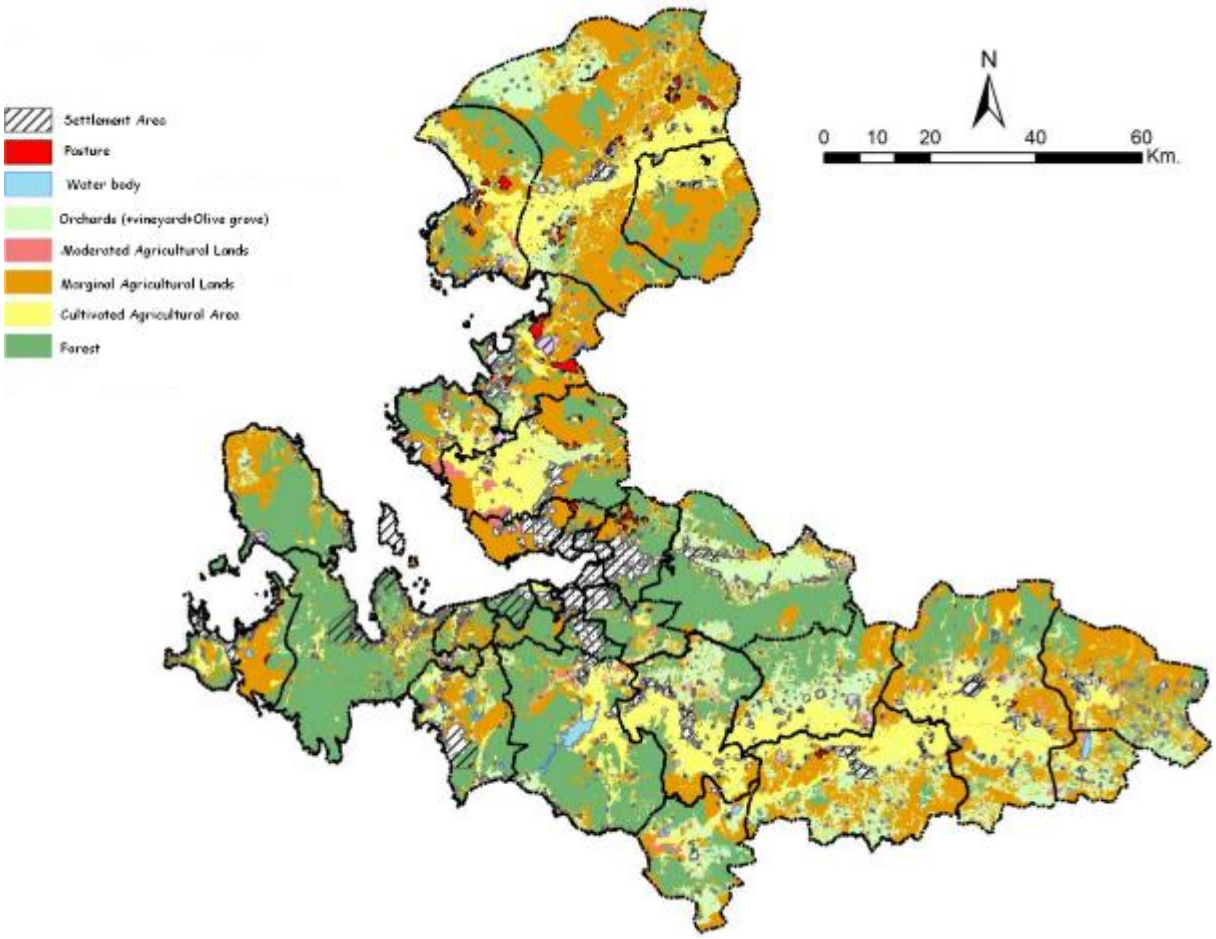

Figure 3-17: Classification map of agricultural area in Izmir Province (Source: IPPA, 2013)

- **Lands Use Capability Classes of Province Izmir**

Land use capability classification is a kind of multi parameter evaluation of soil and land properties. Lands are divided into 8 classes according to their land use suitability within this classification method. Soil and land properties, such as degree of slope, stoniness, drainage conditions, salinity, alkalinity, soil deepness, texture, structure etc. were evaluated for determining Land use capability of soils. According to this classification, 1st class soils can be used for any type of the crop pattern cultivation taking into consider climate of the region. Class VIII lands are unsuitable for agricultural production, while classes VI and VII are generally suitable for olive grove, pastoral or forestry uses. As the land class numbers increase, the soil limits also increase.

İzmir province's lands has been examined under eight groups of land use capability classes (LUCC). It is determined that VII. class lands have the largest area (53.48%) on the contrary I. and II. classes fertile agricultural lands (total %19,34) in İzmir province. Also, VI and IV class lands that not available enough for agricultural proposes, are totally 17 % of İzmir province. Results show that most land of the Izmir province is not available using for agricultural purposes. The scarcity of agricultural land requires their planned use and protection (Table 3-6, Figure 3-18, Figure 3-19)[25].

Land Use Capability Classes	Area (ha)
I	108712,42
II	111588,13
III	63010,35
IV	47155,37
V	510,41
VI	156044,82
VII	642518,53
VIII	11542,06
Water body	4288,56
Settlement	56106,90
General Total	1.201.477,55

Table 3-6: Areas of Land Use Capability Classes of Izmir Province (Source: IPPA, 2013)

[25] IPPA. (2013). *İzmir Land Assets, Izmir Provincial Private Administration Publishing.*

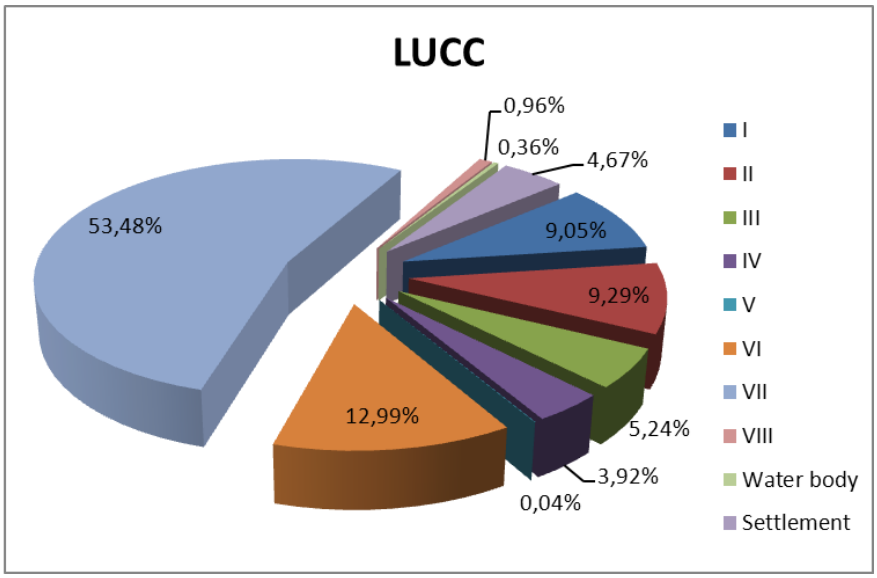

Figure 3-18: Proportional representation of Land Use Capability Classes of Province Izmir (Source: IPPA, 2013)

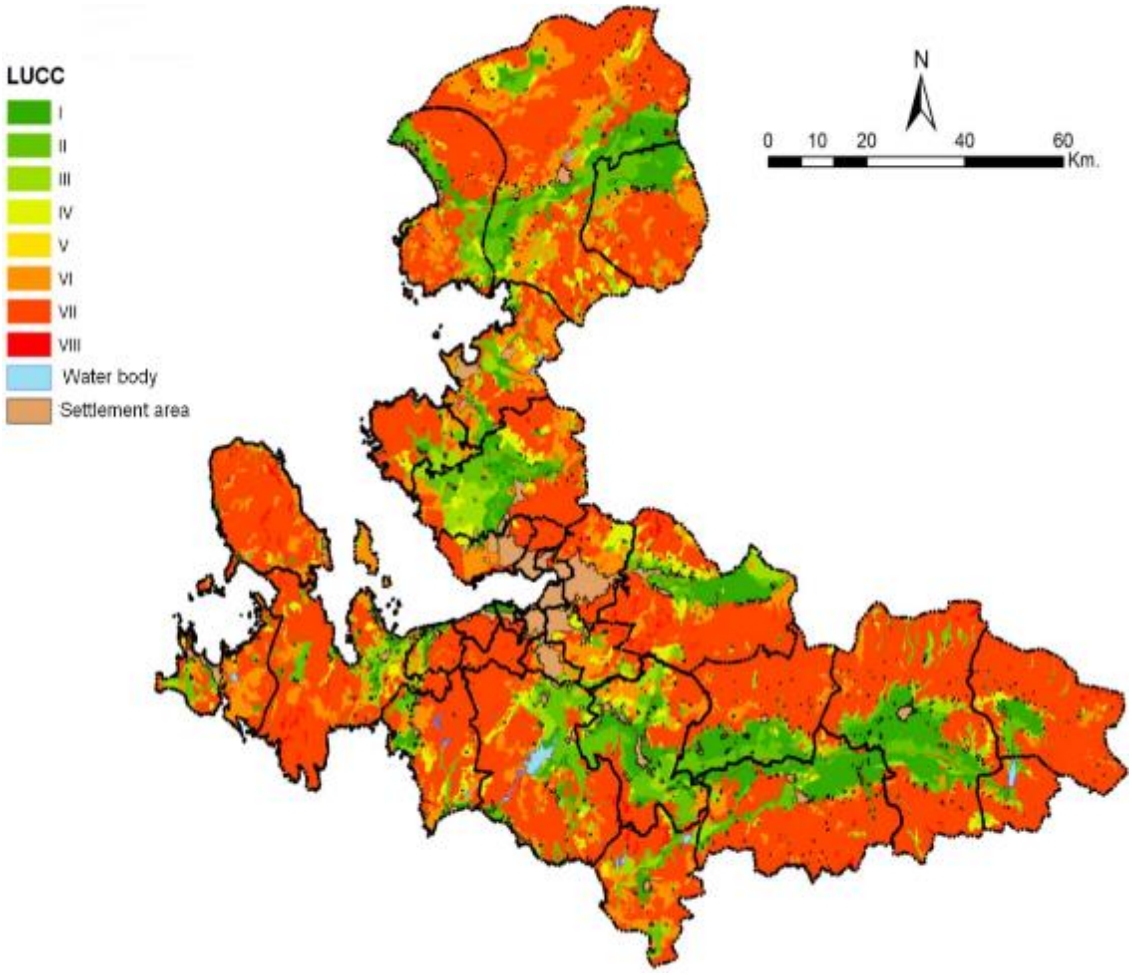

Figure 3-19: Map of land use capability classes of Izmir province (Source: IPPA, 2013)

- **Cooperative Structure**

There are total of 310 cooperatives operating for agricultural purposes, consisting of 163 agricultural development cooperatives, 100 irrigation cooperatives and 47 sea food cooperatives in İzmir Province. Number of the members of these cooperatives is approximately 41.160. Within the growers' associations which are another type of organization, there are 26 associations and 2.746 members on the basis of various productions[26].

3.2. Climate resilience

3.2.1. Introduction to climate resilience

There is no doubt that climate change and global warming are the biggest threats to the planet earth today. IPCC Fourth Assessment Report (AR4) discloses that the global climate system is undoubtedly warming. Observations have shown that many natural systems, including hydrologic systems and water resources, are being affected by regional climate changes, particularly temperature increases[27].

Due to climate change, hundreds of millions of people in European cities and in most of the world will experience rising sea levels, inland floods, more frequent and intense storms, and more frequent periods of extreme heat and cold in the coming years[28].

According to the report of UN-Habitat 2009, different challenges are being faced by many cities these days, including the lack of green development ratio to the built environment. Accordingly, a comprehensive set of green policies and strategies (e.g. distributed green infrastructure strategies, renewable energy and carbon-neutral strategies, etc.) has been indicated to be used for filling the gap between urban and green development toward a higher resilience and adaptability to climate change"[29].

Cities are a large source of carbon emissions. Therefore, local action is becoming increasingly important[30]. For example, the European Commission's Covenant of Mayors obliges European cities to establish an Action Plan to reduce their carbon emissions by over 20%, including by using NBS and through the sustainable management of green space[31].

[26] IDPFAL. (2013). *İzmir Directorate of Provincial Food Agriculture and Livestock.*

[27] Ozkul, S. (2009). Assessment of climate change effects in Aegean river basins: the case of Gediz and Buyuk Menderes Basins. *Climatic Change (2009) 97:*, 253–283

[28] World Resources Institute. (2017, July 17). *Urban Climate Resilience.* Retrieved from World Resources Institute: http://www.wrirosscities.org/our-work/topics/urban-climate-resilience

[29] Motazedian, A., & Leardini, P. (2012). Impact of green infrastructures on urbanmicroclimates. . *Acritical review,46th Annual Conference of the Architectural Science Association (ANZAScA),.* Griffith University, Gold Coast

[30] UNFCCC. (2016). *Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015.* http://unfccc.int/resource/docs/2015/cop21/eng/10.pdf.

[31] COM. (2017). *COM*. Retrieved from http://www.covenantofmayors.eu/index_en.html

Climate resilience is based on two interacting concepts: “adaptation”, that is the capacity to react and respond to an external stimulus or stress such as climate change, and “mitigation”, that is the potential of improving the current status of a parameter or driver through active or passive behaviour, in this case through reducing greenhouse gas emissions or sequestering carbon ([32];[33]). Action on climate mitigation can span the micro level of a single building**,** the meso-level of the whole city or country and the macro level of the entire planet[34].

Urban heat islands are a new type of microclimatic phenomenon that causes a significant increase in temperature of cities as compared to surrounding areas. Green urban areas have environmental and physical impacts on indicators such as air temperature, measures of human comfort, air quality, health risks and energy consumption ([35];[36];[37]). Higher summer temperatures in cities result extra energy consumption for cooling season. Increased cooling energy consumption increases greenhouse gases which is the reason of global warming. Besides energy consideration, high temperatures may also increase health risks and atmospheric pollution. This report provides a general overview of indicators in İzmir.

3.2.2. The case of Izmir

Turkey is no different than other European countries in terms of factors that threaten the quality of life in urban areas. Cities in Turkey have been experiencing many of the aforementioned problems such as high air pollution, urban heat islands, hotter summers, extreme drought seasons, frequent flooding, decreasing surface waters and ground water tables. Furthermore, the lack of climate sensitive approaches in relevant city policies and action plans can be added to these problems.

İzmir has a hot Mediterranean/ dry-summer subtropical climate (Köppen-Geiger classification: Csa) that is mild with moderate seasonality. The World Map of Köppen-Geiger climate classification is given in Figure 3-20[38]. Summers are dry and hot due to the domination of

[32] Van Vuuren, D., Isaac, M., Kundzewicz, Z., Arnell, N., Barker, T., Criqui, P., . . . Scrieciu, S. (2011). The use of scenarios as the basis for combined assessment of climate change mitigation and adaptation. *Glob. Environ. Chang. 21,*, 575–591

[33] Calfapietra, C., Niinemets, Ü., & Peñuelas, J. (2015). Urban plant physiology: Adaptation-mitigation strategies under permanent stress. *Trends Plant Sci. 20,* , 72–75

[34] Raymond, C., Berry, P., Breil, M., Nita, M., Kabisch, N., de Bel, M., . . . Calfapietra, C. (2017). *An Impact Evaluation Framework to Support Planning and Evaluation of Nature-based Solutions Projects.* Wallingford, UK: EKLIPSE Expert Working Group on Nature-based Solutions to Promote Climate Resilience in Urban Areas, Centre for Ecology & Hydrology

[35] Yu, C., & Hien, W. (2006). Thermal benefits of city parks. *Energy Build. 38 (2),*, 105-120.

[36] Tiwary, A., Sinnett, D., Peachey, C., Chalabi, Z., Vardoulakis, S., Fletcher, T., . . . Hutchings, T. (2009). An integrated tool to assess the role of new planting in PM10 Capture and the human health benefits: a case study in London. *Environ. Pollut. 157*, 2645-2653

[37] Cameron, R., Blanusa, T., Taylor, J., Salisbury, A., Halstead, A., Henricot, B., & Thompson, K. (2012). The domestic garden and its contribution to urban green infrastructure. *Urban For. Urban Green. 11 (2),* 129-137

[38] *Koppen Geiger*. (2017). Retrieved from http://koeppen-geiger.vu-wien.ac.at/shifts.htm

subtropical high pressure systems while winters experience moderate temperatures and changeable, rainy weather due to the polar front. These climates usually occur on the western sides of continents between the latitudes of 30° and 45°. Vegetation is adapted to the dry summers and is fragrant and oily making it susceptible to fire. The typical Mediterranean climate average monthly temperatures in excess of 22°C in its warmest month and an average in the coldest month between 18 to -3 °C with at least four months above 10 °C[39].

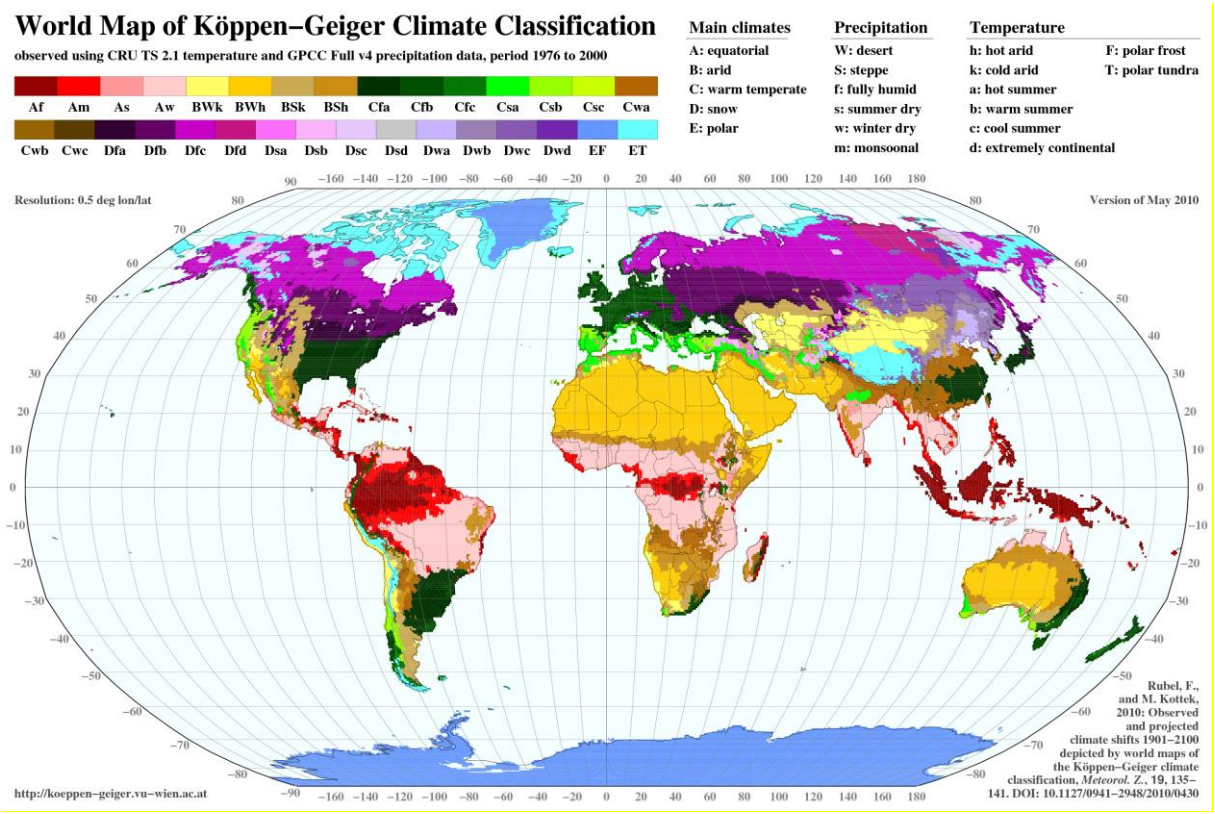

Figure 3-20: World Map of Köppen-Geiger climate classification calculated from observed temperature and precipitation data for the period 1976-2000 on a regular 0.5 degree latitude/longitude grid (Source: Koppen Geiger, 2017).

Based on 78-year data collected between 1938 and 2016 by Turkish State Meteorological Service, average annual temperature of Izmir is 17.9°C. The average heating season (November-April) temperature is measured as 11.6°C whilst the average maximum and minimum temperatures are 15.9 and 8.1°C, respectively. During cooling season (May–October), the average, maximum and minimum temperatures are 24, 29.2 and 18.8°C, respectively[40]. The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) shows that the global mean

[39] Rubel, F., & Kottek, M. (2010). Observed and projected climate shifts 1901-2100 depicted by world maps of the Köppen-Geiger climate classificatio. *Meteorol. Z., 19* , 135-141

[40] *MGM*. (2017). Retrieved from https://mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=A&m=IZMIR

surface temperature has risen by 0.74°C over a period of 1906–2005[41]. The monthly average, maximum and minimum average temperatures of Izmir between 1981 and 2010 are presented in Figure 3-21.

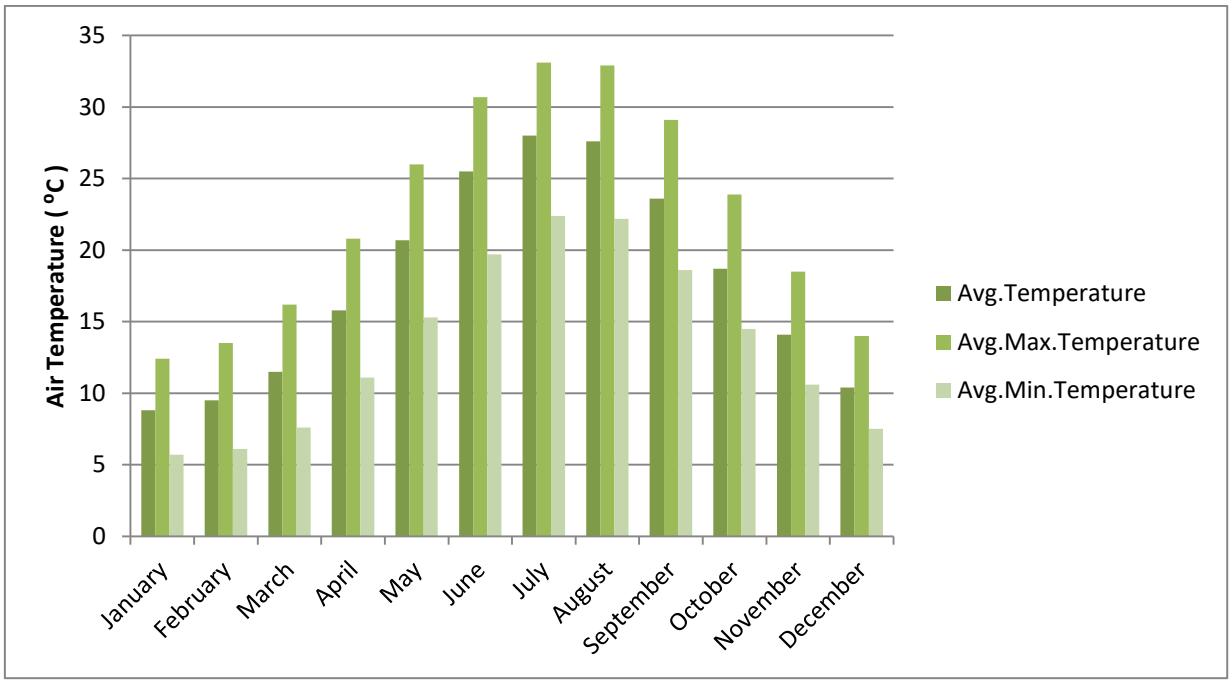

Figure 3-21: Monthly average, maximum and minimum average temperatures of Izmir (Source: MGM, 2017)

Minimum and maximum temperatures encountered in Izmir between 1938 and 2016 are given in Table 3-7 June, July, August and September are the months that the temperatures over 40°C are recorded with a highest 43°C in August.

IZMIR	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Max. temperature (°C)	22.4	23.8	30.5	32.1	37.5	41.3	42.6	43.0	40.1	36.0	29.0	25.2
Min. temperature (°C)	-4.0	-5.0	-3.1	0.6	7.0	10.0	16.1	15.6	12.9	5.7	0.0	-2.7

Table 3-7: Monthly average, maximum and minimum average temperatures of Izmir (Source: MGM, 2017)

[41] Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K., . . . Miller, H. (2007). Observations: surface and atmospheric climate change - Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on climate change. *Climate change 2007: the physical science basis.* Cambridge/New York: Cambridge University Press

In Izmir, annual cooling loads are generally greater than annual heating loads ([42];[43]) and tend to increase because of the climate change. Demir et al. (2007) projected that 6-7°C increase in average outdoor temperature is expected in summer months for the time period of 2071-2100. In a study by[44], annual cooling energy loads for 2012, 2020, 2050 and 2080 using the UK Handley Centre's third generation coupled atmosphere–ocean global climate model (HadCM3) in low-rise apartment buildings were investigated for Izmir. Simulation results for the 2020s, 2050s, and 2080s indicate an increasing trend in annual cooling energy loads and a reduction in heating requirements. The annual cooling energy loads are more than 2.5 times the annual heating loads in the 2020s, 4.5 times in the 2050s, and 7 times in the 2080s. The high differences between annual heating and cooling energy loads may be due to the future global warming. In other words, the annual mean temperature will increase approximately 4 °C and the solar radiation will increase only 5% but the relative humidity will decrease 10% by the 2080s in Izmir.

TEMA Foundation (The Turkish Foundation for Combating Soil Erosion, for Reforestation and the Protection of Natural Habitats) summarized some impacts of climate change over different sectors in Ege Region that includes the city of İzmir; agriculture production has dropped because of temperature anomalies, hotter summer and unexpected fluctuations in seasons started to be very often, severe droughts resulted in extinction of species including fish species, and loss of biodiversity has accelerated because of increasing temperature of seawater, hotter summers causes respiratory health problems due to increasing AC uses, considerable increases happened on ground water consumption during long and dry summers[45].

It is important to mention that Turkey lies in a region that is highly vulnerable to climate change. The future climate change projections agree on an increase in temperatures throughout the country and a reduction in precipitation in the southern half of the country[46]. In other words, climate change will eventually effect hydrology and water resources at regional and local levels[47].

The projections that were based on the high emissions scenarios indicate potential water reductions up to 37% in the Mediterranean basins. The decline in the water resources will, first and foremost, influence the agriculture, animal husbandry and the related sectors. Hydroelectric

[42] Tavil, A. (2005). Window System Design and Selection for Energy Conservation in Turkey. *The 2005 World Sustainable Building Conference,*. Tokyo

[43] Kazanasmaz, T., Erlalelitepe, İ., Akkurt, G., Turhan, C., & Ekmen, K. (2014). On the relation between architectural considerations and heating energy performance of Turkish residential buildings in Izmir. *Energy and Buildings, 72*, 38-50

[44] Yıldız, Y., Korkmaz, K., Göksal, Ö., & Durmuş, A. (2014). An approach for developing sensitive design parameter guidelines to reduce the energy requirements of low-rise apartment buildings. *Applied Energy, 93*, 337-342

[45] TEMA. (2015). *TEMA*. Retrieved from İklim Değişikliğinin Yerel Etkileri Raporu: http://sertifika.tema.org.tr/_Ki/CevreKutuphanesi/Documents/Iklim-Degisiklik-Yerel-Etkileri-Rapor-Kitapcigi.pdf

[46] Şen, O. (2013). Turkiyede Iklim Degisikligi Butunsel Resmi. *III. Turkiye Iklim Degiskligi Kongresi.* İstanbul: TİKDEK

[47] Ozkul, S. (2009). Assessment of climate change effects in Aegean river basins: the case of Gediz and Buyuk Menderes Basins. *Climatic Change (2009) 97:*, 253–283

energy production is another sector that will be affected negatively[48].

Gediz basin is very relevant to the city of Izmir because Gediz delta and the Karşıyaka district will closely be affected by changes in the Gediz basin. In the study that examined the Gediz basin, simulation results of the water budget model have shown that nearly 20% of the surface waters in Gediz and Büyük Menderes basins will be reduced by the year 2030. By the years 2050 and 2100, this percentage will increase up to 35 % and more than 50 %, respectively[49].

Apart from these challenges, another issue that needs to be addressed is poor bioclimatic comfort conditions in İzmir. (Kestane & Ülgen, 2013) stated that most of the residential areas in İzmir are not appropriate for bioclimatic comfort such as Konak and Alsancak[50].

In terms of air quality and temperature, Izmir is not geographically very lucky because central settlements of Izmir are surrounded by hills and mountains that form a physical barrier against incoming airflows and winds. This barrier prevents dirty and hot air from being swept away by airflows and winds from the city[51].

Izmir presents somewhat negative picture because CO_2 emission per capita in Izmir is 5.31 ton per year[52]. Additionally, 41.66 μ/m^3 PM10, 10.75 μ/m^3 SO_2 and 753.91 μ/m^3 CO pollutant emissions were measured in the Bornova district of the city of İzmir. The air pollution data, which include monthly concentrations of SO_2, NO_2, and Particulate Matter (PM10) of İzmir for 2016, was obtained by Ministry of Environment and Urbanization[53].

That is for sure that urban green areas can play very important roles in mitigating the effects of climate change, such as reducing the carbon emissions. To be able prove the value of green areas in carbon sequestration, a study was undertaken in one of the central districts of Izmir, Bornova. Housing campus of Ege University is one of the largest and the most intact urban green patches in the Bornova district. The results revealed that tree and shrub canopy covers 48.3 % of the campus. While about 321.57 tons of Carbon Dioxide was sequestered annually, 8107.86 tons of CO_2 was stored by plants. In addition, it was calculated that these plants removed about 28.70 kg of Carbon Monoxide (CO), 143.85 kg of Nitrogen Dioxide (NO_2), 1.58 tons of Ozone (O_3), 90.6 kg of Sulfur Dioxide (SO_2), 69.61 kg PM2.5 and 479.90 kg PM10 particulate matter per year[54].

[48] Şen, O. (2013). Turkiyede Iklim Degisikligi Butunsel Resmi. *III. Turkiye Iklim Degiskligi Kongresi.* İstanbul: TİKDEK

[49] Ozkul, S. (2009). Assessment of climate change effects in Aegean river basins: the case of Gediz and Buyuk Menderes Basins. *Climatic Change (2009) 97:*, 253–283

[50] Kestane, O., & Ülgen, K. (2013). İzmir İli İçin Biyoklimatik Konfor Bölgelerinin Belirlenmesi. *Journal of Technical Sciences 2013 3 (5)* , 18-25

[51] Koçman, A. (1991). İzmir'in kentsel gelişimini etkileyen doğal çevre faktörleri ve bunlara ilişkin sorunlar. *Atatürk Kültür Dil ve Tarih Yüksek Kurumu Coğrafya Araştırmaları Dergisi, 3,*, 101-122

[52] İzmir Metropolitan Municipality. (2016). *Sustainable Energy Action Plan.* İzmir

[53] MEU. (2016). *Air Pollutant Report.* Ankara: Ministry of Environment and Urbanization

[54] Coskun Hepcan, C., & Hepcan, S. (2017). Assessing Air Quality Improvement as a Regulating Ecosystem Service in the Ege University Housing Campus . *Ege Üniv. Ziraat Fak. Derg., 54*, 113-120

- **Measures of Human Comfort**

Green urban areas play a sufficient role to achieve the thermal comfort by reducing the air temperature in cooling season. (Yu & Hien, 2006) showed that the temperature gradually increases when moving further away from the green zone[55]. The authors measured the maximum average temperature difference between a green zone and 400 m away from the green zone as 1.3°C and concluded that the green areas help to improve the thermal comfort of people.

The Physiological Equivalent Temperature (PET) is a thermal comfort index derived from the human energy balance and is preferable to other thermal comfort indices such as Predicted Mean Vote (PMV) because of its unit (°C). Table 3-8 shows the ranges of the most common thermal comfort index PMV and PET[56].

PMV (-)	PET (°C)	Thermal Sensation
-2.5	8	8<PET<13 Cool 13<PET<18 Slightly cool 18<PET<23 Comfortable 23<PET<29 Slightly warm 29<PET<35 Warm
-1.5	13	
-0.5	18	
0.5	23	
1.5	29	
2.5	35	

Table 3-8: Ranges of the thermal indexes predicted mean vote (PMV) and physiological equivalent temperature (PET) (Source: Mayer & Matzarakis, 1997).

Calculation of the thermal conditions of the body with The Munich Energy Balance Model for individuals (MEMI) for a given combination of meteorological parameters in Eqn. (1).

$$M + W + R + C + E_D + E_{Re} + E_{Sw} + S = 0 \quad (1)$$

Where, M the metabolic rate (internal energy production), W the physical work output, R the net radiation of the body, C the convective heat flow, E_D the latent heat flow to evaporate water diffusing through the skin (imperceptible perspiration), E_{Re} the sum of heat flows for heating and humidifying the inspired air, E_{Sw} the heat flow due to evaporation of sweat, and S the storage heat flow for heating or cooling the body mass. The individual terms in this equation have positive signs if they result in an energy gain for the body and negative signs in the case of an energy loss (M is always positive; W, E_D and E_{sw} are always negative). The unit of all heat flows is in Watt[57].

(Puliafito, Bochaca, Allende, & Fernandez, 2013) measured the meteorological parameters in the city of Mendoza/Argentina and calculated the PET Indexes for various urban areas using Rayman

[55] Yu, C., & Hien, W. (2006). Thermal benefits of city parks. *Energy Build. 38 (2),*105-120

[56] Mayer, H., & Matzarakis, A. (1997). The urban heat island seen from the angle of human-biometeorology. In: Proceedings of the International Symposium on Monitoring and Management of the Urban Heat Island. *Fujisawa*, 84–95

[57] Höppe, P. (1999). The physiological equivalent temperature – a universal index for the biometeorological assessment of the thermal environment. *Int J Biometeorol 43*, 71–75

Software V. 1.2[58]. The authors determined that the green areas had at least 2-4°C lower PET values. Similarly, it is investigated the effect of green areas on thermal comfort in Florence, Italy and proven that the green areas increase the thermal comfort by 10%[59].

Although, there exist sufficient number of studies in the literature for various countries, only a few studies on the effect of green areas on thermal comfort were conducted in Turkey to the authors knowledge. Çınar et al. (2016) investigated PET values on green areas in Fethiye/Turkey. PET values on the green areas, during July and August in Fethiye were lower than the ones in open urban spaces during the day time. Similarly, it is compared the PET values of green areas and the main streets in Erzurum/Turkey. The authors obtained lower PET values on green areas than the streets[60].

Besides the studies in other cities above, no studies were found on the effect of green areas on thermal comfort in Izmir Region. The thermal comfort indices such as PET and Predicted Mean Vote (PMV) must be measured and observed both on green areas and the other zones in Izmir.

- **Heatwave Risks**

An increased number of heat-related illnesses and deaths caused by heatwave episodes (i.e., extremely hot environments) have been noted in recent years ([61];[62];[63];[64];[65];[66]). Table 3-9 shows the heatwave regions and resultant health risks[67].

[58] *MIFUNI*. (2017). Retrieved from http://www.mif.uni-freiburg.de/rayman/download.htm

[59] Petralli, M., Brandani, G., Napoli, M., & Massetti, L. (2015). Thermal comfort and green areas in Florence. *Italian Journal of Agrometeorology 20(2)*, 39-48

[60] Yılmaz, H., Yıldız, N., Avdan, U., Koç, A., & Matzarakis, A. (2015). Analysis of human thermal conditions in winter for different urban structures in Erzurum. *9th International Conference on Urban Climate jointly with 12th Symposium on the Urban Env*

[61] Kenney, W., Craighead, D., & Alexander, L. (2014). Heat waves, aging, and human cardiovascular health. *Medicine & Science in Sports & Exercise, 46(10)*, 1891-1899

[62] Åström, D., Forsberg, B., & Rocklöv, J. (2011). Heat wave impact on morbidity and mortality in the elderly population: A review of recent studies . *Maturitas, 69 (2)*, 99-105

[63] Abrahamson, V. W., Lorenzoni, I., Fenn, B., Kovats, S., Wilkinson, P., Adger, W., & Raine, R. (2011). Perceptions of heat wave risks to health: interview-based study of older people in London and Norwich, UK. *J. Public Health, 31*, 119-126

[64] Berrang-Ford, L., Ford, J., & Paterson, J. (2011). Are we adapting to climate change? *Global Environ. Change, 21:*, 21-33

[65] Semenza, J., Rubin, C., Falter, K., Selanikio, J., Flanders, W., Howe, H., & Wilhelm, J. (1996). Heat-Related Deaths during the July 1995 Heat Wave in Chicago. *The New Journal of Medicine*

[66] Knowlton, K., Rotkin-Ellman, M., King, G., Margolis, H., Smith, D., Solomon, G., . . . English, P. (2009). The 2006 California heat wave: impacts on hospitalisations and emergency department visits. *Environ Health Perspect, 117 (1)*, 61-67

[67] Åström, D., Forsberg, B., & Rocklöv, J. (2011). Heat wave impact on morbidity and mortality in the elderly population: A review of recent studies . *Maturitas, 69 (2)*, 99-105

Regions	Year	Health Risks
England and Wales	2003–2006	No increase in risk regarding heat
California, US	2006	Increased rate ratio for heat related illnesses for 65+ years old people
New York City, US	2004	Increase by 4.7% for respiratory causes and by 3.5% for cardiovascular causes above threshold
Adelaide, Australia	2006	Increased risk among elderly during heat waves, higher for females than males

Table 3-9: Some of the studies of the relationship between heat waves and morbidity (Source: Åström, Forsberg, & Rocklöv, 2011)

Izmir is also considered as an important city in the view of heatwave risks and their results such as health problems and thermal discomfort. **¡Error! No se encuentra el origen de la referencia.** depicts the intensive heatwaves and the maximum air temperature of summer months between 1938 and 1998 for Izmir[68].

Intensive Heatwaves			
Months	June	July	August
Times	7	12	11
Maximum air temperature (°C)	41.3	42.6	40.1

Table 3-10: Intensive heatwaves in Izmir (Source: Erlat, 1999)

According to Table 3-10, the heatwaves were occurred 30 times in summer months (June, July and August). The reason of the heatwaves might be the increased in urbanization and global warming.

- **Energy Consumption and Greenhouse Gas Emissions**

According to construction permits given in 2000–2008, almost 80% of buildings are residential, and 80% of the total energy consumption of buildings are for the heating purposes. According to the breakdown of energy use in buildings in Turkey, almost 80% of energy consumption derived from conventional fuel use; thus 75% of energy is used for heating and cooling[69].

Figure 3-22: Sectoral distribution of total electricity consumption in İzmir (Source: İzmir Metropolitan Municipality, 2016).Figure 3-22 gives the sectoral distribution of total electricity consumption in İzmir[70]. Industry and building sectors are responsible from 41% and 40% of electricity consumption.

[68] Erlat, E. (1999). *İzmirde Maksimum Sıcaklıklar ve Sıcak Dalgaları.* İzmir: Ege Coğrafya Dergisi, 10 :125-148

[69] CSB (The Ministry of Environment and Urbanization). (2011). *National Climate Change Action Plan 2011–2023.* Ankara: General Directorate of Environmental Management, Climate Change Department, Policy and Strategy Development Division

[70] İzmir Metropolitan Municipality. (2016). *Sustainable Energy Action Plan.* İzmir

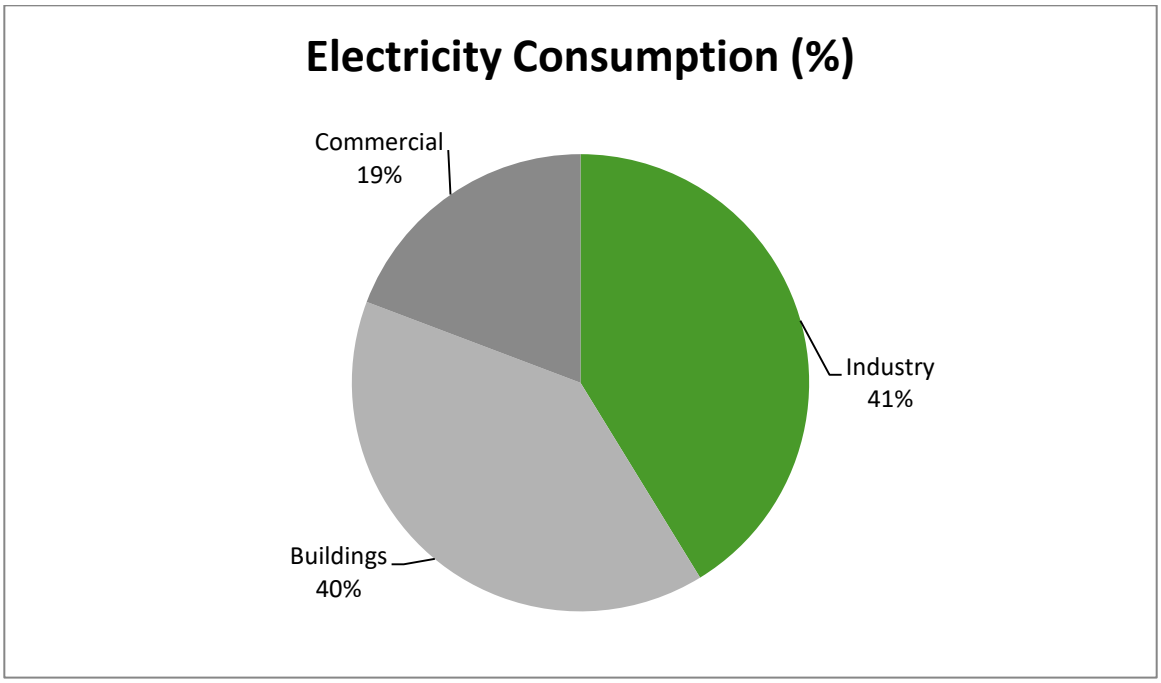

Figure 3-22: Sectoral distribution of total electricity consumption in İzmir (Source: İzmir Metropolitan Municipality, 2016).

Figure 3-23 represents the total electricity consumption of buildings in Izmir (2010-2012)[71]. The Figure indicates that total electricity consumption of buildings was increased by 15% from 2010 to 2012 in Izmir. The reason of increase in electricity consumption could be increase in cooling loads and, increase in air-conditioners and heat pump use.

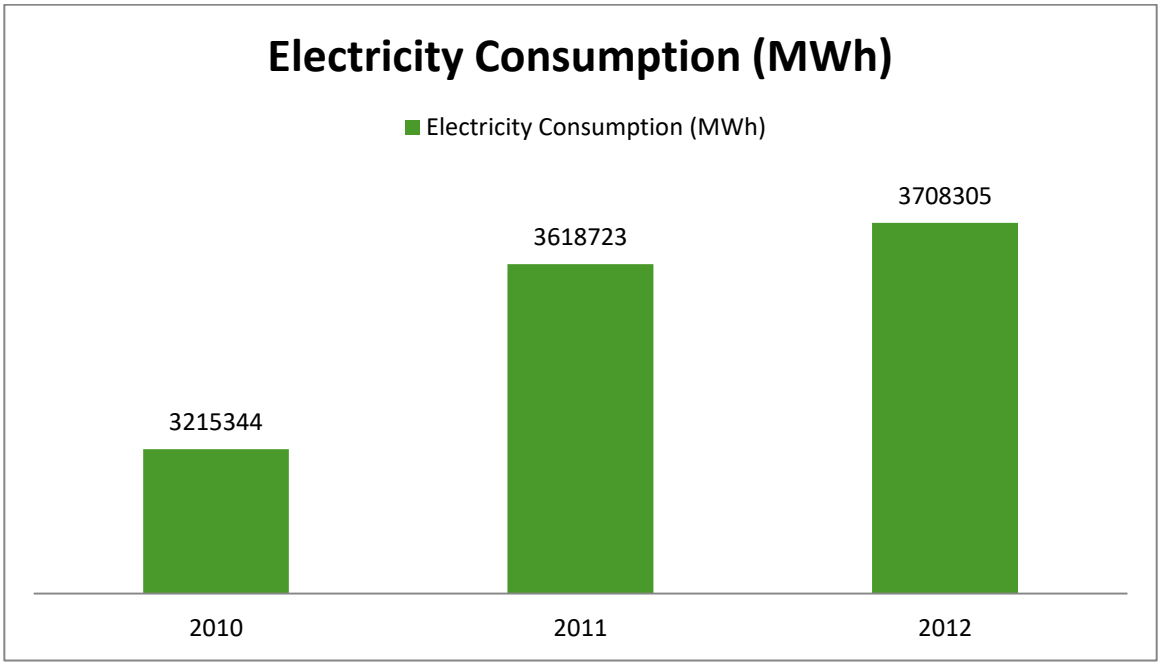

Figure 3-23 Electricity consumption of buildings in Izmir (Source: TUIK, 2013).

[71] *TUIK*. (2013). Retrieved from http://www.tuik.gov.tr/ilGostergeleri/iller/IZMIR.pdf

Figure 3-24 shows the sectoral greenhouse gas emissions of Izmir. The total greenhouse gas (CO_2 + CH_4 + NO_2) emissions of the industry accounts for 44% while buildings are responsible for 12%[72]. The demo sites are located in the vicinity of Çiğli Industrial Zone. Therefore, they are under the effect of both industrial and building effluents. Green urban areas contribute to climate change mitigation by directly removing greenhouse gases from the atmosphere via photosynthetic uptake. Therefore, these values can be decreased by increasing green urban areas.

There is a study about heating energy consumption and related greenhouse gas emissions of 148 multi-storey residential buildings for Konak, Karabağlar and Balçova Municipalities of Izmir[73]. According to the results, heating energy consumption of buildings varied between 100 and 240 kWh/m^2 (Energy Class B-C). Regarding with the CO_2 emissions, 57% of total buildings using autonomous heating system (as coal-fired stove) were in CO_2 Class G.

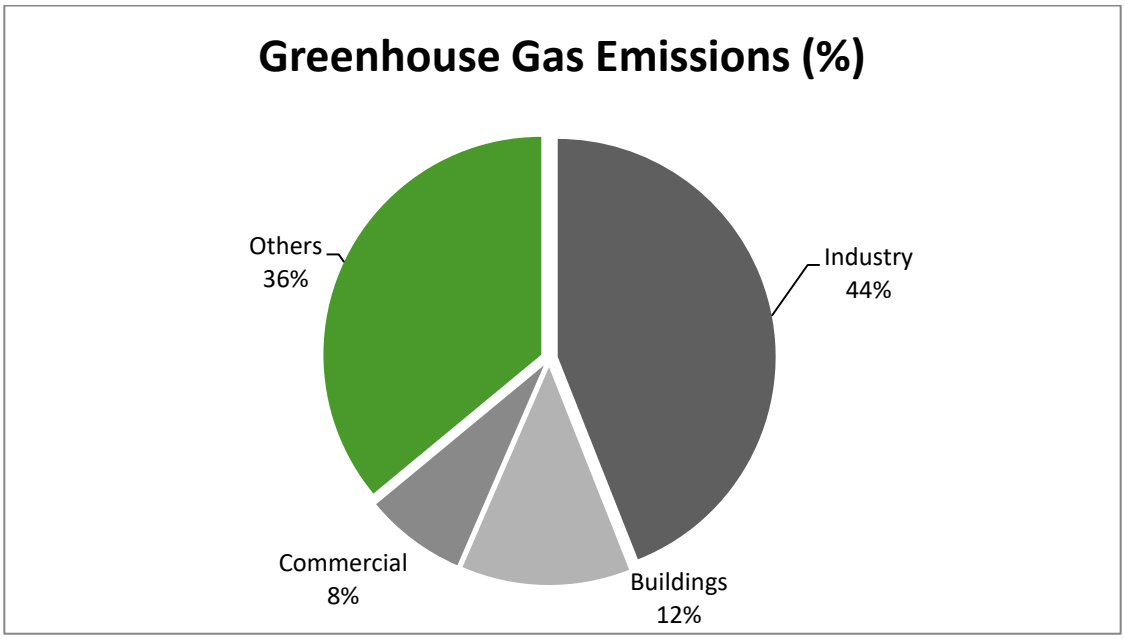

Figure 3-24: The sectoral greenhouse gas emissions in Izmir (Source: İzmir Metropolitan Municipality, 2016).

3.2.3. Summary of challenges

- Vulnerability to climate change as a coastal town
- Reducing ground and surface water potentials
- Very widespread heat island effect and poor bioclimatic comfort conditions in the central districts
- The relatively high amount of air pollutant emissions (CO_2, CO, PM10, NO_2 and SO_2)
- Lack of sufficient green spaces and street tress,
- Fragmented and scattered configuration pattern of green spaces throughout the city

[72] İzmir Metropolitan Municipality. (2016). *Sustainable Energy Action Plan.* İzmir

[73] Kazanasmaz, T., Erlalelitepe, İ., Akkurt, G., Turhan, C., & Ekmen, K. (2014). On the relation between architectural considerations and heating energy performance of Turkish residential buildings in Izmir. *Energy and Buildings, 72*, 38-50

- Degradations and development pressure, such as recently approved bay bridge upon South Gediz delta and its sensitive coastal wetland ecosystems
- Degradation and loss of coastal wetlands and increasing vulnerability and decreasing climate resilience
- Limited natural air ventilation due to İzmir's geographic features and urbanization pattern

3.2.4. Potential actions to be taken

- Measures to reduce PM2.5 and PM10, C, NO_2 and SO_2 emissions such as increasing consumption of natural gas in households and using more environmental friendly public transportation vehicles
- Increasing the amount of urban green areas and street trees by choosing right species for carbon sequestration
- Maintaining and enhancing existing coastal wetland systems
- Increasing green walls and roofs to reduce direct heating by solar radiation.
- Encouraging more pedestrian and bike usage
- Constructing storm water facilities such as rain gardens and bio-swales to store water and/or feed the ground water table as well as avoiding building extensive manholes and other urban drainage facilities
- Planting more native and drought resistance plants to save water in the urban green spaces
- Encouraging smart or eco-buildings
- Planting and management of trees (right tree, right place) and increasing the canopy cover ratio
- Planting climate-effect trees to cool the local microclimate via evapotranspiration and to save on air-conditioning energy in the summer months
- Replacing hard surfacing with permeable/green surfaces in urban areas for urban cooling
- Shading of streets and outer spaces by other shady structures/materials
- Outer and inner wall insulation to keep building's cool in summer and warm in winter
- Replacing low reflective materials with height reflective materials in buildings, pavements and car parks to reduce the UHI and heat absorption
- Climate change risks should be reflected within relevant plan, policy and strategy documents
- In developing areas, heights of the buildings and widths of the streets should be taken to account not to create urban heat islands.

3.3. Water management

3.3.1. Introduction to water management

Growing urban populations, pollution, and economic activities in urban areas put water resources under severe stress, and increase pressure on the quality and quantity of water resources. The sustainable management of water resources is thus a key challenge for climate change mitigation

and adaptation within cities in Europe and beyond[74]. Climate change is expected to exacerbate existing problems connected to urban water resources by changing rainfall patterns and temperature regimes: for most European regions, changes in the frequency and temporal distribution of precipitation are expected, with more intense rainfall events and longer periods of low precipitation levels, while overall precipitation quantities may decrease in some European regions[75]. Intense precipitation events will more frequently produce run-off quantities which exceed the capacities of urban sewerage systems, and cities along rivers and coastlines are at increased risk of flooding, whereas in some regions changes in rainfall patterns will further increase the risk of water scarcity in urban areas. Urban run-off water represents a threat for water quality because of the pollutant load it conveys[76] (Figure 3-25).

Figure 3-25: Meles river, the Konak district - Water pollution and eutrophication (Source: Original, 2010)

3.3.2. The case of Izmir

According to a research held by TEMA Foundation, directly water related impacts of climate change in Ege Region where Izmir is located are summarized. Research report presents that climate change has put pressure on surface water and groundwater systems in the region, water tables decreased and salination became a very frequent problem. Considerable increases happened on ground water consumption during long and dry summers. Furthermore, hotter summer and unexpected fluctuations in seasons have started to observe very often, droughts resulted in degradations of wetland ecosystems. Losing of fish species, extinction of other species and biodiversity has accelerated because of increasing temperature of seawater. Intense

[74] Carter, J. (2011). Climate change adaptation in European cities. *Curr. Opin. Environ. Sustain 3,* 193-198

[75] IPCC. (2014). Climate Change 2014: Impacts, adaptation, and vulnerability. . *Fifth assessment report of the Intergovernmental Panel on Climate Change* (p. Part B: Regional aspects. Contribution of working group II). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press

[76] Wong, P., Losada, I., Gattuso, J.-P., Hinkel, J., Khattabi, A., McInnes, K., . . . Sallenger, A. (2014). Coastal systems and low lying areas, in: Field. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change* (pp. 361-409). Cambridge, United Kingdom, New York, USA: Cambridge University Press

precipitation events brought about severe flooding that destroyed urban infrastructure and agricultural areas and other meteorological disasters as landslides that carry the fertile soil away[77].

Another research of TEMA Foundation on threats to water resources in Turkey[78] reported 59 threats in 33 cities. İzmir, as one of the cities under examination, has a threatened but valuable resource, the Gediz River. Gediz River, is the second greatest river of Ege Region, is under threat of pollution caused by institutions of region, domestic waste, agricultural chemicals and fertilizers[79]. It is noted that the threat has evolved considerably since 1975 and the threat level has expounded as middle degree[80].

Apart from these challenges on water resources, the city of Izmir has also been dealing with urban stream corridors in the name of sustainable water management. In light of the fact that urban development affects stream processes undoubtedly, "modifications of the land surface during urban development change the type and the magnitude of runoff processes. These changes in runoff processes result from vegetation clearing, soil compaction, ditching and draining, and finally covering the land surface with impervious roofs and roads. The infiltration capacity of these covered areas is lowered to zero. Resulting increases in storm runoff rates and total volumes lead to difficulties with storm-drainage control, stream-channel maintenance, groundwater recharge, and water quality. This fundamental change in runoff-generating processes, then, is the major hydrologic consequence of urban development. Besides eliminating soil-moisture storage and increasing imperviousness, urbanization affects other elements of the drainage system. Gutters, drains, and storm sewers are laid in the urbanized area to convey runoff rapidly to stream channels. Natural channels are commonly straightened, deepened, or lined with concrete to make them hydraulically smoother", In these days "there is an emerging perspective that urban stream corridors should be much more than engineered conduits for fast conveyance of runoff and other discharges"[81].

In the case of İzmir, streams flowing through urban fabric are seasonal because of the climate and precipitation regime. Furthermore, they are mostly channelized due to flow and flood control codes and regulations of the city (Figure 3-26).

[77] TEMA. (2016). *Türkiye Su Varlıklarına Yönelik Tehditler Haritası*. Retrieved from http://sertifika.tema.org.tr/_Ki/SuTehditleriHaritasi/download/TEMA_Su_Tehditleri_Haritasi_Değerlendirme_Raporu.pdf

[78] TEMA. (2016). *Türkiye Su Varlıklarına Yönelik Tehditler Haritası*. Retrieved from http://sertifika.tema.org.tr/_Ki/SuTehditleriHaritasi/download/TEMA_Su_Tehditleri_Haritasi_Değerlendirme_Raporu.pdf

[79] Öner, Ö., & Çelik, A. (2011). Gediz Nehri Aşağı Gediz Havzası'ndan Alınan Su ve Sediment Örneklerinde Bazı Kirlilik Parametrelerinin İncelenmesi. *Ekoloji 20 (78):* , 48-52

[80] TEMA. (2016). *Türkiye Su Varlıklarına Yönelik Tehditler Haritası*. Retrieved from http://sertifika.tema.org.tr/_Ki/SuTehditleriHaritasi/download/TEMA_Su_Tehditleri_Haritasi_Değerlendirme_Raporu.pdf

[81] Derek B. Booth and Brian P. Bledsoe (2009) Streams and Urbanization

Figure 3-26: Peynircioğlu river, the Karşıyaka district - Urbanization and channelization (Source: Original, 2016)

As engineering functions come into prominence, urban streams are valued just as conduits of water according to city managers and water management institutions. For instance, İZSU (İzmir Water and Sewerage Administration) had executed a big project, Great Channel Project that collects domestic and industrial wastewater, and discharges it to the Izmir Bay after a purification process. İZSU engineered the streams that serve as an open sewer system during the project[82]. Unfortunately for some local people, the streams are just for dumping of domestic wastes and a source of bad odour in the neighbourhoods (Figure 3-27). Urban streams of the city of İzmir are mostly under pressure of urban infrastructure.

Figure 3-27: Bornova river, the Bornova district - Dumping wastes into the concrete channel (Source: Original, 2017)

Nowadays, "many communities are now focusing on stream and river corridors as high-value amenities not only for recreation, but as focal points for providing social, aesthetic, and educational benefits. Stream corridors are increasingly viewed not only as a right-of-way for

[82] İZSU. (2004). *İzmir'de Su ve Kanalizasyon 1990-2000-2001-2002-2003-2004.* İzmir: İzmir Büyükşehir Belediyesi Basın Yayın ve Halkla İlişkiler Müdürlüğü

floodwaters, but also as places where urban dwellers can access pedestrian and bicycle paths, go boating, experience a renewing environment, learn more about local animals and plants and whole ecosystems, and even swim. Stream corridors in urban areas range from repulsive, polluted drainage ditches to verdant oases of biodiversity, recreation, and renewal"[83]

"However ecological and social services of urban streams such as being home to flora and fauna, providing microclimatic comfort and meeting recreational needs of local people are mostly being ignored in the case of İzmir. Furthermore, when it comes to the management of urban streams in Izmir, there are also some legal gaps and administrative issues preventing urban streams from being used as green corridors and generating ecological services" [84]Nowadays, it is fair to say that mind-set and mentality have started to change towards the streams and İzmir Metropolitan Municipality has taken some sustainable actions and initiated a project for Peynircioğlu Stream in the Karşıyaka district named Peynircioğlu Riverside Recreation Park.

3.3.3. Summary of challenges

- Increasing development pressure on the quality and quantity of water resources
- Changing rainfall patterns and temperature regimes because of climate change
- Increased risk of flooding
- Increased risk of water scarcity
- Increasing pressure on surface water and groundwater systems
- Decreased water tables and increased salination
- Increased ground water consumption during long and dry summers
- Droughts resulted in degradations of wetland ecosystems
- Extinction of species and/or acceleration in biodiversity because of increasing temperature of seawater
- Meteorological disasters like landslides that carry the fertile soil away
- Increased in storm runoff rates and total volumes
- Giving preference to concrete channels instead of natural channels/riverbeds
- Ignorance of ecological and social services of urban streams
- Legal gaps and administrative issues, poor multi-stakeholder navigation

3.3.4. Potential actions to be taken

- Renaturing heavily engineered urban water bodies as part of a green infrastructure system in the city
- Doing ecological restoration to create vegetated urban stream corridors
- More large street trees, lawn areas, green roofs and walls as well as rain gardens
- More native and drought resistant plants in urban green areas
- İZSU has to have sustainable storm management policies and guidelines such as preparing sustainable storm water management manuals to meet the specific requirements of the city.

[83] Derek B. Booth and Brian P. Bledsoe (2009) Streams and Urbanization

[84] Özeren Alkan, M., & Hepcan, Ş. (2013). Kent İçi Akarsu Koridorlarının Canlandırılması-İzmir Kent Merkezi Örneği. *TMMOB İzmir 2. Kent Sempozyumu - Kentine Sahip Çık*, (pp. 839-849). İzmir

- Creating sustainable storm water facilities such as like bio-swales, bio-retention and detention ponds to detain and/or retain storm runoff
- Restoring or creating wetlands in the river basins
- Increasing pervious surfaces as much as possible (as it is at pre-development stage)
- Making possible the re-use of water for various purposes

3.4. Coastal resilience

3.4.1. Introduction to Coastal Resilience

The equilibrium of coastal ecosystems is threatened, especially by urban development, and NBS are being increasingly used in maintaining or restoring some of the key ecosystem services provided by coastal areas. NBS can increase coastal resilience by protecting communities against extreme events such as storms and stabilizing shorelines against water erosion.[85] Furthermore, the use of multifunctional NBS in coastal areas can provide a range of other economic and cultural values[86].

3.4.2. The case of Izmir

Due to the recessed geography of the bays and the peninsulas, the morphological structure of the İzmir coast is very diverse. İzmir coast consists of small and large coves, peninsulas, high and low shores, dunes, deltas and fishponds. Marine structures on along the sea side and filled land also cover large areas (Table 3-11, Figure 3-28). Due to physical and geomorphological formation, İzmir city coast is rich in biodiversity, natural resources and natural landscape has attractive features[87].

Morphological description	Length (km)
Estuary, Delta, fishponds	99,78
Dunes, beaches, low coasts	138,49
High and step coasts, rock outcrops, stony lands	534,84
Filled land, marine structures	93,67
Total	866,79

Table 3-11: Distribution of coastal lands of Izmir according to geomorphological aspects (Source: Ministry of Environment and Urbanization 2016)

[85] Gedan, K., Kirwan, M., Wolanski, E., Barbier, E., & Silliman, B. (2011). The present and future role of coastal wetland vegetation in protecting shorelines: Answering recent challenges to the paradigm. *Clim. Change 106*, 7-29

[86] Narayan, S., Beck, M., Reguero, B., Losada, I., van Wesenbeeck, B., Pontee, N., . . . Burks-Copes, K. (2016). The effectiveness, costs and coastal protection benefits of natural and nature-based defences. *PLoS One 11*

[87] *Ministry of Environment and Urbanization*. (2016). Retrieved from http://www.csb.gov.tr/gm/mpgm/index.php?Sayfa=sayfa&Tur=webmenu&Id=261

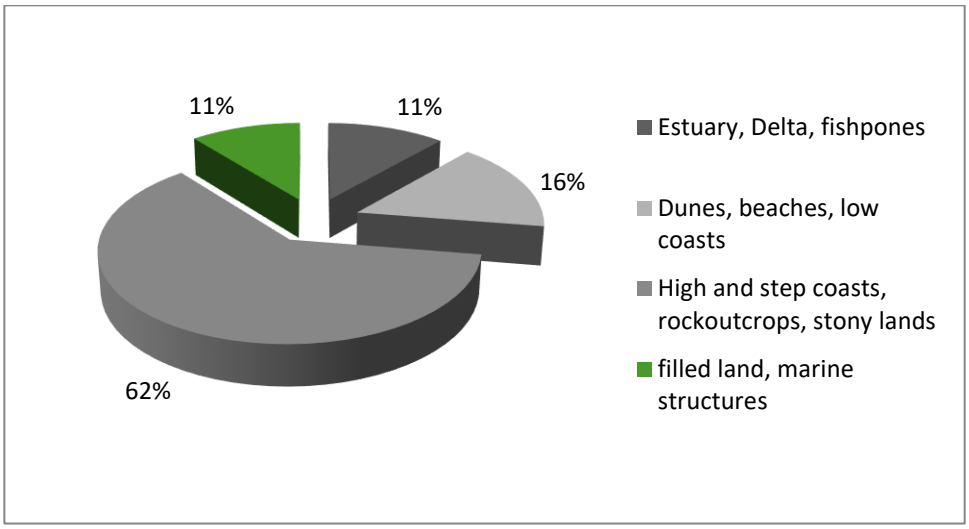

Figure 3-28: Ratio of geomorphological formation types of Izmir coasts (Source: Ministry of Environment and Urbanization, 2016)

Izmir Metropolitan Municipality has initiated a Coastal Design Project in 2011 (Figure 3-1Figure 3-29) to reinforce the relation of citizens with the sea by presenting a development plan for redesigning the coastal areas of the city.

Figure 3-29: Design areas of the Coastal Design Project (Source: İzmirdeniz, 2012)

In the design strategy report, some important guidelines are presented as follows [88] (cited in[89]):

1. Designing the İzmir bay as a place of activity, which is naturally formed. Designing İzmir bay as a natural place for demonstration can have a positive impact on the quality of life.

[88] İzmirdeniz. (2012). *Kıyı Tasarımı Kitapçığı.* İzmir: İzmir Büyükşehir Belediyes

[89] Yilmaz, E., & Kutucu, S. (2015). The participatory design process, local government and the design of coastal İzmir. *CUI '15 / III. International Contemporary Urban Issues Conference Proceedings*, (pp. 179-188). Istanbul, Turkey.

2. There is a long stretch of coast beginning from Mavişehir to İnciraltı where public space can be considered as a whole. This line, which is open to public use and is not subject to private property, can be designed in a more effective way contributing to everyday life of citizens.

3. The city grows on the slopes. Natural born urban terraces on the slopes can generate new relations between the sea and the background. 11 common targets for all design areas are determined as the following:

1. To determine real expectations of the public about the coast
2. To evaluate physical environment of design areas
3. To propose new activities and improving the old ones
4. To develop a unified approach which involves variety
5. To foster life on and in the sea
6. To fulfil physical infrastructural deficiencies
7. To find solutions to the access of the shore
8. To keep the suggestions of public in mind and to take participation as a means to deal not as a goal
9. To obtain designs with high quality in parallel to the general vision of the city, "the city of design"
10. To determine necessary steps for the implementation of designs
11. To identify the required time, labour and budget and to ensure participation between participants.[90]

That strategy report is a very important document for the city of Izmir because it attempts to redefine and reinforce the interaction between community and the sea. It is also restatement of what was started in the past in the form of coastal parks along the Izmir bay because Izmir has expanded its area of land by reclaiming some parts of the coastline of İzmir bay, which has been a frequent practice somewhat affecting the growth pattern of the city over the last couple of decades. These enlarged areas have been designated as linear coastal parks and promenades along the bay in the Karşıyaka, Bayraklı, Konak, Balçova, Narlıdere and Güzelbahçe districts[91]. These coastal parks and promenades today are among the most prestigious and popular green spaces in the city.[92]

As a coastal town, İzmir metropolitan area is somewhat under the threat of sea-level rise and flood. The flood risk map of the study region (Figure 3-30) indicated that Menemen delta along Gediz River and the settlements of Karşıyaka, Aliağa, Alaçatı, Çandarli and Selçuk are at high risk in order of decreasing vulnerability by the next century. In general, the south coastlines of the

[90] Yilmaz, E., & Kutucu, S. (2015). The participatory design process, local government and the design of coastal İzmir. *CUI '15 / III. International Contemporary Urban Issues Conference Proceedings*, (pp. 179-188). Istanbul, Turkey.

[91] Hepcan, Ş., Coşkun Hepcan, Ç., Kılıçaslan, Ç., Özkan, M., & Koçan, N. (2013). Analyzing Landscape Change and Urban Sprawl of a Mediterranean Coastal Landscape: A Case of İzmir. *Turkey Journal of Coastal Research, 29, Issue 2,*, 301 – 310

[92] Hepcan, Ş. (2013). Analyzing the Pattern and Connectivity of Urban Green Spaces: A Case Study of İzmir. *Turkey Urban Ecosystems16, Issue 2*, 279-293

Izmir Bay including Bornova, Konak, Balçova, Narlıdere, Güzelbahçe, Foça, Urla, and Dikili settlements appeared to be less vulnerable to the projected sea-level rise than the northern coastlines of the Izmir Bay.[93]

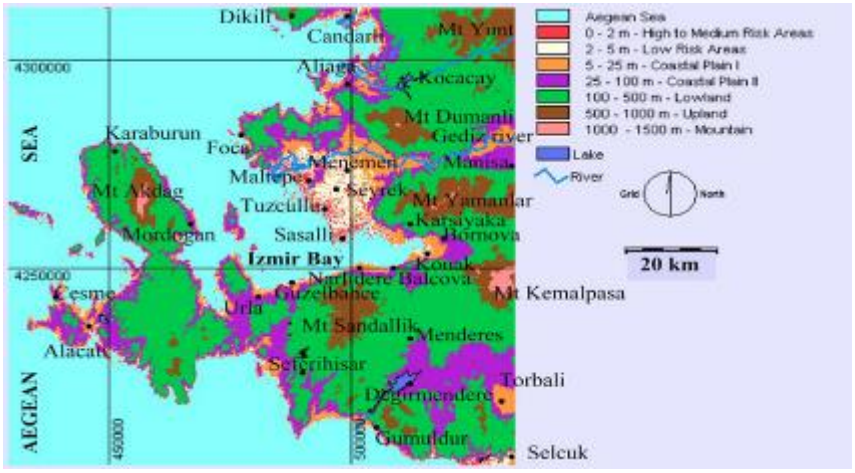

Figure 3-30: A coastal flood risk map of Izmir region (Source: Demirkesen, Evrendilek, Berberoglu, & Kilic, 2007)

Above-mentioned study showed that the Karşıyaka district is at high risk of sea-rise level and flooding. That makes Karşıyaka more important and interesting because all project and intervention areas selected for URBAN GreenUP are located in the district.

In terms of coastal resilience, coastal wetlands play a pivotal role. So, southern Gediz delta and its valuable wetlands ecosystems are key defence lines. It is a vital service provider for the city of İzmir, including protecting community against storms and water erosion as well as providing countless ecological, economic and recreational opportunities as underlined by [94] and [95] Unfortunately, between 1963 and 2005, the coastal marshes in the south Gediz delta decreased by more than 40 % during the 42 years period and converted into by built-up areas.[96]

Another study that targeted Gediz delta suggested similar results. In this study, land cover and land cover change, both in time and space, were analysed GIS and remote sensing were used to estimate the impact of land use changes on habitats over a 35 years period from 1975 to 2010. The delta has been subject to substantial changes over this time period. Important declines in

[93] Demirkesen, A., Evrendilek, F., Berberoglu, S., & Kilic, S. (2007). Coastal Flood Risk Analysis Using Landsat-7 ETM+ Imagery and SRTM DEM: A Case Study of İzmir, Turkey. . *Environ Monit. Assess (2007) 131:*, 293–300

[94] Gedan, K.B., Kirwan, M.L., Wolanski, E., Barbier, E.B., Silliman, B.R., 2011. The present and future role of coastal wetland vegetation in protecting shorelines: Answering recent challenges to the paradigm. Clim. Change 106, 7–29. doi:10.1007/s10584-010- 0003-7

[95] Narayan, S., Beck, M.W., Reguero, B.G., Losada, I.J., van Wesenbeeck, B., Pontee, N., Sanchirico, J.N., Ingram, J.C., Lange, G.-M., Burks-Copes, K.A., 2016. The effectiveness, costs and coastal protection benefits of natural and nature-based defences. PLoS One 11, e0154735. doi: 10.1371/journal.pone.0154735

[96] Hepcan, Ş., Coşkun Hepcan, Ç., Kılıçaslan, Ç., Özkan, M., & Koçan, N. (2013). Analyzing Landscape Change and Urban Sprawl of a Mediterranean Coastal Landscape: A Case of İzmir. *Turkey Journal of Coastal Research, 29, Issue 2,*, 301 – 310

natural habitats such as sansoeurs, beaches, dunes and reed beds have been replaced by increased areas of urbanization and annual agricultural crops. This analysis demonstrates the important pressures that continue to impact the delicate natural Mediterranean habitats and puts in evidence the need to enforce current legislation in order to conserve the deltas in the future[97].

In another paper, Konak, Bayraklı, Karşıyaka, Çiğli, Balçova, Narlıdere and Güzelbahçe coastal towns of İzmir Metropolitan Municipality were analyzed in 1963, 1995 and 2005 by using major landscape metrics in terms of landscape structure and the effects of urbanization on the landscape pattern. The results suggested that the landscape pattern of these coastal town and so İzmir has significantly changed over time. The main reason is conversion of natural vegetation and arable lands into urban fabric. Urban areas expanded over low or medium slope agricultural lands and natural vegetation (mostly maquis) cover in the study area. Additionally, forest vegetation has been fragmented in all districts. While Güzelbahçe and Balçova were the most urbanized settlements, Bayraklı and Narlıdere are the districts where the largest agricultural lands were lost and replaced by built-up areas.[98]

This study reveals that coastal settlements of Izmir has rapidly been urbanizing at the expense of natural vegetation and agricultural lands. Multifunctional NBS could be useful to ease the effects of urbanization by maintaining or restoring some of the key ecosystem services, such as renaturing of channelized streams and providing economic opportunities, such as urban agriculture.

Another serious threat that southern Gediz delta is facing today is the recently approved new İzmir Bay Bridge. It is planned to extend from southern coast of the bay to northern coast over southern Gediz delta. That bridge will likely to cause a lot of ecological for both Izmir bay and coastal marshes of Gediz delta. Since it is a decision of the central government, it is very difficult to reverse or stop it.

3.4.3. Summary of challenges

- Recently approved new bay bridge poses a serious threat for south Gediz delta and will hurt coastal resilience of İzmir deeply
- In the coastal district of İzmir, replacement of agricultural lands and natural areas by mostly high-density built-up areas threatens coastal resilience by exposing coastal communities to extreme events such as intense precipitation and flooding
- Reclaiming some parts of the coastline of Izmir bay is a common practice. It is extremely important to create multifunctional and connected green spaces along the İzmir bay.
- Along with some other northerly settlements of İzmir, Karşıyaka is at high risk of flooding. In URBAN GreenUP project, since all of the NBS interventions are planned in and around the Karşıyaka district, flooding risk could be highlighted as a serious challenge

[97] Ernoul, L., Sandoz, A., & Fellague, A. (2012). The evolution of two great Mediterranean Deltas: Remote sensing to visualize the evolution of habitats and land use in the Gediz and Rhone Deltas. *Ocean & Coastal Management 69*, 111-117

[98] Coşkun Hepcan, Ç., Özeren, M., Hepcan, Ş., & Özkan, M. (2015). 2015. Landscape Pattern Analysis of the Coastal Metropolis District of İzmir. *Ege Üniv. Ziraat Fak. Derg.52 (3):*, 353-362

- History of Izmir area is full of very destructive earthquakes that presents quite a challenge and risk for the resilience of the city and underlines the value of open spaces

3.4.4. Potential actions to be taken

- Engineering structures to protect the coastline
- Protecting coastal habitats and ecosystems including coastal wetland
- Creating a network of linear coastal promenades across the city
- Integrated coastal planning and design
- Restoration of southern Gediz delta and its valuable wetlands ecosystems as they are vital service providers for the city + flood protection.

3.5. Green space management

3.5.1. Introduction to green space management

Green and blue spaces are areas based on natural and semi-natural elements that provide a range of ecological[99], economic[100] and societal benefits[101].

Green and blue spaces are useful instruments for spatial planners in achieving a sustainable urban structure. They can provide elements characterizing the heritage and aesthetics of the area ([102] [103]), as well as being valued for recreation[104], social interaction, education [105]and supporting healthy living[106]. Green and blue spaces are also important for urban biodiversity [107]as they provide habitats for various species.

Urban green spaces (UGSs) contribute notably to quality of life. UGSs with good connectivity forming a green network to permeate the city constitute the hallmarks of a naturalistic design.

[99] Elmqvist, T., Setala, H., Handel, S., van der Ploeg, S., Aronson, J., Blignaut, J., . . . de Groot, R. (2015). Benefits of restoring ecosystem services in urban areas. *Curr. Opin. Environ. Sustain. 14,*, 101-108

[100] Claus, K., & Rousseau, S. (2012). Public versus private incentives to invest in green roofs: A cost benefit analysis for Flanders. *Urban For. Urban Green. 11,*, 417–425

[101] Gómez-Baggethun, E., & Barton, D. (2013). Classifying and valuing ecosystem services for urban planning. *Ecol. Econ. 86*, 235–245

[102] Madureira, H., Nunes, F., Oliveira, J., Cormier, L., & Madureira, T. (2015). Urban residents' beliefs concerning green space benefits in four cities in France and Portugal. *Urban For. Urban Green. 14,*, 56–64

[103] Niemelä, J. (2014). Ecology of urban green spaces: The way forward in answering major research questions. *Landsc. Urban Plan. 125,*, 298–303

[104] Fors, H., Molin, J., Murphy, M., & Bosch, C. v. (2015). User participation in urban green spaces–for the people or the parks? *Urban For. Urban Green. 14*, 722–734

[105] Krasny, M., Lundholm, C., & Kobori, H. (2013). Urban landscapes as learning arenas for biodiversity and ecosystem services management. Springer Netherlands

[106] Carrus, G., Scopelliti, M., Lafortezza, R., Colangelo, G., Ferrini, F., Salbitano, F., . . . Sanesi, G. (2015). Go greener, feel better? The positive effects of biodiversity on the well-being of individuals visiting urban and peri urban green areas. *Landsc. Urban Plan. 134*, 221–228

[107] Bennett, E. C., Díaz, S., Egoh, B., Geijzendorffer, I., Krug, C., Lavorel, S., . . . Meyfroidt, P. (2015). Linking biodiversity, ecosystem services, and human well-being: three challenges for designing research for sustainability. *Curr. Opin. Environ. Sustain. 14,*, 76–85

Preservation and creation of natural areas with rich biodiversity offer a new dimension to UGS design. Innovative ideas of development right transfer; street pedestrianization, river and canal revitalization, green roofs and green walls could mobilize hitherto underused plantable resources. Lacking appropriate institutional setup and scientific capability pose intractable bottlenecks[108].

In spite of countless benefits and services of UGSs, they are mostly relegated to leftover spaces and considered for ornamentation. This is also a frequent case in Turkey[109] In most cases, green spaces were implemented simply to ornament leftover land in congested urban settings.

3.5.2. The case of Izmir

In Turkey, spatial planning at any level is not concerned with connectivity and multi-functionality of open and green spaces and the focus has been in individual spaces rather than establishing open and green space networks.[110] Naturally, this way of spatial planning overshadows systematic open space planning and never encourages a sustainable vision and implementations for establishing open and green space networks.

The conventional open space-planning approach that is often associated with just setting simple quantitative standards per population[111]. However, this threshold value of 10 m^2 open spaces per inhabitants is far from realization in Turkey. In addition to above-mentioned reality, lacking of systematic planning is one of the major obstacles for fully functional urban open spaces in the country. This mostly results in highly fragmented pattern and absence of the necessary qualities and quantities and evenly distribution. Additionally, lacking of sound legal leverages to help establishing and protecting high quality open spaces in urban landscapes is also worth mentioning. In spite of the fact that İzmir metropolitan municipality has done a lot in the last decades in terms of developing open spaces (see Figure 3-31, Figure 3-32), such as designation of coastal parks and promenades along the bay in the Karşıyaka district[112] and urban renewal projects where a wide variety of open spaces are projected as well as developing efforts of urban green infrastructure strategy, there is still much to do in terms of open space planning and design because both quantitative and qualitative pictures of the urban open spaces are not promising in the city. According to a recent study conducted in the central districts of the city of Izmir, while urban fabric occupied almost 26 % of the study area, the managed UGS cover just 1.45%.

[108] Jim, C. (2012). Sustainable urban greening strategies for compact cities in developing and developed economies. *Urban Ecosyst*

[109] Hepcan, S., Kaplan, A., Özkan, M., Küçükerbas, E., Yigit, E., & Türel, H. (2006). Public space networks as a guide to sustainable urban development and social life: a case study of Mugla, Turkey. *Int J Sust Dev World 13:*, 1–15

[110] Hepcan, Ş. (2013). Analyzing the Pattern and Connectivity of Urban Green Spaces: A Case Study of İzmir. *Turkey Urban Ecosystems16, Issue 2*, 279-293

[111] Moseley, D., Marzano, M., Chetcuti, J., & Watts, K. (2013). Green networks for people: Application of a functional approach to support the planning and management of greenspace. *Landscape and Urban Planning 116*, 1–12

[112] Hepcan, Ş., Coşkun Hepcan, Ç., Kılıçaslan, Ç., Özkan, M., & Koçan, N. (2013). Analyzing Landscape Change and Urban Sprawl of a Mediterranean Coastal Landscape: A Case of İzmir. *Turkey Journal of Coastal Research, 29, Issue 2,*, 301 – 310

Furthermore, the configuration of UGSs was generally small and highly fragmented. Similarly, the overall connectivity of UGSs was very low [113](Table 3-12). The ratio of green spaces in some countries is significantly higher than Izmir. For example, according to the (BUUF, 2003) in Örebro (Sweden), the amount of public park area is about 20 % of the urban area. The city of Salzburg (Austria) with its 150,000 inhabitants is covered by approximately 60 % UGSs (Lang et al. 2008). Nine percent of the total area of Hamburg (Germany) is occupied by UGSs[114]. Over 16% of the city area of Budapest (Hungary), 14 % of the area of Birmingham (United Kingdom), and 11 % of Antwerp (Belgium) are composed of UGSs.[115]

District Name	Total size of the district (km^2)	Size of the built-up area (km^2)	Size of the urban green space (km^2)	CONNECT scores of the green areas
Balçova	20.60	7.89	0.62	2.48
Konak	24.40	21.31	2.15	0.86
Bayraklı	25.06	16.32	0.74	1.51
Narlıdere	44.65	7.35	1.51	2.41
Karşıyaka	52.40	15.38	1.51	1.21
Gaziemir	58.44	22.57	0.28	2.12
Güzelbahçe	85.58	6.97	0.13	3.75
Karabağlar	102.93	21.57	0.70	0.79
Çiğli	133.39	43.61	0.70	1.80
Buca	174.33	26.62	1.36	0.79
Bornova	214.40	52.68	3.88	0.59

Table 3-12: Green space sizes and connectivity results of the central districts of İzmir (Source: Hepcan Ş., 2013)

[113] Hepcan, Ş. (2013). Analyzing the Pattern and Connectivity of Urban Green Spaces: A Case Study of İzmir. *Turkey Urban Ecosystems16, Issue 2*, 279-293

[114] BUUF. (2003). *Baltic University Urban ForumCity Status Report V. Project part-financed by the European Union (European Regional Development Fund) within the BSR INTERREG III B Neighbourhood Programme.* BUUF City Status Reports

[115] URGE-Team. (2004). Making greener cities-a practical guide. *UFZ-Bericht Nr. 8/2004* , 120

Figure 3-31: Aşık Veysel Park, one of the largest parks in the Bornova district (Source: Original 2017)

Figure 3-32: Aşık Veysel Park, very popular for outdoor activities in the Bornova district (Source: Original 2017)

It is important to mention that existing coastal parks and promenades today are among the most prestigious and popular green spaces in Izmir. In addition to pedestrian and bike routes on these coastal promenades (Figure 3-33, Figure 3-34), İzmir Metropolitan Municipality has been constructing a railway for streetcar (light rail) along the Izmir bay (between Mavişehir and Balçova) and also inner parts of the city. That is a very good example on how a coastal greenway can be used to address multiple purposes in a sustainable way. Moreover, the next goal should be to create a system of uninterrupted coastal parks from north to south along İzmir bay. But the Izmir port area, one of the largest container ports in Turkey, constitutes a significant physical barrier against a coherent system of coastal parks throughout the city. In order to eliminate this barrier, the outcome and projections of the İzmir Port Area Urban Design Competition can be used as guide to integrate the port area into the city as has happened in the Port of Rotterdam, in the Netherlands[116].

[116] Hepcan, Ş. (2013). Analyzing the Pattern and Connectivity of Urban Green Spaces: A Case Study of İzmir. *Turkey Urban Ecosystems16, Issue 2*, 279-293

Figure 3-33: Coastal promenade in Güzelyalı, among the most prestigious and popular places in İzmir (Source: Original, 2017)

Figure 3-34: Coastal promenade in Güzelyalı, a place where pedestrian, bike and light rail lane are met (Source: Original, 2017)

3.5.3. Summary of challenges

- Conventional open-green space planning regulations are one of the major challenges because they are often associated with just simple quantitative standards.
- Likewise, conventional spatial planning is not concerned with connectivity and multi-functionality of green spaces.
- Maintaining and/or improving ecosystem services are not major concerns in green space planning and design. So, protecting biodiversity is not a variable in green space planning process.

- Qualities and ecological functions of green spaces are ignored and mostly left over areas are designated as green spaces. This is the case for the entire country.
- Mapping out all the green areas in the city and setting up a GIS database are two important tasks that need to be dealt with.
- As other cities in Turkey, it is not possible to mention of existence of urban green infrastructure in Izmir although there are some opportunities to establish and combine it with blue infrastructure in the city. For instance, Izmir Metropolitan Municipality has been working on establishing a citywide green infrastructure strategy for Izmir. That could result in a green infrastructure planning that would help improve all the green areas in the city.
- The city of Izmir has been suffering from insufficient “large green spaces” that can act as core areas of a future green infrastructure. Green areas are mostly small and fragmented across the city.
- Street trees are not mostly problematic in the city because of several factors. Unfortunately, there is no inventory about them. This lacking of sufficient number of large canopy trees is an important concern.

3.5.4. Potential actions to be taken

- GIS inventories and maps should be conducted for all the green spaces in the city
- As a plan decision, changing the mentality of spatial planning process and including citywide open-green space networks in the process
- Preparing a green infrastructure strategy and planning
- In the framework of the green infrastructure planning, green and blue spaces should be interwoven.
- Blue spaces need to be mapped out and renaturalized starting in pilot sites to attract community’s attention and support.
- Providing ecosystem services as well as protecting and enhancing biodiversity should be prioritized in green space and planting design.
- Street trees are solely important in the city. Street tree inventories should be conducted. Long-lived, large canopy trees should be preferred and excessive trimming should be avoided.
- Executing small-scale pilot NBS projects across the city with the community participation such as urban farming and nature inventory

3.6. Air quality

3.6.1. Introduction to air quality

Air quality is a major concern worldwide, particularly in urban areas, due to its direct consequences on human health. In the political agenda, air quality issues can be coupled with climate change mitigation policies as described in Challenge 1. NBS based on the creation, enhancement, or restoration of ecosystems in human-dominated environments also exploit the synergy between ecosystem processes that regulate pollutants and CO_2 in the atmosphere. In order to mitigate these air pollutant problems, the use of urban vegetation is often promoted as an effective measure to reduce concentrations. This measure is based on the underlying argument

that trees (and vegetation in general) have the capability of cleaning the air by filtering out the pollutants. Vegetation leaves absorb gaseous pollutants through their stomata, while particles are removed from the air by deposition onto the leaves and the branches[117].

People with heart or lung disease (including heart failure and coronary artery disease, or asthma and chronic obstructive pulmonary disease), older adults (who may have undiagnosed heart or lung disease), and children are most at risk[118]. Local air quality affects how residents live and breathe. Like the weather, it can change from day to day or even hour to hour. Therefore, it is very crucial to monitor local air quality regularly. The most dangerous air pollutants are carbon monoxide (CO), sulphur dioxide (SO2), nitrogen dioxides (NO2), ozone (O3) and particulate matter (PM2.5-PM10)[111].

In European countries, various policy instruments have been implemented to improve air quality in urban areas. The Directive 2010/75/EU was released for industrial emissions, the Euro Standards for road vehicle emissions and the Directive 94/63/EC for volatile organic compounds emissions from oil storage and distribution[119]. As for many other large European cities, air quality improvement is one of the major environmental policy challenges for Izmir. Between 2012 and 2016, the city has not exceeded the EU limit values which are shown in Table 3-13.[120]

Parameter	Short Term Limit	Long Term Limit
PM_{10} ($\mu g/m^3$)	50	40
SO_2 ($\mu g/m^3$)	350	125

Table 3-13: The EU limits for pollutants (Source: Directive 2008/50/EC, 2008)

3.6.2. The case of Izmir

In wintertime, poor meteorological conditions especially inversion in Izmir are serious issues. Air pollution due to inversion (temperature reversal) is affected by industrial pollutions and low-quality fossil fuels. As a result, both air temperature and air pollution increase. Additionally, northerly winds blowing through Bornova lowland bring additional air pollution to the city of Izmir from the industrial facilities located both in Bornova and Kemalpaşa lowlands[121].

[117] Vos, P., Maiheu, B., Vankerkom, J., & Janssen, S. (2013). Improving local air quality in cities: To tree or not to tree? . *Environ. Pollut. 183,* , 113–122

[118] EPA. (2010). *Science and Research at the U.S. Environmental Protection Agency.* Washington, DC: EPA Progress Report 2010 Office of Research and Development, U.S. Environmental Protection Agency

[119] Baró, F., Chaparro, L., Gómez-Baggethun, E., Langemeyer, J., Nowak, D.J., Terradas, J., 2014. Contribution of ecosystem services to air quality and climate change mitigation policies: The case of urban forests in Barcelona, Spain. Ambio 43, 466–479. doi:10.1007/s13280-014-0507-x

[120] Directive 2008/50/EC. (2008). *Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe*

[121] Koçman, A. (1991). İzmir'in kentsel gelişimini etkileyen doğal çevre faktörleri ve bunlara ilişkin sorunlar. *Atatürk Kültür Dil ve Tarih Yüksek Kurumu Coğrafya Araştırmaları Dergisi, 3,*, 101-122

Carbon dioxide (CO_2) emission per capita (person) in İzmir is 5.31 tones/year[122]. A proper emission inventory is very important for planning pollution control programs, particularly in coastal sites like İzmir, where environmental quality is of growing concern owing to their typical meteorological conditions. Industry is the most polluting sector for SO_2 in the study area contributing about 88 % of total emissions. On the other hand, domestic heating is the most polluting sector contributing about 56 % of total PM emissions while traffic has the highest portion for NOX emissions. Especially, emissions from industries located outside the metropolitan city centre are much higher in amount. Industries located around the Izmir metropolitan centre contribute to the industrial SO_2 emissions by 93 %, PM emissions by 59 % and NOX emissions by 80 % of the total[123].

Up to the present study, several studies were completed about VOC (volatile organic compounds) in İzmir. In one of these studies a good relationship was established between traffic emission and ambient VOC levels for urban and suburban by examining the toluene-to-benzene ratios in the city. In another study which was completed between 2000 and 2001 at three sampling sites located around a petrochemical complex and oil refinery in İzmir, VOC concentrations were found 4-20 times higher than those measured at a suburban site in İzmir[124].

Poor meteorological conditions especially inversion events for the efficient mixing of air pollutants occurred during the winter months in İzmir. With this work we quantify the amount of domestic heating emissions for PM10, SO_2, NO_2, volatile organic compounds (VOC) and CO together with greenhouse gases that are CO_2, nitrous oxide (N_2O) and methane (CH_4) in İzmir for 2008–2009 winter season. The results showed that the most affected residential areas were central districts in the city centre from domestic heating emissions due to meteorological condition and demographic reasons[125].

Urban air pollution is undoubtedly a significant risk factor for human health. (Ozcan & Cubukcu, 2014). conducted a research to test the relation between the number of asthma cases and the levels of air pollutants SO_2 and PM10 in Izmir between 2007 and 2010. The results from the regression showed that there was a statistically significant relation between the number of asthma cases and the level of urban air pollution[126].

[122] İzmir Metropolitan Municipality. (2016). *Sustainable Energy Action Plan.* İzmir

[123] Elbir, T., & Müezzinoğlu, A. (2004). Estimation of emission strengths of primary air pollutants in the city of İzmir, Turkey. *Atmospheric Environment 38*, 1851–1857

[124] Müezzinoğlu, A., Elbir, T., Dinçer, A., Bayram, A., Odabaşı, M., Çetin, E., & Seyfioğlu, R. (n.d.). Emission of Air pollutants: Measurements, Calculations and Uncertainties. In *Developing emission inventories for Turkey* (pp. 318-334)

[125] Sari, D., & Bayram, A. (2014). Quantification of emissions from domestic heating in residential areas of İzmir, Turkey and assessment of the impact on local/regional air-quality . *Science of the Total Environment 488–489 (2014)* , 429–436

[126] Ozcan, N., & Cubukcu, K. (2014). Evaluation of Air Pollution Effects on Asthma Disease: The case of İzmir. *Procedia - Social and Behavioral Sciences 202*, 448 – 455

Figure 3-35 displays the annual emissions of two main air pollutants (PM_{10} and SO_2) in Çiğli/Izmir from 2012 to 2016 PM_{10} level of Çiğli/Izmir is increased gradually while SO_2 level is decreased.[127] However, pollutants level never exceeded the EU levels. Green urban areas can decrease pollutants level, simultaneously reduce the environmental damages and health risks.

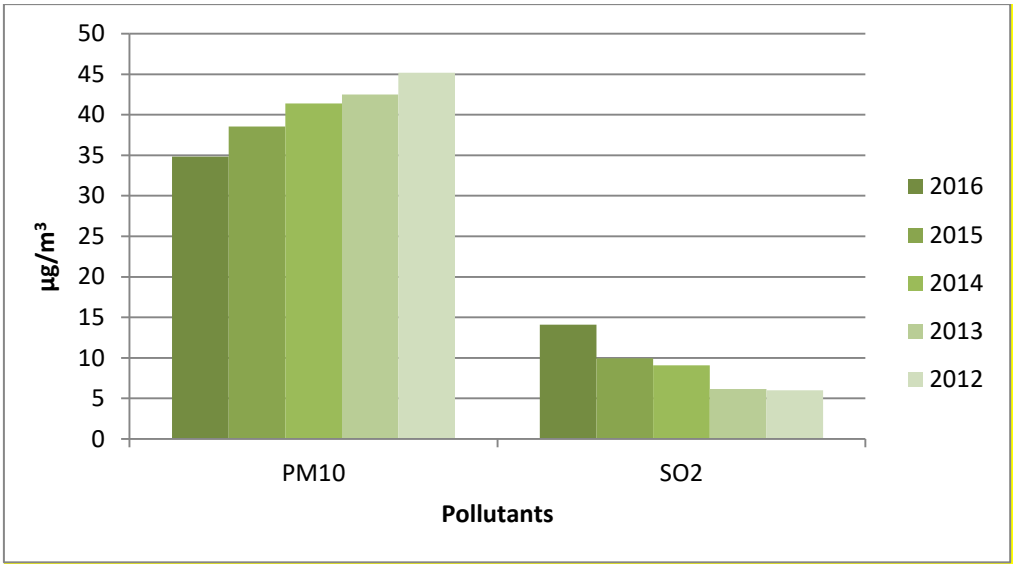

Figure 3-35: The annual emissions of PM10 and SO2 in Çiğli/Izmir (Source: İzmir Metropolitan Municipality, 2017)

Quality of air in İzmir changes according to season and location in the city. It has been is observed that traffic and weather conditions are two important parameters. It is monitored the air quality in different locations, inner city and rural hinterland of Izmir, where they measured Ozone and CO2 concentrations (Table 3-14, Table 3-15)[128]. They determined ambient air ozone and nitrogen dioxide by passive samplers located at urban, sub-urban, rural, and industrial sites of Izmir. They sampled weekly and samples were collected at 16 sites. They measured the highest NO2 concentrations at urban sites with heavy traffic. But they measured the highest ozone concentrations at rural sites (Figure 3-36, Figure 3-37). While the highest ozone concentrations were measured in summer, winter concentrations were also relatively high. Correlations between ozone levels and several meteorological parameters such as solar radiation, temperature, and humidity were investigated. Both solar radiation and temperature had a significant correlation with ozone concentrations while humidity had a very low correlation.

Sampling Location	Sample No	Minimum	Maximum	Average	Standard Deviation	Medium	%95 ratio
Urban	N–1	7,70	126,10	72,80	31,80	77,10	114,50
	N–7	17,50	96,10	57,30	23,50	63,50	92,70

[127] *İzmir Metropolitan Municipality*. (2017). Retrieved from: http://www.izmir.bel.tr/eislem/HavaDegerleri/HavaDegerleri.aspx

[128] Dumanoğlu, Y., & Bayram, A. (2013). Investigation of Temporal Variations in Ozone and Nitrogen Dioxide Concentrations Measured at Izmir City Centre and It's Surroundings. *Hava Kirliliği Araştırmaları Dergisi (Journal of Air Pollution researches)*

Sampling Location	Sample No	Minimum	Maximum	Average	Standard Deviation	Medium	%95 ratio
	N–8	5,70	75,10	39,30	21,10	45,40	66,50
	N–9	2,00	78,90	44,40	25,30	48,70	76,50
	N–12	12,80	106,00	73,60	23,40	78,40	100,90
	N–13	10,80	121,40	58,30	30,30	65,00	100,30
Rural	N–2	11,00	134,80	76,40	29,40	78,90	115,20
Semi-urban	N–4	0,30	102,60	55,50	24,90	59,20	83,40
	N–5	11,90	131,90	67,10	30,60	69,10	110,60
	N–6	11,30	100,20	48,40	22,90	51,40	77,50
	N–10	14,50	116,30	66,10	25,60	68,80	99,40
	N–14	15,40	161,90	79,90	35,40	79,80	118,60
Industrial zone	N–3	9,90	142,40	64,20	33,40	60,70	108,40
	N–11	12,00	127,00	70,70	29,90	71,60	106,40
	N-15	7,40	151,8	63,40	36,80	65,80	101,50
	N–16	16,50	127,00	73,00	32,70	66,50	119,80

Table 3-14: Average Ozon concentration of İzmir district (µg m-3) (Source: Dumanoğlu & Bayram, 2013)

Sampling Location	Sample No	Minimum	Maximum	Average	Standard deviation	Medium	%95 Ratio
Urban	N–1	5,1	26,3	13,3	5,3	12,1	20,8
	N–7	14,6	75,8	36,3	13,5	32,1	56,7
	N–8	20,4	77,8	50,6	14,6	52,1	72,1
	N–9	6,2	66,6	34,8	11,6	33,9	51,8
	N–12	6,6	30,8	15,9	5,8	15,6	25,6
	N–13	16,3	78,7	43	16,1	40,1	67,5
Rural	N–2	1,9	17,8	7,8	3,8	6,8	13,6
Semi-urban	N–4	4,6	53,3	29,6	11,7	30,7	46,4
	N–5	14,6	42,8	24,6	7,3	23	38,7
	N–6	9,3	41,1	31,7	41,1	22,6	40,7
	N–10	7,7	28,4	16,3	5,3	14,9	24,9
	N–14	1	20,2	6,4	5,4	4,9	17,5
Industrial zone	N–3	13,9	50,4	25,6	7,9	24,8	38,3
	N–11	4,1	31,6	14,9	6,3	15,1	24
	N-15	14	45	22,2	6,9	20	32,8
	N–16	6,6	41,3	18,8	8,3	19,6	33,4

Table 3-15: Average NO2 concentration of İzmir district (µg m-3) (Source: Dumanoglu and Bayram, 2013)

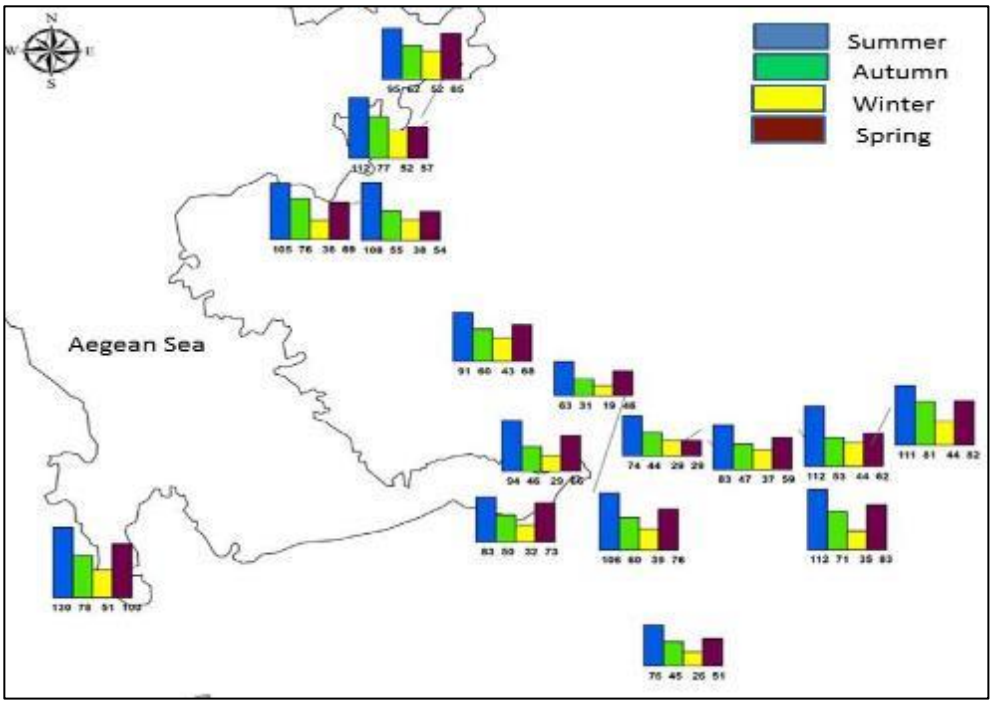

Figure 3-36: NO2 (µg m-3) concentration changes according to locality and seasonally (Source: Dumanoğlu & Bayram, 2013)

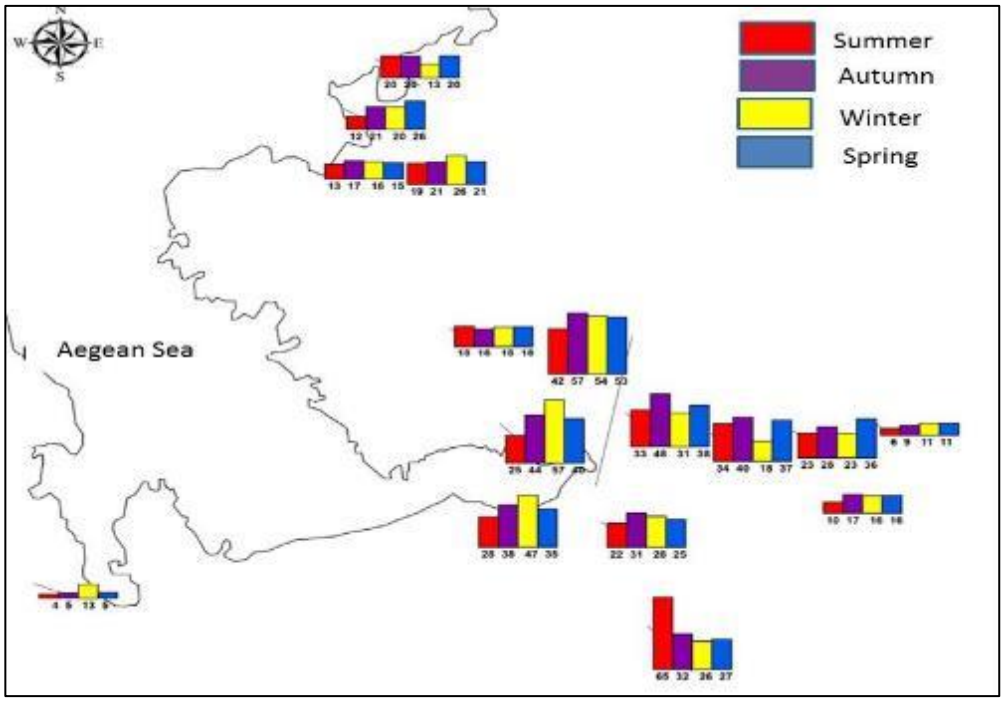

Figure 3-37: Ozone (µg m-3) concentration changes according to locality and seasonally (Source: Dumanoğlu & Bayram, 2013)

3.6.3. Summary of challenges

- CO_2 emitted by İzmir is relatively high and needs to be tackled urgently.
- Industry is the most polluting sector for SO_2 in İzmir contributing about 88 % of total emissions.
- There is a significant relation between the number of asthma cases and the level of urban air pollution in İzmir.
- In wintertime, poor meteorological conditions, especially inversion in İzmir, are serious issues.
- Northerly winds blowing through Bornova lowland brings additional air pollution to İzmir from the industrial facilities located both in Bornova and Kemalpaşa lowlands.
- Central settlements of İzmir are surrounded by a hilly topography that forms a physical barrier against incoming airflows and winds. This barrier prevents dirty and hot air from being swept away by airflows and winds

3.6.4. Potential actions to be taken

- Monitoring the amount of atmospheric air pollutants regularly to find out more vulnerable areas in the city
- Calculating and mapping air purification service provided by existing green areas
- Increasing the number of urban trees and canopy cover in the city: in private domestic gardens, along the streets and urban parks etc. but pollution-sensitive species should be avoided in heavily polluted areas
- Maintain the canopy cover by avoiding unnecessary pruning
- Increasing existing green infrastructure elements such as building green roof and green walls
- Planting low maintenance and long-lived trees for long-term pollution reduction
- Planting trees to shade parked cars to reduce vehicular VOC (volatile organic compounds) emissions
- SO emission reduction programs including control technology implementation, energy conservation planning and pollution prevention techniques must be urgently prepared and implemented

3.7. Urban Regeneration

3.7.1. Introduction to Urban Regeneration

Urban regeneration aims at improvements in the economic, physical, social and environmental conditions of an area that has been subject to negative change and is considered vulnerable (non-resilient)[129]. It can include aspects of (local) business development, housing growth and improvement, community building and environmental improvement[130]. Attention also needs to

[129] Tallon, A., 2013. Urban Regeneration in the UK. Routledge, Abingdon, Oxon

[130] Tyler, P., Warnock, C., Provins, A., Lanz, B., 2013. Valuing the benefits of urban regeneration. Urban Stud. 50, 169–190. doi:10.1177/0042098012452321

be paid to ecological restoration across scales[131]. and aspects of social justice. Urban regeneration brings new opportunities for cities to reconsider their planning strategies in the context of limited available space, deprived areas, social inequities or global environmental changes[132]. NBS projects need to consider the interlinkages between urban regeneration, aesthetic appeal, urban development/building culture, urban structure, design and aesthetics, urban ecology and its relation to energy and water use ([133];[134];[135]). For example, landscapes that look well-cared for discourage crime, and social capital may be nurtured by physical evidence of care[136].

3.7.2. Case of İzmir

First large scale spatial transformation of Izmir started in 1920s. There was the need to re-erect the city after the 1922 Fire devastating almost three fourths of the city. The fire damaged physical, cultural and social topography of the central city. The first citywide regeneration plan then prepared by the French architect Rene Danger (1925) for the burned-up areas of İzmir (Figure 3-38).

[131] Andersson, E., Barthel, S., Borgström, S., Colding, J., Elmqvist, T., Folke, C., Gren, Å., 2014. Reconnecting cities to the biosphere: Stewardship of green infrastructure and urban ecosystem services. Ambio 43, 445–453. doi:10.1007/s13280-014-0506-y

[132] Couch, C., Fraser, C., Percy, S. (Eds), 2008. Urban Regeneration in Europe. Blackwell, Oxford

[133] Hemphill, L., Berry, J., McGreal, S., 2004. An indicator-based approach to measuring sustainable urban regeneration performance: Part 1, conceptual foundations and methodological framework. Urban Stud. 41. doi:10.1080/0042098042000194089

[134] Sepe, M., 2013. Urban history and cultural resources in urban regeneration: A case of creative waterfront renewal. Plan. Perspect. 28, 595–613. doi:10.1080/02665433.2013.774539

[135] Laprise, M., Lufkin, S., Rey, E., 2015. An indicator system for the assessment of sustainability integrated into the project dynamics of regeneration of disused urban areas. Build. Environ. 86. doi: 10.1016/j.buildenv.2014.12.002

[136] Nassauer, J.I., Raskin, J., 2014. Urban vacancy and land use legacies: A frontier for urban ecological research, design, and planning. Landsc. Urban Plan. 125, 245–253. doi: 10.1016/j.landurbplan.2013.10.008

Figure 3-38: Izmir Alsancak district regeneration plan after Fire of 1922 (Source: Kiliç, S. and Karataş, N., 2015)

After 1960s Turkey started to adopt import-substituted industrialization. One of the most important results of this development was the emergence of squatter settlements in the peripheral areas of big cities because of the migration of rural unemployed population. Those migrants had to solve their sheltering problems themselves by contracting informal settlements generally to public lands towards peripheral districts and have spread all over the city. Those areas are subject to most urban regeneration programs in today's municipal agenda (Figure 3-39)[137].

[137] Kiliç, S. and Karataş, N. (2015). The Role of the Urban Renewal Projects on the Reshaping of the Cities: İzmir (Turkey) Case, International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering Vol:9, No:3, pp.239-243

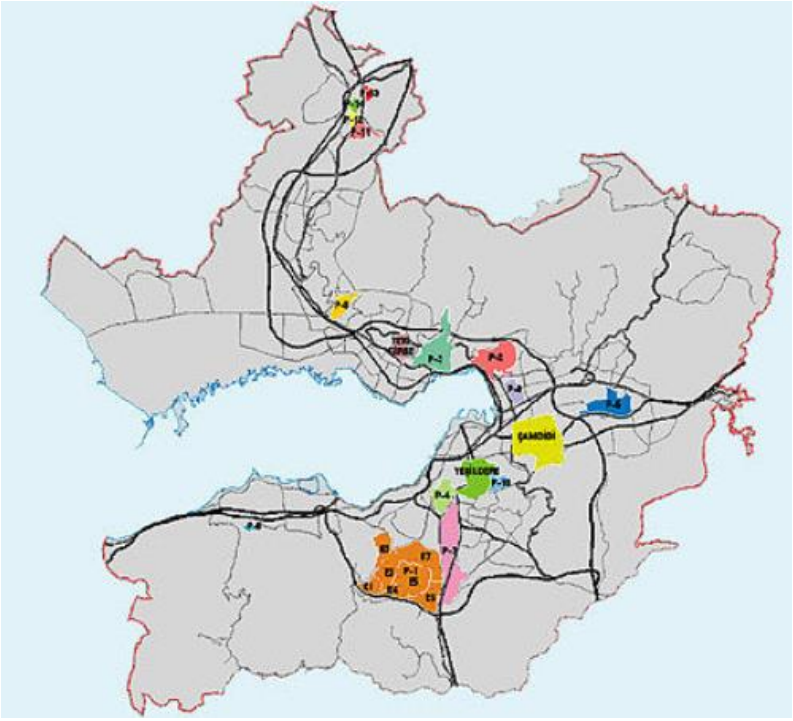

Figure 3-39: Distribution of Urban Renewal Program Areas in Izmir (Source: Kompil, E., 2017)

Starting from urban restructuring after 2000s, regeneration efforts have been concentrated on the core urban areas with the development of new city centre plan of 2003. İzmir Metropolitan Municipality opened an international urban design competition for the redevelopment of the backside of Alsancak Port, as a new centre of the city (Figure 3-39). Winning project, widely known as the "Third İzmir Project", offered a new central business district area with a new image of high density and high-rise developments. Since then designing a new city centre in this declining urban area (ranging from the backside of the Alsancak Port towards the Karşıyaka District and including 538 hectares of urban space) has become a flagship urban regeneration project to attract foreign capital through a commerce and consumption-based activities, luxury and gated residents, shopping malls etc. This regeneration plan was introduced to the public as "the crucial opportunity to regenerate the old industrial and storage-oriented use of this declining and abandoned urban area, flagship urban design and regeneration projects to make İzmir an internationally competitive word city"[138].

Another notable regeneration effort in the same region was the brownfield regeneration in old industrial buildings close to Izmir Port and Meles River. Historical Airgas Factory, which was constructed by French 150 years ago, was renovated by Izmir Metropolitan Municipality in 2009. The building and its surrounding open areas are used as an active culture-art centres of Izmir today. More recently, Izmir Metropolitan Municipality was renovated an old flour factory into an adult education centre called "Meslek Fabrikası" aimed to human recycling by giving them new skills and education on issues demanded by local industrial sectors.

[138] Kompil, E. (2017). Analysis of urban growth in developing countries and strategies for sprawl management: the case of İzmir, Unpublished Doctoral Dissertation, University of Seville

Figure 3-40 Urban regeneration of brownfield areas, Historical Airgas Factory (before and after) (Source: Kiliç, S. and Karataş, N. 2015)

Figure 3-41: Renovation of old flour factory into an adult education centre with FabLab (Source: Kiliç, S. and Karataş, N. 2015)

In line with 'Urban Renewal Program Areas', in recent decade, the first urban regeneration efforts of İzmir were initiated in the most expansive squatter areas that are located at the core urban areas of the city. İzmir Metropolitan Municipality's urban regeneration agenda in the Kadifekale region is one of the most important implementation efforts among them. Kadifekale (old castle area) is the symbol of the old city and also described as geologically disadvantaged area due to landslides. Regeneration works was initiated in the area between 2005 and 2012. Within the area, old squatter settlements are cleared and their residents were transferred to newly built residences in Uzundere region (far from the city centre). In the cleared area forestation works are still in progress[139] (Figure 3-42).

[139] Kiliç, S. and Karataş, N. (2015). The Role of the Urban Renewal Projects on the Reshaping of the Cities: İzmir (Turkey) Case, International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering Vol:9, No:3, pp.239-243

Figure 3-42: Kadifekale (before and after) (Source: Kiliç, S. and Karataş, N. 2015)

Another type of urban regeneration has been implemented by central government agencies by the determination of at-risk areas and high-risk buildings based on National Law no 6306 (Figure 3-43). In Turkey, approximately 7.5 million buildings were estimated as high risk and subject to urban regeneration and expected to renew within next decades. According to Building Construction Statistics by Turkish Statistical Institute, the share of multi-storey buildings is 40% of total residential buildings constructed between 1960 and 2008 in Izmir[140]. Considering the existing building stock of Izmir, it is obvious that most part of the housing stock must be transformed through demolition, retrofitting and reinforcement activities which should be applied in the short-term due to high natural hazard risks (earthquake, landslides etc.).

Figure 3-43: At-risk areas determined according to Law No 6306 (Source: Kazanasmaz et al., 2014)

Regeneration of such a large building stock may have occur many environmental problems in coming decades. Construction and demolition waste have long term effect not only on environmental issue but also on economy. For this reason, several legislations regarding to the waste management were released in Turkey such as Article 4 of the "Law Regarding Assistance and Precautions for Disasters Occurring in Public Life", Article 23 of the "Regulation Regarding the Control of Solid Wastes" and "Regulation of the Control of Excavation Soil and Construction and Demolition Waste" enacted by the Ministry of the Environment and Forestry in 2004.

[140] Kazanasmaz, T., Erlalelitepe, İ., Gökçen Akkurt, G., Turhan, C., Ekmen, K.E.,2014. On the relation between architectural considerations and heating energy performance of Turkish residential buildings in Izmir, Energy and Buildings, 72: 38-50

While EU urges to recycle 70% of the construction and demolition wastes by 2020 and to decrease the amount of these wastes by %50 by 2050, Turkish legislations has no force on the issue. Construction and demolition wastes are approximately 45 million tons in Turkey according to National Recycle Strategy Document and Action Plan 2014-17. It is reported that 125 million tons/year excavated earth from the construction sites have been recycling only[141]. The construction and demolition wastes have been disposing to the storage areas. Consequently, it could be concluded that construction and demolition waste management is an important problem in Turkey.

3.7.3. Summary of challenges

- Decent housing supply for low-income communities is often inadequate and squatter housing areas have very low environmental standards.
- Social, cultural and historical aspects of urban regeneration are often ignored, it has generally seen as a part of renewing physical building stock in high rented areas.
- The dynamics of segregation and exclusion involved in the process of most private sector urban regeneration project.
- Old industrial sites are ruined close to central part of the city and they are need to adaptive re-use actions to survive.

3.7.4. Potential Actions to be taken

- In Izmir, urban regeneration not displacing its local residence has great success in municipality-operated projects. The coverage and content of the regeneration schemes should be extended.
- Non-housing building stock considered as industrial heritage should be preserved as in the case of old Airgas factory regeneration towards cultural centre.
- There should be NBSs and energy efficiency schemes should be implemented at least for the renewed stock of public lands.

3.8. Participatory planning and governance

3.8.1. Introduction to Participatory Planning and Governance

Socio-economic and spatial plans are prepared at different levels in Turkey such as local, regional and national. Urban planning in the forms of urban master plans, implementation plans and plans for specific purposes, on the other hand, is considered at the local level. The Planning Law (No: 3194) and some related regulations impose rules for the urban planning process and gives local governments authority for the preparation of the above-mentioned plans[142]. In other words, the

[141] Egercioglu, Y., İregol, A., 2017. Evaluation of Sustainable Construction Waste Management for Urban Regeneration Project in Izmir, Planlama, doi: 10.14744/planlama.2017.41636 (in Turkish)

[142] Say, N., Çolakkadıoğlu, D., & Özyurt, S. (2010). *Sea of Urban Development Plans in Turkey*

authority of the local governments starts with urban master planning in the urban planning process. There is also macro scale planning that come before urban master plans in the top of planning hierarchy in Turkey. Those plans are made by the central government-the Ministry of Environment and Urbanization.

Municipalities are responsible to produce local plans. However, development legislations do not define the regional and local differences that depend upon climate, topography and orientation. Hence urban environments cannot be formed depending on the local context that is the main pillar of identity of cities[143]. Furthermore, in Turkey, spatial planning at any level is not thoroughly concerned with connectivity and multi-functionality of open spaces and the focus has still been in isolated public areas rather than establishing a citywide socially and ecologically sustainable open space system.[144] Naturally, this spatial planning approach cripples the sustainable vision for establishing open and green space networks. More important is still implementation plans which impose certain standards on housing, industry and open spaces etc., within boundaries drawn by urban master plans. In this process, quantity of green spaces is much more important than the quality. For example, 10 m^2 of land has to be allocated as active open space per inhabitant[145]. However, distribution and access to different levels of urban green areas are not defined in that manner.

The style of governance, restructuring process of public administration and the role of the State in Turkey have been affected due to the impacts of globalisation and the process of information society, developments in the relations with the European Union (EU) and the like. Increasing demands of citizens from the administration required new mechanisms to be established for better quality services. In that manner, one of the first important steps affecting local organizations is the development of Local Agenda 21 initiative by UNDP, Turkish Government, and IULA-EMME (International Union of Local Authorities-Eastern Mediterranean and Middle East) in 1997. Then, some of the Turkish municipalities including İzmir started their Local Agenda 21 initiatives.[146] Another important step is the establishment of “City Councils” defined as a part of The Municipality Law enacted in 2005. The aim was to widen governance approach with the more comprehensive contribution of the civil society organizations, professional chambers and the other actors in the city that take part in the decisions and urban practices. In accordance with this Law “City Councils Regulation” entered in to force in 2006. In this context, the establishment of the City Councils has become an obligation for the municipalities in Turkey[147].

[143] Can, I. (2010). Urban Design and Planning System in İzmir, Journal of Landscape Studies Vol.3, pp.181-189

[144] Hepcan, Ş. (2013). Analyzing the Pattern and Connectivity of Urban Green Spaces: A Case Study of İzmir. *Turkey Urban Ecosystems16, Issue 2*, 279-293

[145] Official Gazette. (1999). *Active open space per inhabitant.* Retrieved from The Official Gazette of the Turkish Republic: http://www.resmigazete.gov.tr/arsiv/23804.pdf

[146] Palabıyık,H. and Toprak, Z. (2000). Participation and Civil Society: The Experiences of Izmir Local Agenda 21, Turkish Public Administration Annual, TODAİE, Vol. 24-26, pp. 95-106

[147] Tosun, E, Keskin, E. and Selimoglu, E. (2016). Bursa Kent Konseyi’nin Bilinirliğinin Araştırılması, Yönetim ve Ekonomi, 23(6), pp. 97-112

3.8.2. The case of İzmir

Recent governance efforts in Turkey and Izmir has gained momentum to promote Local Agenda 21 process. Before that, Izmir Metropolitan Municipality launched its own initiatives by partnerships involving local universities and voluntary sectors in l995. Positive impacts of HABITAT II summit in Istanbul has initiated the city-based dialogue for the establishment of Izmir's Local Agenda 21. First task of this new organization was investigating the vital urban and environmental problems of Izmir based on the issues like urbanization, environment and migration. Working groups were formed by volunteers. The group representatives held regular advisory meetings. The ultimate aim of these meetings is the preparation of an action plan for Izmir. All initiatives are systematic and continuous; and, they are waiting for great support from public and private sectors. Local governments in metropolitan area of Izmir; central government agencies, universities, interest groups and citizens were the participant of these studies[148].

When Local Agenda 21 initiatives has turned to be "City Councils" after 2005, most district municipalities of Izmir (population over 50.000) established its own city council and platform of Izmir City Councils. Local governments, the representatives of the public institutions and organizations, professional chambers, NGO representatives and the executives who served as governor and mayor level in İzmir participated in the council.

Integrated with democratic city governance, Izmir Metropolitan Municipality and Izmir Development Agency has started local advisory committees covering wide variety of private and public-sector institutions, universities and NGOs. The aim is the steering of local economic development by active contribution of those actors. Economic Development and Coordination Committee was established by İzmir Metropolitan Municipality [İzmir Ekonomik Kalkınma Koordinasyon Kurulu] in 2009. İzmir Development Agency's Development Board is another participatory city-based platform that are composed of local actors from the central government and provincial representatives. Its main task is to advise the Board of Directors related to the Izmir's problems and proposed solutions.

Regarding to participatory planning and design, The Municipality attempted to incorporate the views and the evaluations of the civil society, related public authorities, universities and professional organizations with their participation in the process of the formulation of these large-scale urban projects. Firstly, starting from the late 1990s and especially with the impetus gained during the 2005 UNIVERSIADE, the city has started to extend its local peculiarities within the perspective of Mediterranean Basin.

In 2009, Izmir Metropolitan Municipality has initiated a Culture Workshop that brought many creative people from various art and design fields, scientists and intellectuals from the academy and practice have become aware of the identity enhancement attempts by the city and started to be a part of the new vision based on (a) the city of innovation and design; (b) provide the vision in democratic and participatory practice; and (c) improve the vision through cultural and

[148] Kiliç, S. and Karataş, N. (2015). The Role of the Urban Renewal Projects on the Reshaping of the Cities: İzmir (Turkey) Case, International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering Vol:9, No:3, pp.239-243

ecological relationships via cities of Mediterranean Basin[149] (Figure 3-44) After a while, there became an apparent progress in the initiation of a number of macro-scale urban projects (such as Izmir Sea and Izmir History projects) which all made based on a local assets and contexts of Izmir.

One of the concrete outputs of this workshop is the initiation of idea of 'İzmir Akdeniz Akademisi' [Izmir Mediterranean Academy] as a civic, democratic platform and think-tank that functions under the leadership of İzmir Metropolitan Municipality, established in 2012. İzmir Mediterranean Academy undertook the role of supporting the innovation and design potential of the city and actualizing İzmir's vision of strengthening relations with the Mediterranean area with which it had constant relations throughout the course of its historical development. The Academy functions as four separate coordination units under the fields of history, design, culture-arts and ecology[150].

Secondly, another path of locality was described around fertile ground of city's hinterland largely based on agriculture and tourism. Those ecologically-sensitive urban-rural fringe is under pressure of rapid urbanization and need to be protected in a sustainable way. Therefore, Izmir Metropolitan Municipality initiated 'Urla-Çeşme-Karaburun Peninsula Local Development Idea Competition' held in 2008. One prominent outcome of this competition was 'İzmir Peninsula Sustainable Development Strategy' in 2013 as a model of Izmir's rural development agenda then later extended to series of basin-based local development strategies (Gediz-Bakirçay and Küçük Menderes Basins) between 2013 and 2016([151];[152]).

The common denominator of local development, planning and design strategies is harnessing local and regional asset base for the sustainable development of the city. The principal aim is to achieve high added value products and services from all kinds of regional resources and to transform them into local benefits taking into account the protection and low-impact development of valuable local and regional assets.

[149] Mengi, O., Durmaz Drinkwater, S.B., Oner, A.C., Velibeyoglu, K. (2017). Place Management of a Creative City: The Case of Izmir, International Journal of Knowledge Based Development, Vol.8 No:3, pp.271 - 291

[150] İZKA (2013a). Izmir Situational Analysis, Izmir Development Agency, İzmir.

[151] Velibeyoglu, K., Özdemir S., Baba A., Arsan Z.D., Yazdani H., Hazar D., Kaplan A., Boyacı M., Kurucu Y., Erdoğan N., Yıldız Ö., Erkan H., Afşar E. (2014). 'Urla-Çeşme-Karaburun' Peninsula Sustainable Development Strategy 2014-2023, İZKA (Izmir Development Agency) Publication, Izmir

[152] Velibeyoglu, K., Özdemir S., Baba A., Arsan Z.D., Yazdani H., Duran, E., Kaplan A., Boyacı M., Kurucu Y., Erdoğan N., Yıldız Ö. (2016). 'Gediz-Bakircay Basins Sustainable Development Strategy, Izmir Metropolitan Municipality Publication, Izmir

Figure 3-44: Izmir Culture Workshop of 2009, a new urban agenda of Izmir (Source: Original, 2009)

3.8.3. Summary of challenges

- Spatial planning at any level in Turkey is not concerned with establishing a socially and ecologically sustainable open and green space system.
- Spatial planning process in Turkey is not participatory and transparent enough. In some cases, even local governments are not consulted for spatial planning decisions taken by the central government.
- Proper definitions of the role and authority of institutions is needed. This helps to prevent the conflicts between central and local governments (usually central government does not tend to give the authority to decide on big investment projects to local authorities, also different institutions develop synchronous plans).
- In the development of local plans, concurrent relation between many actors is needed instead of consecutive relation between architects and planners.

3.8.4. Potential actions to be taken

- Participative mechanism should be enhanced by active citizen engagement programs and schemes applied by both metropolitan and district municipalities.
- Izmir Mediterranean Academy is a good case to provide both think tank and democratic platform for the citizen engagement. However, the latter should be given more importance in the future planning.
- Participatory thematic strategic plans like “Izmir Green Infrastructure Strategy” should be integrated with physical plans in order to provide networks of ecologically sustainable open and green space system.

3.9. Social justice and social cohesion

3.9.1. Introduction to Social Justice and Social Cohesion

Greening cities, namely installing new parks, rooftop gardens or planting trees along the streets, undoubtedly contributes to an increase in wellbeing and enhances the attractiveness of open spaces in cities. At the same time however, increasing use of greening strategies as ingredients of urban renewal, upgrading and urban revitalization as primarily market-driven endeavours

targeting middle class and higher income groups sometimes at the expense of less privileged residents can be observed. What trade-offs between social and ecological developments in cities mean for the future debate on greening cities and a socially balanced and inclusive way of developing cities for various groups of urban dwellers need to be further debated. Current and future functions and features of greening cities have to be discussed more critically including a greater awareness of social impacts.

The European Commission has introduced legislation and several strategies for developing and enhancing urban green and blue spaces, such as the Green Infrastructure Strategy, the Biodiversity Strategy, the Habitats Directive and the Water Framework Directive. These initiatives (more indirectly) and the current research EU research programme Horizon 2020 emphasize two concepts in particular; Green Infrastructure (GI) and Nature-based Solutions (NBS) as important concepts in the discussion about sustainable cities and as ways to address the UN Sustainable Development Goal No. 11: Make cities and human settlements inclusive, safe, resilient and sustainable (https://sustainabledevelopment.un.org). Both GI and NBS are concepts based on the different contributions of green spaces to the urban environment: GI refers to an interconnected network of green spaces that helps stop the loss of biodiversity and enable ecosystems to deliver their many services to people and nature. NBS are instruments inspired by nature and using the properties and functions of ecosystems to enhance ecosystem services and multiple health benefits. They claim to provide solutions for a broadly contextualized 'environmental and health challenge' in cities mainly referring to air pollution, extreme heat and flood events and increasing numbers of cardio-vascular diseases, asthma or obesity on the one hand, and losses of life and disproportional property values on the other. These arguments build upon the 'healthy city debate', and the discussion around climate change adaptation where urban green spaces play an important role in mediating climate change related impacts. At the same time, GI and NBS often claim to address social issues such as social cohesion, socio-spatial inequalities and an unequal distribution of goods and burdens in/across cities. EU documents on GI and NBS argue that the multiple benefits of their installation include 'fostering social cohesion', and contribute to the solution of 'various societal challenges'. The EC's report uses the term social inclusiveness to describe the cumulative social benefits created and supported by GI and NBS in cities: Nature-based solutions use the features and complex system processes of nature, in order to achieve desired outcomes, such as improved human wellbeing and socially inclusive green growth. However, in reality, little is known about how the implementation of green strategies or policies affect health and wellbeing, livelihood and the living conditions of the urban poor in the mid and longer term. There is an alleged straightforward relation between GI, NBS and the socio-spatial dimensions of urban life as described above that needs to be challenged and scrutinized.[153] As these concepts become more popular and political processes mainstream their use, it is important to establish a more nuanced understanding of the social implications of greening strategies central to both GI and NBS concepts. It has been argued that, under certain circumstances, greening strategies carry a paradoxical risk of fostering greater inequality among social groups

[153] Haase, D. et al. (2017). Greening Cities, To be Socially Inclusive; About the Alleged Paradox of Society and Ecology in Cities. *Habitat International, 64 (2017)*, 41-48

rather than fostering social cohesion and inclusiveness: Projects that benefit one district may have negative impacts next door[154].

Undoubtedly, greening cities, installing new parks and using the space along the streets for diverse greenery for example contributes to an increase in wellbeing and enhances the attractiveness of open spaces in cities despite potential disservices like pollen allergies. At the same time, an increasing use of greening strategies that are official adopted as ingredients of urban renewal, upgrading and revitalization projects are observed but are in reality first and foremost market-driven endeavours primarily catering for higher income residents. Less affluent, low income and homeless people, in contrast, are threatened by displacement. “Cleaning up and clearing out”, or the contradiction between environmental and social ethics during processes of infill, upgrading and urban renewal, are central arguments in the emerging debate on green or eco(logical) gentrification. It questions whether social-ecological trade-offs are unintentional (seen as unexpected policy effects or externalities), or whether they are deliberately accepted or even desired when employing green strategies for urban renewal. This debate is not just theoretical; many studies analysing real estate markets have shown that the presence of nearby urban green spaces increases housing prices. Unequal socio-spatial distribution is reflected by differences in the quantity and size of green spaces, the structure of vegetation, and their quality. Poorer areas often have less vegetation, especially fewer trees, in contrast to more affluent urban areas with plenty of private gardens and shady green spaces, providing a larger amount and diversity of ecosystem services. In this context, greening projects may be seen as “ways that entrepreneurial urban regimes have sought to incorporate the green agenda” into a neoliberal development, something articulated as a ‘sustainability fix’. One effect (intended or not) is that existing social inequalities in access to public resources and the possibilities for urban dwellers to benefit from environmental goods are, in some cases, not improved by urban renewal activities, and might be even exacerbated. There is a documented trend of growing inequality in many cities across Europe, as evidenced by, among other things, increasing socio-spatial segregation, even polarization How to use greening to shape more liveable and healthy urban environments that meet the needs and wants of various groups of urban dwellers in a socially balanced and inclusive way is the quest for projects such as URBAN GreenUP. Needed approaches include;

a. Deliberate acknowledgement and consideration of socio-spatial inequalities in the planning, implementation and monitoring/evaluating of greening strategies by scientists and planners.
b. Consider and include not only different groups of actors into the design, planning and implementation of urban green areas or greening strategies but also different opinions and, as far as possible, contrasting views, needs and demands, including tacit and community knowledge. There is not just one view the shape, functionality and benefit of urban nature. Inclusiveness means not just to give all people access to urban green, but recognize their views and demands, sometimes even if they oppose experts’ preferences.

[154] Cucca, R. (2012). "The Unexpected Consequences of Sustainability, Green Cities Between Innovation and Ecogentrification". *Sociologica, 5(2)*

c. Acknowledgement and in-depth treatment of existing trade-offs between ecological and social processes or outcomes of a greening strategy or project. There is much evidence that greening is not socially just or fair per se, and more knowledge has to be gathered on how greening strategies and projects can be planned and implemented to maximize and widespread social benefits, too.
d. Green spaces are planned and managed, regardless of top-down, bottom-up or jointly, in a way that they can serve as places of encounter for different groups of people.
e. A multi-actor governance structure is needed to steer greening agendas in cities. Such governance structures may include national and local governments together with civil society organisations to ensure an inclusive representation of all residents and to prevent the aforementioned negative side-effects.
f. Even when the focus is on environmental issues, research should explicitly look at the political and economic context and related power constellations to avoid underestimating the embeddedness of greening into market-oriented strategies and pay more attention to ambivalences and trade-offs.

3.9.2. Case of Izmir

Social justice and social cohesion in Izmir's urban environment is summarized by the capability of access to affordable housing, social services and environmental infrastructure and amenities.

- **Access to affordable housing:**

In the beginning of 1960s, impacts of industrialization and consequent urbanization has brought problem of housing shortage and the city has started to grow beyond the Izmir Bay. Industrial developments also encourage other land use developments close by, such as mass housing, illegal housing, commercial land uses and etc. The squatter houses (gecekondu in Turkish), with insufficient infrastructure had started to surround the cities inevitably. As a result, low income and upper income neighbourhoods has started to distinguish in terms of access to daily urban services and basic living conditions (such as, clean water, drainage, even roads and electric line). This type of illegal and uncontrolled development has started to change social-spatial pattern of Izmir. These physical and social inequality in newly developed areas is still valid today, and most of old gecekondu neighbourhoods close to coastal parts of the city are now the subject of urban renewal projects for the sake of developing affluent communities(Figure 3-45). From the beginning of 1990s new type of housing started to be produced: closed (gated) and luxury housing for middle-upper income groups. Gradually, the signs of social and spatial segregation became more evident than the past[155]. Gentrification in inner areas of the city threatens low-income communities to be displaced from their neighbourhoods.

Earliest efforts to cope with housing shortage, other than gecekondu, was the development of social housing by municipalities and central government in Izmir. Izmir Metropolitan Municipality

[155] Kompil, E. (2017). Analysis of urban growth in developing countries and strategies for sprawl management: the case of İzmir, Unpublished Doctoral Dissertation, University of Seville

started to develop social housing projects on municipal land in mid 1980s. Those houses were produced by partnership with housing cooperatives with the leadership of the Municipality. Evka Projects, Egekent projects and various similar projects with district municipalities can be counted as a part of this process[156].

Figure 3-45: Squatter housing neighbourhoods close to İzmir's Central Business District (Bayraklı) (Source: IZKA, 2013a)

At the same time, traditional city centre—or inner areas—of the city of Izmir physical and social detoriation has occurred, high and middle-income groups left those areas. In post-1980s, poverty has been embedded within structures of social exclusion. This has led to the concentration of poverty in urban areas. A pattern of the concentrated urban poverty evolved in inner areas because certain jobs in the informal economy are located in the inner areas of metropolitan cities of Turkey. In Izmir, poverty becomes concentrated in central, old city neighbourhoods with a small-scale manufacturing and informal-marginal job opportunities for migrants. Also, the poor migrants, who usually choose these inner areas as their first stop for residence in the city, work in these small-scale manufacturing areas. Those people live low level access to the opportunities for upward social mobility[157]. Problems that may be caused due to the immigration from neighbouring provinces, intraregional migration from rural districts to metropolitan Districts (also recent international migration from the Middle East) have to be studied. Policies to support social integration over education, health, employment, urbanisation, urban awareness have to be included[158].

- **Access to social services (Healthcare, Education):**

As mentioned above disparities between affluent groups and low-income neighborhoods are still valid in inner city locations of Izmir. By creating new inequalities urban renewal projects alongside coastal areas have deepen this process as an output of gentrified enclaves. Another type of social inequalities has become more obvious in center and periphery due to the enlarging administrative boundaries of Izmir in current decade (Figure 3-46). Due to the growing population, peripheral

[156] Yörür, N. (1999). Use of public lands for mass housing projects in the privatization process-İzmir case, Unpublished Master Thesis, Izmir Institute of Technology

[157] Sönmez, I. (2007). Concentrated Urban Poverty: The Case of Izmir Inner Area, Turkey, European Planning Studies, Vol.15, No:3, pp

[158] İZKA (2013a). Izmir Situational Analysis, Izmir Development Agency, İzmir.

regions are still reflecting rural character that most of the daily urban social services are limited or lacking in numbers.

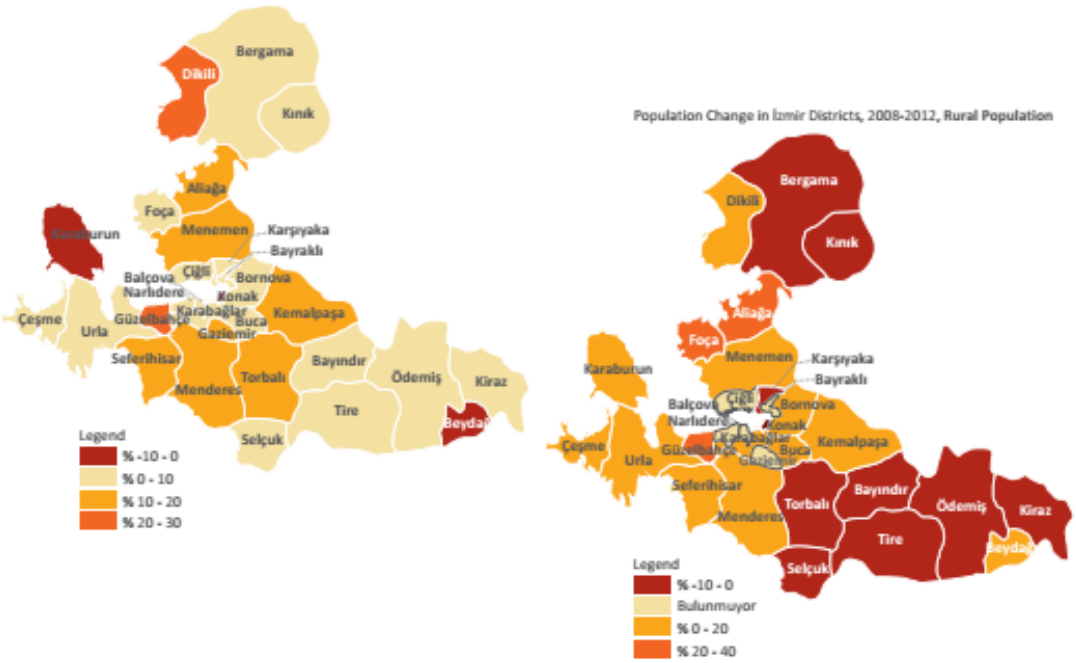

Figure 3-46: Population change in Izmir's districts, (Source: İZKA 2013a)

Due to the impact of actions carried out in healthcare field in İzmir along with the raised awareness, positive developments are observed in service delivery, access to services and basic health indicators. However, the imbalances between rural-urban areas and regions regarding physical infrastructure and healthcare facilities and personnel are still important. Because healthcare services are concentrated at the city centre in İzmir, districts far from the centre face accessibility problems. Intra-regional imbalances regarding accessibility to healthcare services should be eliminated (Figure 3-47)[159].

Intra-regional disparities in healthcare services are also valid for education. When district-based schooling ratios are examined, it is seen that ratios are close to each other at primary education level, while there are significant differences in regards to preschool and secondary education levels between districts. Districts with the lowest schooling ratios at preschool and secondary education level and districts with the highest ratio of illiterate population that mostly occurs at the rural and distant part of the Izmir (such as Beydağ, Bayındır, Menderes and Kiraz)[160].

[159] İZKA (2013b). Izmir Regional Plan (2104-2023), Izmir Development Agency, İzmir

[160] İZKA (2013a). Izmir Situational Analysis, Izmir Development Agency, İzmir.

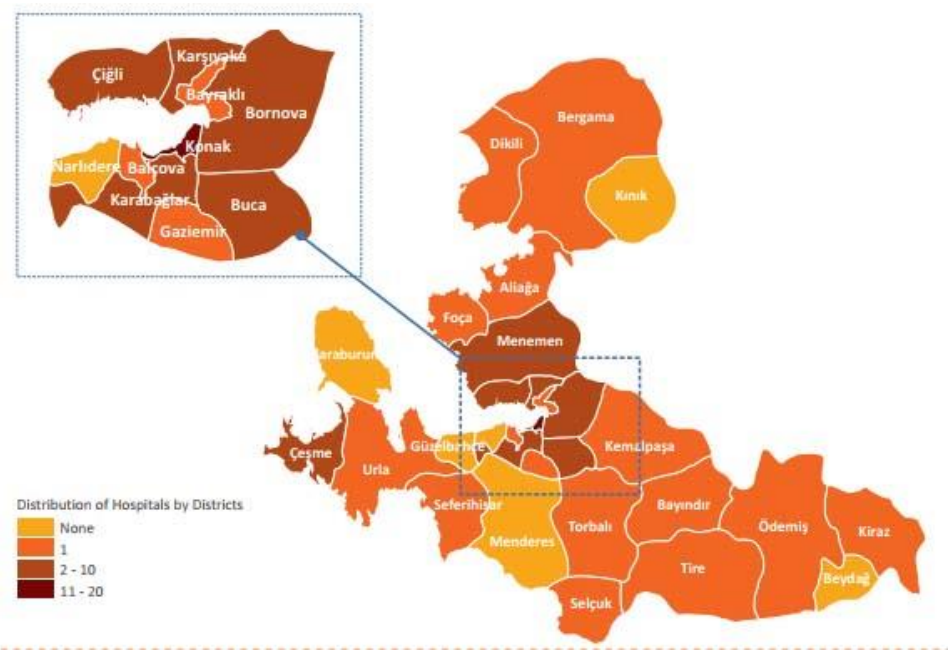

Figure 3-47: Regional distribution of healthcare services by districts (Source: İZKA, 2013a)

- **Access to Quality Living and Environmental Infrastructure:**

One of the most important tools for improving living quality is realization of an effective environment management. According to a study titled "Türkiye'nin Şehirleri Sürdürülebilirlik Araştırması" [Sustainability Survey of Turkish Provinces] conducted by Boğaziçi university for MasterCard Turkey indicated that Izmir is ranked first in natural assets and environmental infrastructure and management[161]. In terms of quality of living there is an old district-base study called "The Study on Socioeconomic Development Gradation of Provinces and Regions" (SEGE) published by the Ministry of Development in 2004. According to this study, there are striking differences between Izmir's remote regions and the districts become wealthier with manufacturing and tourism.

In addition to services directly related to employment such as continuous income, healthcare and social security, access to basic public services such as education, accommodation and transportation is also among the prerequisites for healthy integration into society. In this perspective, some individuals and groups such as handicapped people, women, people with different sexual orientations, Roma people, migrants and poor people face social exclusion at varying degrees. Social exclusion, which makes individuals face issues against existing effectively within social processes and brings along some very adverse social problems, is a phenomenon that represses social development. In this regard, an absolute intervention is required in both central and regional sense[162].

[161] Boğaziçi and MasterCard (2011). Türkiye'nin Sürdürülebilir Şehirleri Araştırması, İstanbul.accessed at: http://v3.arkitera.com/UserFiles/File/download/Turkiyenin_Illeri_Surdurulebilirlik_Arastirmasi.pdf

[162] İZKA (2013a). Izmir Situational Analysis, Izmir Development Agency, İzmir.

- **Citizen Engagement:**

Citizen engagement requires an active, intentional dialogue between citizens and public decision makers. Citizen engagement within the city has become more visible when Izmir Metropolitan Municipality implemented large-scale urban projects covering larger portions of the city.

The Izmir Mediterranean Academy, for example, has been developed in order to ensure the materialisation of the Izmir Vision and to fulfil the functions of think-tank and democratic platform that will contribute to the efforts of the inhabitants of Izmir to lead their lives by forming a community (Izmir Model, 2019). The Academy has intended to be an engagement platform with the means of some pre-determined sections: culture, history, ecology and design.

In ecology group in the academy, for instance, has developed a model of citizen science activities for the urgent sustainability issues such as biodiversity, archaeology that require active and volunteer involvement of citizens. Culture group, on the other hand, established Izmir Cultural Platform Initiative with local artists in the city and they mapped the cultural inventory of the city's creative industries. They also publish regularly cultural events in the called "Pla+form". Therefore, The Academy serves as an urban learning and civic engagement platform aiming to extend its horizon especially across the wider Mediterranean region. To this end, recently the mayor of Izmir Metropolitan Municipality sent a letter to the local governors in Barcelona, Beirut, Alexandria, Marseilles, Thessaloniki and Venice and offered them mutual cooperation for improving economic and cultural relationships of the Mediterranean cities[163].

Regarding to RUP, Izmir has completed Turkey's first green infrastructure strategy with the collaboration of academia, NGOs and other interested parties. With the know-how acquired by URBAN GreenUP project firstly has been devised to large scale urban design projects and then new spatial planning process which chooses the path of green and blue development[164].

3.9.3. Summary of challenges

- Rising affordable housing demand against the problem of immigration and uncontrolled urban growth, consequent physical divide between haves and have nots.
- Integration of public services to eliminate interregional disparities among the districts
- Healthy and safe access to environmental infrastructure and resources
- Innovative social policies and implementation options reducing social inequalities and exclusion

3.9.4. Potential actions to be taken

- Public services and infrastructures should take account of disadvantaged areas to create spatial justice.

- Accessibility and mobility to low-income neighborhoods should be enhanced.

[163] Izmir Metropolitan Municipality (2019). "First Step towards United Mediterranean" https://www.izmir.bel.tr/en/News/%E2%80%8Bfirst-step-towards-united-mediterranean/39554/162

[164] İzmir Metropolitan Municipality (2017). "İzmir'in Doğaya Saygı Planı" [Izmir's Respect to Nature Plan], https://www.izmir.bel.tr/tr/Haberler/izmirin-dogaya-saygi-plani/22219/156

- There should be social innovation actions to take place in the city beginning from the poor districts.

3.10. Public health and well-being

3.10.1. Introduction to public health and well-being

The urban environment significantly affects the health and well-being of residents.[165] NBS are supposed to improve the health and well-being of urban residents through the provision of ecosystem services by UGSs[166]. Urban trees and vegetation provide climate regulation services as they reduce the UHI-effect through evapotranspiration, and shading and can thus prevent heat related morbidity, and mortality[167]. NBS may reduce exposure to environmental pollution through mitigating the UHI ([168];[169]) and reducing air pollution[170] and noise[171]. As summarized in the Reducing Urban Heat Risk Final Report, high temperatures have a direct impact on human health and hot weather is already considered by many experts as a significant risk for many major cities around the world (Reducing Urban Heat Risk Final Report, 2014).

Scientific studies proved the beneficial effects of urban green spaces, such as improved mental health, reduced cardiovascular morbidity and mortality, obesity and risk of type 2 diabetes, and improved pregnancy outcomes. Mechanisms leading to these health benefits include psychological relaxation and stress alleviation, increased physical activity, reduced exposure to air pollutants, noise and excess heat.

Characteristics of urban green spaces are associated with health benefits. Healthier citizens mean reducing demands on health services and contributing to a stronger economy[172].

Although there are few direct empirical studies on negative/positive health effects of urban renaturing, one modelling study, carried out in Barcelona, based on UTOPHIA model (Urban and

[165] Barton, H., & Grant, M. (2006). A health map for the local human habitat. *J. R. Soc. Promot. Health 126,*, 252–253

[166] Keniger, L., Gaston, K., Irvine, K., & Fuller, R. (2013). What are the benefits of interacting with nature? *Int. J. Environ. Res. Public Health 10,*, 913–35

[167] Chen, D., Wang, X., Thatcher, M., Barnett, G., Kachenko, A., & Prince, R. (2014). Urban vegetation for reducing heat related mortality. *Environ. Pollut. 192*, 275–284

[168] Alexandri, E., & Jones, P. (2008). Temperature decreases in an urban canyon due to green walls and green roofs in diverse climates. *Build. Environ. 43*, 480–493

[169] Bowler, D., Buyung-Ali, L., Knight, T., & Pullin, A. (2010). Urban greening to cool towns and cities: A systematic review of the empirical evidence. *Landsc. Urban Plan. 97,*, 147–155

[170] Baro´, F., Chaparro, L., Go´mez-Baggethun, E., Langemeyer, J., Nowak, D., & Terradas, J. (2014). Contribution of Ecosystem Services to Air Quality and Climate Change Mitigation Policies: The Case of Urban Forests in Barcelona, Spain. *AMBIO 2014, 43*, 466–479

[171] Madureira, H., Nunes, F., Oliveira, J., Cormier, L., & Madureira, T. (2015). Urban residents' beliefs concerning green space benefits in four cities in France and Portugal. *Urban For. Urban Green. 14,*, 56–64.

[172] WHO. (2016). *Urban green spaces and health.* Copenhagen: WHO Regional Office for Europe

Transport Planning Health Impact Assessment) developed by CREAL, The Centre for Research on Environmental Epidemiology, is worth mentioning[173].

Physical inactivity and ambient air pollution are estimated to cause more than five million premature deaths each year worldwide, ranking them among the leading risk factors in the global burden of disease study. Car-centric city designs typical of preceding decades have little space assigned for green infrastructure, despite increasingly-known benefits for physical and mental health. Further to being the main source of air pollution in urban areas, motorized road traffic exposes an estimated 40% of Europeans to day time noise levels exceeding the WHO recommended threshold of 55 dB as well as produces anthropogenic heat that together with re-radiation effects of dense urban structures can amplify urban summer temperatures resulting in urban heat islands. Reducing exposure to urban environmental hazards, increasing exposure to green spaces and promoting physical activity (PA) may be achievable through community-level interventions such as health-promoting urban and transport planning.

The study showed the that an estimated 20% of annual mortality could be prevented if international recommendations for performance of PA, exposure to air pollution, noise, heat, and access to green space were complied with. Estimations showed that the biggest share in preventable deaths was attributable to increases in PA, followed by exposure reductions in air pollution, traffic noise and heat. Access to green spaces had smaller effects on mortality. Compliance was estimated to increase the average life expectancy by 360 (95% CI: 219, 493) days and result in economic savings of approximately 9.3 billion € per year. The researchers concluded that PA factors and environmental exposures can be modified by changes in urban and transport planning. We emphasize the need for (1) the reduction of motorized traffic through the promotion of active and public transport and (2) the provision of green infrastructure, which are both suggested to provide PA opportunities and mitigation of air pollution, noise, and heat.

3.10.2. The case of İzmir

As a result of climate change, extreme weather conditions and hotter summers caused increases in many health-related problems such as respiratory illnesses in İzmir. In a similar fashion, increased UV radiation resulted in more cases skin diseases in summer time. In winter, excessive of fossil fuels caused air pollution and increased respiratory diseases.[174]

In İzmir, quality and quantity deficiencies in UGSs and lacking of a well-functioning and complete urban green system or green infrastructure present a major challenge that needs to be tackled

[173] Mueller, N. (2016). "Urban and Transport Planning Related Exposures and Mortality, A Health Impact Assessment for Cities", . *Environmental Health Perspectives*, EHP online; https://ehp.niehs.nih.gov/EHP220/

[174] TEMA. (2015). *TEMA*. Retrieved from İklim Değişikliğinin Yerel Etkileri Raporu: http://sertifika.tema.org.tr/_Ki/CevreKutuphanesi/Documents/Iklim-Degisiklik-Yerel-Etkileri-Rapor-Kitapcigi.pdf

urgently [175] because positive relations between public health and well-being and green areas are very well documented ([176];[177];[178];[179];[180]).

Providing air quality is important tackling with lung cancer cases in İzmir. The flourishing manufacturing industry, fossil-fuel energy stations, rising levels of traffic density and fusel-fuel domestic heating are major sources of air pollution. In addition to long-term exposure to air pollution other factors include as tobacco smoke, chemical pollutants (such as asbestos, beryllium, cadmium), radiation treatment to the lungs, personal and family history, genetics and diet. According to recent study concerning lung cancer cases in Izmir found that spatial clusters of lung cancer were detected in central geographic locations with low level environmental quality and high-level socio-economic profile (Figure 3-48)[181].

[175] Hepcan, Ş. (2013). Analyzing the Pattern and Connectivity of Urban Green Spaces: A Case Study of İzmir. *Turkey Urban Ecosystems16, Issue 2*, 279-293

[176] de Vries, S., Verheij, R., Groenewegen, P., & Spreeuwenberg, P. (2003). Natural environments — healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environ. Plan. A 35*, 1717 – 1731

[177] Thompson, C., Roe, J., Aspinall, P., Mitchell, R., Clow, A., & Miller, D. (2012). More green space is linked to less stress in deprived communities: Evidence from salivary cortisol patterns. *Landsc. Urban Plan. 105*, 221–229

[178] Roe, J., Ward Thompson, C., Aspinall, P., Brewer, M., Duff, E., Miller, D., . . . Clow, A. (2013). Green space and stress: Evidence from cortisol measures in deprived urban communities. *Int. J. Environ. Res. Public Health 10*

[179] Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Nature and health. Annu. Rev. . *Public Health 35*, 207–208

[180] Bratman, G., Daily, G., Levy, B., & Gross, J. (2015). The benefits of nature experience: Improved affect and cognition. *Landsc. Urban Plan. 138,*, 41–50

[181] Özkan, P. (2013). An Assessment of Spatial Relationship between Lung Cancer Incidence Rate and Quality of Urban Life: Izmir Case, Unpublished Master Dissertation, Izmir Institute of Technology, İzmir

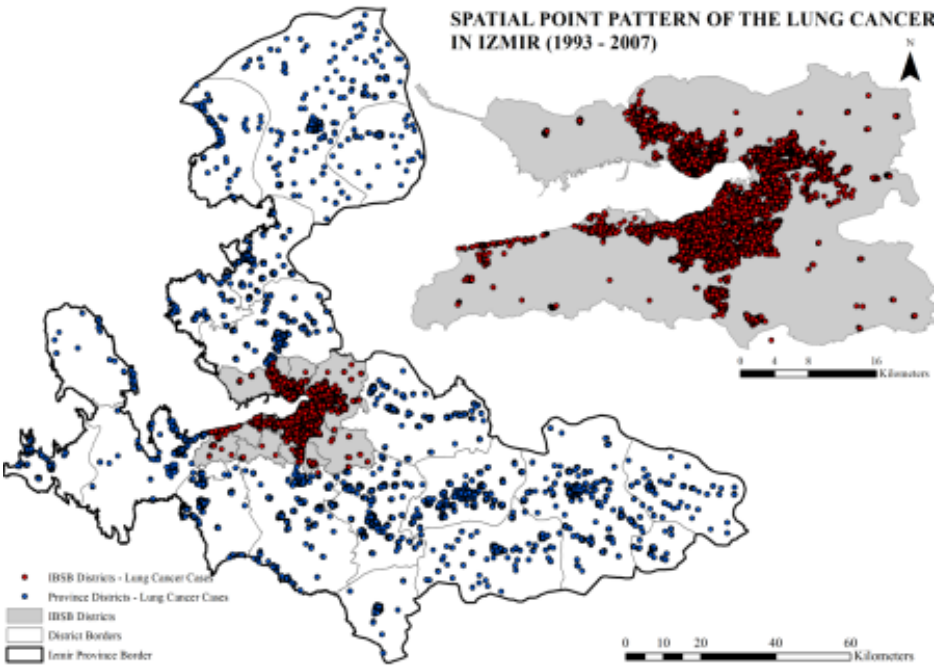

Figure 3-48: Distribution of Lung Cancer cases among districts (Source: Özkan P., 2013)

Streams in İzmir are not a source of attraction for people in terms of physical activities through on and off water experiences. Designated trails along the streams for pedestrian and bikes may attract people to experience a diverse set of activities because urban water bodies provide significant opportunities for physical activity through on- and off-water experiences. Given urban water bodies typically incorporate trails, and they serve as magnets for physical activity[182].

On the other hand, green promenade along the İzmir bay that extends all way from Guzelyalı to Bostanlı is a real magnet for İzmirians. It is also connected with public transportation (street car-light rail) and bicycle and pedestrian routes. What is supposed to do is to review the planting design along this promenade (more large canopy trees) in order to make it more attractive for urban wildlife and increase the ecosystem services provided. More importantly, the promenade needs to be extended into inner parts of the city with the same mentality and design approach.

3.10.3. Summary of challenges

- Lack of evenly distributed urban green areas across the city is an important challenge.
- Lacking of sufficient trails and urban park system except the coastal promenade is another problem.
- Planting design in green areas is somewhat problematic because maintaining or enhancing biodiversity and preventing or mitigating plant and pollen allergies are not considered.
- Pollen and allergens in the city are not measured and monitored.

[182] Schneider, I. E. (2009). Urban Water Recreation: Experiences, Place Meanings, and Future Issues (ch.7), . In L. A. (Ed.), *The Water Environment of Cities* (pp. 125 - 140). New York, USA,: Springer Science+Business Media, LLC

- Walking and cycling trails could be considered both within the city and its peripheries that present countless opportunities. As a part of a citywide green infrastructure, blue corridors provide good spaces for pedestrian and bike trails.

3.10.4. Potential actions to be taken

- Well-connected urban green areas that offer safe opportunities for urban residents for active mobility and sports as well as for stress recovery, recreation and social contact should be designed
- Pollen allergies should be considered for selection of plant species in urban green spaces.
- Management and maintenance of urban green areas is solely very important. Proper and more sustainable approaches are required in the city.
- Densely branched large canopy trees (preferably long-live trees) are mostly recommended for all the green areas in the city for the comfort of city dwellers and removing atmospheric pollutions.

3.11. Economic opportunities and value of ecosystem services

3.11.1. Introduction to Economic Opportunities and Value of Ecosystem Services

The new urban era in which the ecology of the planet as a whole is increasingly influenced by human activities, with cities as crucial centres of demand for ecosystem services and sources of environmental impacts. Approximately 60% of the urban land expected to exist 2030 is forecast to be built in 2000–2030. Urbanization therefore presents fundamental challenges but also unprecedented opportunities to enhance the resilience and ecological functioning of urban systems.

For instance, urban ecosystems, that is, the urban 'green and blue infrastructure', may have a crucial role in increasing the adaptive capacity to cope with climate change. Analyses of urban investments in green infrastructure and ecosystem-based adaptation to climate change are gaining interest, particularly since such investments simultaneously generate many other services enhancing human well-being. Furthermore, there is a growing interest in restoring urban ecosystems, spurred in part by commitments made by the parties to the Convention on Biological Diversity to restore at least 15% of degraded ecosystems by 2020. Investing in urban green and blue infrastructure constitutes a tangible contribution that cities can make to the United Nations' agenda on a Green Economy for the 21st Century and the Sustainable Development Goals (SDGs). Although several recent studies highlight the importance of urban ecosystem services still, ecosystem dynamics in urban landscapes are poorly understood, especially when it comes to designing, creating and restoring ecological processes, functions, and services in urban areas.

Urban ecosystem services are generated in a diverse set of habitats such as: green spaces, such as parks, urban forests, cemeteries, vacant lots, gardens and yards, campus areas, landfills; and blue spaces, including streams, lakes, ponds, artificial swales, and storm water retention ponds. Urban ecosystem services are generally characterized by a high intensity of demand/use due to a very large number of immediate local beneficiaries, compared for example to ecosystem services

generated in rural areas distant from densely populated areas. Examples of important services provided by green and blue infrastructure in urban areas can be seen below[183].

- ✓ **Microclimate regulation**: Urban parks and vegetation, including green roofs and green walls, reduce the urban heat island effect. Data from Manchester (United Kingdom) show that a 10% increase in tree canopy cover may result in a 3–4 degrees decrease in ambient temperature and save large amounts of energy used in air conditioning. The cooling effect of trees in cities may contribute significantly to reduce energy needs from fossil fuels and cut carbon emissions.
- ✓ **Water regulation**: Interception of rainfall by trees, other vegetation, and permeable soils in urban areas can also be crucial in reducing the pressure on the drainage system and in lowering the risk of surface water flooding. Urban landscapes with 50–90% impervious ground cover can lose 40–83% of incoming rainfall to surface runoff whereas forested landscapes only lose ca. 13% of rainfall input from similar precipitation events.
- ✓ **Pollution reduction and health effects**: Urban vegetation is widely reported to improve air quality although this effect can be context dependent due to the high spatial and temporal variability in and among cities. Many other potentially positive public health benefits have been identified. Green area accessibility has been linked to reduced mortality and improved perceived and actual general health. The distribution and accessibility of green space to different socio-economic groups, however, often reveals large asymmetries in cities, contributing to inequity in both physical and mental health among socio-economic groups.
- ✓ **Habitat:** An important characteristic of urban areas is their mosaic of habitats and a surprisingly high diversity of plant and animal species. In addition to the innate, or inherent value of species and biodiversity, this service also provides deeply important benefits for many citizens or many or all cultures, and also for national and local governments trying to implement their commitments to reduce biodiversity loss and restoring 15% of all degraded ecosystems (including 10% of the oceans).
- ✓ **Cultural services**: Many cultural services are associated with urban ecosystems and there is evidence that biodiversity in urban areas plays a positive role in enhancing human well-being. It has been shown for example, that the psychological benefits of green space increase with biodiversity, whereas a 'green view' from a window increases job satisfaction and reduces job stress. Many studies have shown an increased value of property with greater proximity to green areas. Diverse ecosystems in urban areas may also be important in providing design features that can be utilized in the context of eco-design and bio-mimicry in architecture and urban planning.

Although the importance of ecosystems to human society has many dimensions (ecological, socio-cultural and economic), expressing the value of ecosystem services in monetary units is an important tool to raise awareness and convey the (relative) importance of ecosystems and biodiversity to policy makers. Information on monetary values enables more efficient use of limited funds through identifying where protection and restoration is economically most

[183] Elmqvist, T., Setala, H., Handel, S., van der Ploeg, S., Aronson, J., Blignaut, J., . . . de Groot, R. (2015). Benefits of restoring ecosystem services in urban areas. *Curr. Opin. Environ. Sustain. 14,*, 101-108

important and can be provided at lowest cost. It can also assist the determination of the extent to which compensation should be paid for the loss of ecosystem services in liability regimes. Expressing ecosystem service values in monetary units also provides guidance in understanding user preferences and the relative value current generations place on ecosystem services. These values help to make decisions about allocating resources between competing uses whereby it should be realised that monetary values that are based on market prices only, usually neglect the rights (values) of future generations. Furthermore, the measurement of the broad range of ecosystem service flows and their values in monetary units or otherwise is a fundamental step to improve incentives and generate expenditures needed for their conservation and sustainable use, such as systems of Payments or Rewards for Ecological Services.

It should be emphasized that monetary valuation does not imply that economic incentives are the only solution but should be seen as an addition to other instruments such as spatial planning and regulation. To stimulate public debate and policy action, a global assessment of The Economics of Ecosystems and Biodiversity (TEEB) was launched in 2007 and the results published in 2010 and 2011[184] (TEEB Foundations, 2010; TEEB in Business, 2011; TEEB in Local Policy, 2011; TEEB in Policy, 2011; TEEB Synthesis, 2010).

Supporting the TEEB study, an Ecosystem Service Value Database (ESVD) with more than 1350 value-estimates was developed[185]. The figure below shows the relational representation of the Ecosystem Service Valuation Database - ESVD.

[184] TEEB in Business, 2011. In: Bishop, J. (Ed.), The Economics of Ecosystems and Biodiversity in Business and Enterprise. Earthscan, London, Washington.
TEEB in Local Policy, 2011. In: Wittmer, H., Gundimeda, H. (Eds.), The Economics of Ecosystems and Biodiversity in Local and Regional Policy and Management. Earthscan, London, Washington.
TEEB in Policy, 2011. In: ten Brink., P. (Ed.), The Economics of Ecosystems and Biodiversity in National and International Policy Making. Earthscan, London, Washington.
TEEB Foundations, 2010. In: Kumar, P. (Ed.), The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations. Earthscan, London, Washington.
TEEB Synthesis, 2010. Mainstreaming the Economics of Nature: A Synthesis of the Approach Conclusions and Recommendations of TEEB. Earthscan, London, Washington.
[185] De Groot, R. Et al, " Global estimates of the value of ecosystems and their services in monetary units", 1 (2012), 50-61.

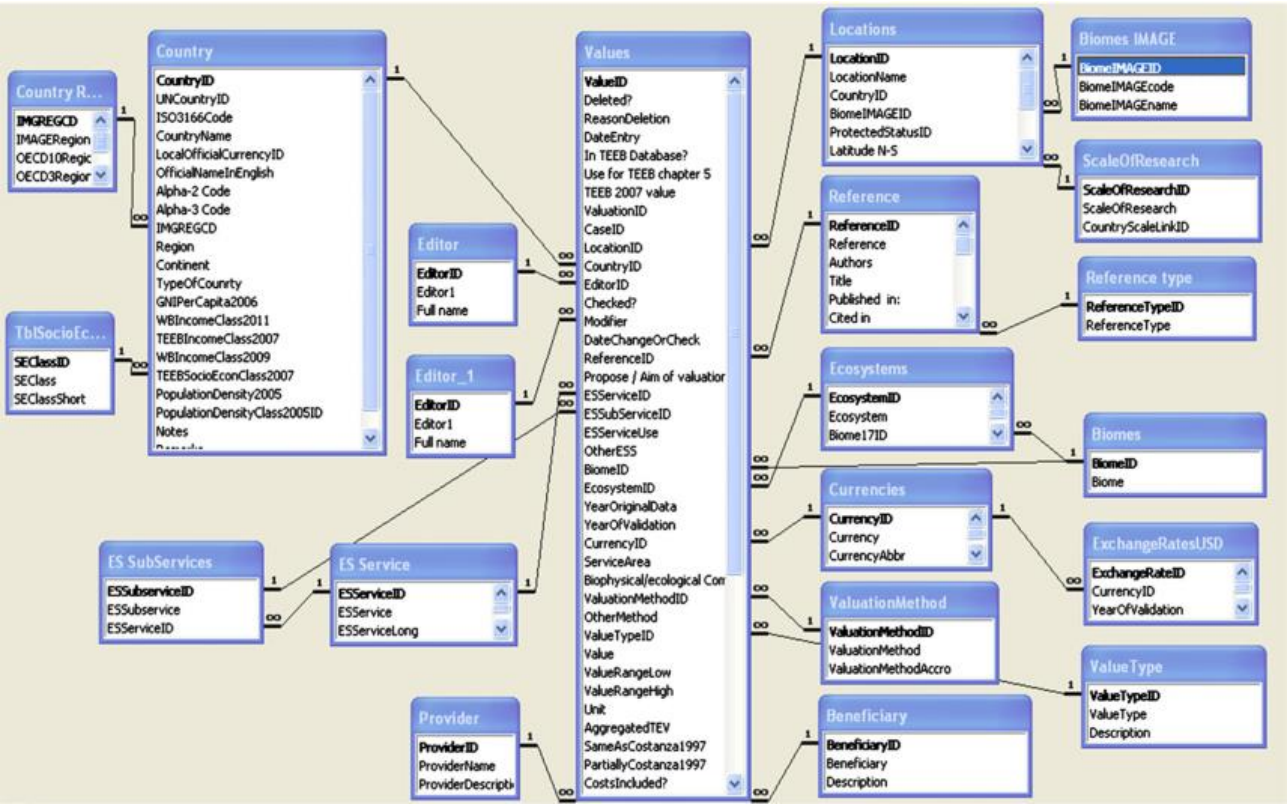

Figure 3-49: Schema of the ESVD (Source: De Groot, R. Et al, 2012)

A summary of the ESVD can be seen in the table below describing the monetary value as a result of a large number of studies worldwide.

Summary of monetary values for each service per biome (values in Int.$/ha/year, 2007 price levels).

	Marine	Coral reefs	Coastal systems	Coastal wetlands [a]	Inland wetlands	Fresh water (rivers/ lakes)	Tropical forest	Temperate forest	Woodlands	Grasslands
Provisioning services	102	55,724	2396	2998	1659	1914	1828	671	253	1305
1 Food	93	677	2384	1111	614	106	200	299	52	1192
2 Water				1217	408	1808	27	191		60
3 Raw materials	8	21,528	12	358	425		84	181	170	53
4 Genetic resources		33,048		10			13			
5 Medicinal resources				301	99		1504			1
6 Ornamental resources		472			114				32	
Regulating services	65	171,478	25,847	171,515	17,364	187	2529	491	51	159
7 Air quality regulation							12			
8 Climate regulation	65	1188	479	65	488		2044	152	7	40
9 Disturbance moderation		16,991		5351	2986		66			
10 Regulation of water flows					5606		342			
11 Waste treatment		85		162,125	3015	187	6	7		75
12Erosion prevention		153,214	25,368	3929	2607		15	5	13	44
13 Nutrient cycling				45	1713		3	93		
14 Pollination							30		31	
15 Biological control					948		11	235		
Habitat services	5	16,210	375	17,138	2455	0	39	862	1277	1214
16 Nursery service		0	194	10,648	1287		16		1273	
17 Genetic diversity	5	16,210	180	6490	1168		23	862	3	1214
Cultural services	319	108,837	300	2193	4203	2166	867	990	7	193
18 Esthetic information		11,390			1292					167
19 Recreation	319	96,302	256	2193	2211	2166	867	989	7	26
20 Inspiration		0			700					
21 Spiritual experience			21							
22 Cognitive development		1145	22					1		
Total economic value	**491**	**352,249**	**28,917**	**193,845**	**25,682**	**4267**	**5264**	**3013**	**1588**	**2,871**

Table 3-16: Monetary value for ecosystem services (Source: De Groot, R. Et al, 2012)

Investing in restoring, protecting, and enhancing green infrastructure and ecosystem services in cities is not only ecologically and socially desirable. It is also very often economically viable, even under prevailing economic models, provided that the multiple services and all their associated benefits for the large number of beneficiaries in cities are properly quantified and recognized. Such information is essential to include in decision-making processes related to land use and management in urban landscapes, and to help guide urban and landscape planners, architects, restoration practitioners, and public policy makers, as well as private and institutional stakeholders. Even though economic calculations provide useful arguments for environmental improvements, they are insufficient to fully capture, measure or monitor the scope of benefits related to restoring ecosystem services in cities. Indeed, many important ecosystem services were not taken into account in the few published studies featuring economic assessments of urban green infrastructure benefits considered here, including multiple health effects, provisioning services, and social well-being related to non-use values. Much further works is needed to adequately capture and visualize these values.

3.11.2. Case of Izmir

Few studies exist in Turkey regarding the value of ecosystem services. One noteworthy study, though not directly related to İzmir, and not related to urban renaturing, was carried out by FAO (UN Food and Agriculture Organization) and Plan Bleu with the support of FFEM (Fonds Français pour le Environment Mondial) and collaboration of DKM (Doğa Koruma Merkezi), Turkish Ministry of Forestry and Water Affairs as well as the General Directorate for Forestry (OGM)[186]. Despite the fact that the study concerns a non-urban habitat, it is useful to note the results. The study aimed at optimizing the production of goods and services by Mediterranean Forest Ecosystems in the context of global changes. Table 3-17 summarized the findings of the study.

Goods or services	Data source	Assessment method	Physical quantity	Economic unit value	Total value/year	Value/ha
Wood Products	General Directorate of Forestry	Market Price Method	8,607.47 m^3	256.57 Euro/m^3	285,662 € (in 2014)	16.15 €/ha/year
Biodiversity Protection	General Directorate of Nature Conservation and National Parks	Cost Based Method	17,688 ha of forest (521 ha of breeding station in the forest area)		80,895 € (in 2013)	4.57 €/ha/year[10]
Recreation and Tourism	Döşemealtı Municipality	Benefit Transfer Method	206,110 visitors	1.61 euro/visitor	331,228 €/year (in 2014)	18.73 €/ha/year
Carbon sequestration	General Directorate of Forestry	Shadow Price	2.06 tCO_2/ha/year (average from 2008-2013)	29 €/tCO_2	1,056,023 €/year (average from 2008-2013)	59.74 €/ha/year

Table 3-17: Ecosystem services valuation for the Düzlerçamı Forest in Antalya (Source: FFEM, DKM, OGM, 2016)

One other study was undertaken by researchers from Ege University in İzmir[187]. This one pertained to urban green area valuation and could be taken as an example directly related to İzmir

[186] Technical Report, "Assessment of Socio-Economic Value of Goods and Services Provided by Mediterranean Forest Ecosystems, Düzlerçamı Forest Antalya", 2011-2016

[187] Hepcan, C.C., Hepcan, S., " Assessing Air Quality Improvement as a Regulating Ecosystem Service in the Ege University Housing Campus ", Ege Üniv. Ziraat Fak. Derg., 2017, 54 (1):113-120

ecoservices valuation. The university housing area, separate from the main campus body of Ege University, has been measured in the study to contain 50% green cover as can be seen in the aerial photo (Figure 3-50).

Figure 3-50: Aerial photo of Ege University Housing campus. (Source: Hepcan, Ş. 2017)

The study showed that the housing campus, approximately 54 ha in area and up to 48% green cover, had the capacity to hold about 321.57 tons of CO2 annually, 8107.86 tons of Carbon Dioxide was stored by the green canopy. In addition, it was calculated that these plants removed about 28.70 kg of Carbon Monoxide (CO), 143.85 kg of Nitrogen Dioxide (NO2), 1.58 tons of Ozone (O3), 90.6 kg of Sulphur Dioxide (SO2), 69.61 kg PM2.5 and 479.90 kg PM10 particulate matter per year. The total valuation via pollutant absorption for the campus area was calculated to amount to ~ 112,000 USD by international comparisons. These calculations are valuable due to the fact that İzmir green canopy has been used in an urban context. The introduction of NBS offers an opportunity for the creation of "Green-Collar Jobs", from low-skill, entry-level positions to high skilled, higher-paid jobs.[188] Green jobs tend to stay local as they are not easily outsourced.[189] In Izmir there is no statistical data about the share of green jobs in local economy. But, it can be said anecdotal evidences from the various field of actions throughout the city. For example, beautification of green public spaces in the city through agricultural cooperatives, greening of public administration (Izmir claims getting the needs of all municipal buildings from renewable energy sources), supporting the development of green enterprises and the like.

In Izmir, there are also some avenues of opportunity in exploiting the potential of green jobs. With this regard, recent sustainable local development strategies of Izmir offer many opportunities for asset-based entrepreneurs from agri-business to green enterprise clusters. For example, Izmir is the leader in organic food export. Organic agriculture activities throughout Turkey have been first initialized in İzmir. Due to most of the product processing facilities being located in İzmir and most of the produced goods are exported from İzmir Seaport, central offices of almost all organic agriculture sector organizations housed in İzmir. 9 out of 19 organic agriculture and certification organization authorized by TKB are located in İzmir. Therefore, organic food cluster is aimed to

[188] Apollo Alliance, 2008; Falxa-Raymond et al., 2013

[189] Eurocities (2014). Green jobs for social inclusion, Report funded by European Union Programme for Employment and Social Innovation

become a respected and competitive organic raw material and food supplier. The transition from the regional base agricultural produce production to supply of branded organic food products for consumers with developed consumption trends within the domestic market is set as objective[190].

Izmir Metropolitan Municipality is now preparing a green infrastructure strategy that aims to develop more green jobs in the city using The Municipality-operated adult training organization called "Meslek Fabrikası". Additionally, The Municipality supports organized good practice agricultural production by means of agricultural cooperatives and applies green procurement and support purchase from them including products like milk and flowers. Therefore, Izmir Metropolitan Municipality supports local economy and production capability that help low impact development in which the internal migration has dramatically reduced and quality of life and social inclusion in peripheral regions has enormously been risen.

3.11.3. Summary of Challenges

- The share of green jobs in both national and local economy is very low.
- There is no proper inventory of stocks of natural assets in regional basis.
- Agricultural production and fragile natural stocks are under the threat of rapid urbanisation.
- Lack of valuation study about the impact of green spaces and NBSs.

3.11.4. Summary of Challenges

- Izmir has rich natural and cultural assets that asset-based entrepreneurship should be supported from agri-business to green enterprises.
- Vocational education in the implementation of NBS should be supported by publicly owned learning infrastructure (i.e. Meslek Fabrikası in Izmir case).

3.12. Calculation indicator for city diagnosis

The target of this chapter is the definition of a list of indicators which will be investigated under various challenges for İzmir to be considered during URBAN GreenUP project. These challenges can be listed as:

- Climate mitigation & adaptation
- Water Management
- Coastal Resilience
- Green Space Management
- Air Quality
- Urban Regeneration
- Participatory Planning and Governance
- Social Justice and Social Cohesion
- Public Health and Well-being
- Potential of economic opportunities and green jobs

[190] İZKA (2013a). Izmir Situational Analysis, Izmir Development Agency, İzmir.

Indicators which distributed and will be investigated under these challenges have the purpose of defining current situation and also showing and improving the behaviour of the city regarding the climate change.

During the decision making, features of each indicator identified will be taken into account to be able to describe the impact of the different challenges in terms of physical, chemical, biological, social, cultural and environmental structure of Izmir. These indicators are also going to help to measure the behaviours of each NBS that will be implemented during the project with qualitative results.

The table below (Table 3-18) also allows observing the scale of identified indicators in various ranges, as; regional, metropolitan, urban, street and building scales. This will provide to specify the current situation more effectively on selected zones by taking into consideration their own characteristics of the problems, challenges, budget, social issues, climate, etc.

CHALLENGES	INDICATOR	SCALE[191]
Climate mitigation & adaptation	Tonnes of carbon removed or stored per unit area per unit time	R
	Measurements of gross and net carbon sequestration of urban trees	R
	Decrease in mean or peak daytime local temperatures	RMU
	Measures of human comfort	RMU
	Heatwave risks	RMU
	kWh/y and t C/y saved	RMU
Water Management	Run-off coefficient in relation to precipitation quantities	RMUSB
	Absorption capacity of green surfaces	RMUS
	Temperature reduction in urban areas	RM
	Soil water storage capacity	RM
	Volume of water removed from water treatment system	USB
	Volume of water slowed down entering sewer system	USB
Coastal Resilience	Shoreline characteristics and erosion protection	RM
	Flooding characteristics	U
	Avoided damage costs	USB

[191] R=Regional M=Metropolitan U=Urban S=Street B=Building

CHALLENGES	INDICATOR	SCALE[191]
	Changes in property value	SB
	Recreation and public access	MU
	Number of students benefiting from education and research about coastal resilience/amenity	R
	Estimates of species, individuals and habitats distribution	RM
	Invasive and planted species	RMU
	Algal bloom	R
	Concentration of nutrients	US
	Salinity, pH	US
Green Space Management	Distribution of public green space	RMU
	Accessibility of urban green spaces for population	RMUS
	Recreational or cultural value	RMUS
	Accessibility to public parks gardens and play-grounds	RMUS
Air Quality	Annual amount of pollutants captured by vegetation	RMUS
	Net air quality improvement	MUS
	Pollutant fluxes per m2 per year	MUS
	Annual mean levels of fine particulate matter concentration	MUS
	Trends in emissions NOX, SOX	MUS
	Value of air pollution reduction	MU
	Air quality parameters NOX, VOC, PM, etc.	RMUS
Urban Regeneration	Index of biodiversity, provision and demand of ecosystem services	RMUSB
	Ecological connectivity	RMU
	Accessibility distribution, configuration, and diversity of green space and land use changes	RMU
	Percentage of reclaimed materials from existing buildings.	B
	Points awarded according to energy efficiency checklist	B

CHALLENGES	INDICATOR	SCALE[191]
	Percentage of total building stock	B
	Percentage of site area occupied by roads	RMUS
	Percentage of built from retained for culture	B
	Land dedicated to pedestrians: percentage of road network	RMUS
	Public transport links: walking distance to nearest facilities	US
	Access to open space: average distance for residents / employees	MUS
	Access to cultural facilities: average distance for residents	MUS
	Level of devices contributing to the safety of users in the neighbourhood	B
Participatory Planning and Governance	Openness of participatory processes	RMUS
	Legitimacy of knowledge in participatory processes	RMU
	Social learning concerning urban ecosystems and their functions / services	RMUS
	Policy learning concerning adapting policies and strategic plans by integrating ecosystem services and possibly their valuation	RMUSB
	Perceptions of citizens on urban nature	RMU
	Social values for urban ecosystems and biodiversity	RMU
Social Justice and Social Cohesion	Income per capita in a given neighbourhood, or urban area	US
	Being able to move freely from place to place; crime by time of day	SB
	Being able to use the senses, to imagine, think, and reason about the environment	SB
	Being able to have attachments to things and people outside ourselves	USB
	Being able to participate effectively in political choices; quality of public participation in environmental management	RMUSB
	Average share of the built-up area of cities that is open space for public use for all	RMU
	Indicators of family and friendship ties	S

CHALLENGES	INDICATOR	SCALE[191]
	Indicators of trust, attachment to neighbourhood, practical help, tolerance and respect	S
Public Health and Well-being	Increase in walking and cycling in and around areas of interventions	US
Potential of economic opportunities and green jobs	Number of subsidies or tax reductions applied for NBS measures	RMUSB
	Number of jobs created; gross value added	RMU
	Change in mean or median land and property prices	RMUSB
	New businesses attracted and additional business rates	RMU
	Resource efficiency in the urban system	RMU
	Public-sector cost per net additional job	RMU
	Net additional positive outcomes into employment	RMU
	Net additional jobs in the green sector enabled by NBS projects.	RMU
	Gross value added per employees based on full-time equivalent jobs in the green sector.	RMU
	Production benefit: earnings uplift arising from skills enhancement in the design and implementation of NBS.	RMU
	Consumption benefits: property betterment and visual amenity enhancement resulting from NBS.	RMU

Table 3-18: Indicators planned to be measured in Izmir

3.13. Barriers

A workshop on barriers and boundaries held in Izmir during the preparation stage of this report with the participation of stakeholders from Izmir Metropolitan Municipality and universities located in Izmir. People who are working for design and implementation of NBSs in Izmir shared their opinions and experiences about the barriers and boundaries for implementing NBSs in Izmir. The results from these discussions summarized in following paragraphs.

Administrative culture and practice are one of the most important issues regarding urban renaturing. A considerable number of items concerning administrative power distribution that must be considered as cross-cutting barriers limiting implementation of city renaturing strategies can be pointed out:

- ✓ **Lack of understanding of the challenges of sustainable development/ environment / climate change mitigation and adaptation by** local government.

- ✓ Knowledge and **know-how**: Fears of new innovative actions because of the lack of knowledge and lock-in to traditional practice.
- ✓ **Low municipal awareness on innovative funding schemes**: too much focus on central government handouts, EU funds, weak attention on other markets/community-funding opportunities.
- ✓ **Lack of appropriate skills** at city staff for Renaturing projects.
- ✓ Lack of communication within the Local Authority departments: in general terms there is no cross vision in the context of climate policy. **A holistic approach is needed and as opposed to silo mentality.**
- ✓ **Slow decision-making processes** - Too many hierarchical levels.
- ✓ Lack of inspiring examples of similar context, no specific cases to value, close to the city. Usually very parochial vision of local administrators.
- ✓ Awareness needs to be raised among real decision makers. It depends on who has *the last word* to implement this kind of interventions.
- ✓ Need to have a **strong political support** at top level for projects to succeed.
- ✓ Nervousness about new techniques and approaches, fear of taking a wrong decision because of bad communication and **the use of public money**.
- ✓ **Timing of investments**: Temporality of investments: How to benefit in the short run from long term investments and transformations.

Public Procurement processes for Renaturing have been identified as another critical cross-cutting issue. The points which weaken a suitable implementation of sustainable solutions are:

- ✓ **Lengthy procurement procedures:** The procedures, in many countries, are very lengthy and complex (involve -too- many stakeholders, at central, regional and local level);
- ✓ **"Lowest price" against "best offer":** it is difficult to identify the best value for money;
- ✓ **Delays in the public procurement process:** Changing anything in the public procurement process takes a lot of time as it requires so many levels of validation at central/regional and local levels.
- ✓ **Despite benefits, little real experience with PPP;** weak experience and knowledge of municipal staff on the methodology to be applied for PPP, lack of knowledge on benefits.

In the case of **legal matters,** it is revealed in most cases to be something involving all fields of intervention and an issue *not without difficulties.* In particular:

- ✓ **Complexity of legal framework:** with many power levels (state, regional, local).
- ✓ **In some cases, main infrastructural decisions may involve managing at different scales.** The city is not always the owner of the main infrastructure or relevant land.

Financial issues, sometimes critical to have a correct outcome regarding performance. There are several aspects to bear in mind:

- ✓ **Economic crisis:** observed by the lack in financial means and no knowledge on how to access to funds.
- ✓ **Lack of funding:** no knowledge of mechanisms and funding sources.
- ✓ **Cuts in subsidies and financial incentives:** Governments of many Countries (both central and regional) have cut subsidies

- ✓ **Costs of infrastructures and heavy procedures of procurement:** Costs of infrastructure and lengthy procedures of procurement in many Countries.

In conclusion, it can be said that Cities are vitiated by a lack of adaptation and flexibility to changes, growth and new challenges. The convergence of multiple stakeholders' interests is crucial in order to achieve a more sustainable future.

Critical Point: Lack of clarity in legal frameworks pertaining to urban planning.

The redistribution of competences to various central government institutions, causing an overlap between central and local governments, continues to be at the core of urban policy-making during the 2000s in Turkey. In 2003, the Tourism Encouragement Law no. 4957, for example, amended the previous law on tourism investments, which widens the authority of the Ministry of Culture and Tourism in planning, public land allocation and certification for tourism zones. The intervention by central power in local planning processes through tourism development areas has not been introduced for the first time. Nevertheless, its negative impact on urban development has become more complex.

The Privatisation Administration, a department under the supervision of the Prime Ministry, has become another powerful central public institution with the enactment of the Law no. 5398 in 2005. The integrity of urban policies is disregarded, and interventions in local dynamics are exercised more often especially through special privileges.

Noteworthy to mention is TOKI, the powerful public body responsible for housing. As a result of changes in legal and institutional instruments, amending the powers and responsibilities of TOKİ, the institution has acquired considerable power. Preparation of plans, when the ownership of land has been transferred to TOKİ; planning and selling the public land for the purpose of urban land development and housing provision are the responsibilities assigned to this institution. The central government enables large scale private sector's entry into the construction sector by either directly financing the sector through TOKİ or establishing partnerships with local governments. Opening up high urban rent potential areas either for the central government or for the private sector, TOKİ is definitely not using its authority to provide affordable housing to low-income segments of urban population, which was the initial founding aim of the institution. Development of the profit-oriented projects on public land either through subsidiary firms or through public-private partnerships is appropriation of public land, which leads to a transfer of the urban rent.

Each legal and institutional change constitutes a step towards strengthening the power of TOKİ while weakening that of local governments.

The enactment of Law no. 6306 on urban transformation in 2012 along with the establishment Ministry of Environment and Urbanism in 2011, widen the scope of urban transformation projects while reinforcing the authority of central government.

Therefore, it can be said that the evolution of urban policy in Turkey indicates feeble attempts toward devolution of power. The EU accession process stepped up the transition towards the decentralisation of power, however, recent years have seen a swing to centralisation of power embodied in central government institutions.

4. Conclusions

The diagnosis of urban challanges in Izmir, facing global climate change and in the context of the URBAN GreenUP Project, have been attempted by the present Report. A whole set of detailed reviews have been carried out to accurately characterize the geogeraphical and physical attributes of the city, the major challanges affected by long term climate change and the cities main avenues of resilience in the form of green space and water management, coastal resilience and quality of life determinants such as air quality.

The dynamics of urban expansion in Turkey, signified by rapid urban migration, significant social and economic urban stratification, urban sprawl and annihilation of natural and cultural heritage have also stamped their mark on Izmir's historical development, as documented comprehensively in different sections of the Report. The litany of challanges and problems are exasperated and multiplied by governance challanges for local goverments in Turkey as they try to attempt long term urban planning under the shadow of central government interventions. This dimension of difficulties has also been amply documented in the Report.

On the other hand, Izmir's, and the local government's insistent and determined striving towards a healthy and livable city cannot be overlooked as detailed in sections of the Report on Urban Regeneration, Participatory Planning and Governance, Social Cohesion and Justice. The city's colorful and plentiful social, economical and natural endowments should also be pointed at. The overwhelming dynamic of a globally urbanizing metropolis, under the economic circumstances dictated by national economic and political forces, faces locally driven strategies for a "sustainable urban climate" . The very logic of such a Project as URBAN GreenUP, signifies and enhances this local drive towards renaturing with a socially inclusive dimension. The successful implementation of NBS actions in Izmir, with strong participation by its citizens, not only implies a succesful final to the URBAN GreenUP Project but also, reaching of one more important milestone towards a resilient and livable city.