URBAN GreenUP

D4.3: Technical specifications of Izmir demo

WP 4, T 4.3 – T 4.4 – T 4.5

Date of document

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Technical References

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[1] PU = Public

Versions

Table 0-1: List of versions

Version	Person	Partner	Date
V1	Koray Velibeyoğlu & Gülden Gökçen Akkurt	IZT	14.05.2018
V2	Kaan Emir & Baha Kuban	DEM	15.05.2018
V3	Şerif Hepcan, Çiğdem Coşkun, Merve Özeren, Gülşah Adıgüzel	EGE	23.05.2018
V4	Yusuf Kurucu, Tolga Esetlili, Hüsnü Kayıkçıoğlu	EGE	25.05.2018
V5	Municipality team	IZM	20.06.2018
V6	Esra Demir, Baha Kuban, Kaan Emir, Oya Tabanoğlu	DEM	27.06.2018
V7	Koray Velibeyoğlu & Gülden Gökçen Akkurt	IZT	16.07.2018
V7	Yusuf Kurucu, Tolga Esetlili, Hüsnü Kayıkçıoğlu	EGE	17.07.2018
V8	Kaan Emir	DEM	25.07.2018
V9	Gülden Gökçen Akkurt, Gülşah Adıgüzel	IZT, EGE	26.07.2018
V10	Şerif Hepcan, Çiğdem Coşkun, Merve Özeren	EGE	26.07.2018
V11	Yusuf Kurucu, Tolga Esetlili, Hüsnü Kayıkçıoğlu	EGE	31.07.2018
V12	Koray Velibeyoğlu	IZT	01.08.2018
V13	Esra Demir, Baha Kuban, Kaan Emir, Oya Tabanoğlu	DEM	03.08.2018
V14	Municipality team	IZM	09.08.2018
V15	Şerif Hepcan, Çiğdem Coşkun, Merve Özeren, Gülşah Adıgüzel	EGE	10.08.2018
V16	Gülden Gökçen Akkurt	IZT	13.08.2018
V17	Municipality team	IZM	14.08.2018
V18	Koray Velibeyoğlu	IZT	14.08.2018
V19	Kaan Emir	DEM	16.08.2018
V20	Municipality team	IZM	17.08.2018
V21	Koray Velibeyoğlu	IZT	21.08.2018
V22	Kaan Emir, Baha Kuban	DEM	21.08.2018

V23	Şerif Hepcan, Çiğdem Coşkun, Merve Özeren, Gülşah Adıgüzel	EGE	27.08.2018
V24	Yusuf Kurucu, Tolga Esetlili, Hüsnü Kayıkçıoğlu	EGE	27.08.2018
V25	Municipality team	IZM	28.08.2018
V26	Gülden Gökçen Akkurt	IZT	28.08.2018
V27	Esra Demir, Kaan Emir, Oya Tabanoğlu	DEM	28.08.2018
V28	Koray Velibeyoğlu	IZT	28.08.2018
V29	Gülden Gökçen Akkurt	IZT	29.08.2018
V30 (Review)	Laura Pablos López	CAR	29.08.2018
V31	Kaan Emir	DEM	30.08.2018
V32	Koray Velibeyoğlu	IZT	31.08.2018
V33 (Review)	María González Ortega	CAR	10.06.2019
V34	Esra Demir, Kaan Emir	DEM	12.06.2019
V35	María González Ortega	CAR	13.06.2019

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0 Executive Summary

This report, D4.3 Technical Specifications of Izmir Demo, aims to explain SUBDEMO's interventions in detail for İzmir. The city of İzmir will become resistant to climate change effects with the replication of pilot nature-based solutions that will be implemented for the URBAN GreenUP project. The NBS specified are located in 3 demo sites and there are also non-technical interventions. According to the result of the analysis of sub demo areas conditions, interventions will be implemented.

A description of interventions to specific SUBDEMOs is included in this report. In addition, that SUBDEMO's feature, intervention's economic, operational and technical aspects have been discussed in the report in detail.

SUBDEMO – A interventions which are arboreal areas around car park areas, installation of parklets, smart soil into green shady structures, cool pavement around car parking area, green covering shelter for car parking area, green shady structures for car parking area can be followed within section 2.

In section 3, SUBDEMO – B interventions, which are smart soil production in climate-smart urban farming precinct, natural pollinator's modules, development of smart soils from mud plant to use in urban farming, grassed swales and water retention ponds around bio-boulevard and climate smart greenhouses, have been explained.

For SUBDEMO – C interventions which are cycle and pedestrian route in green corridor, planting 4,800 trees, urban carbon sink, culvert works for Peynircioğlu Stream, green pavements for Peynircioğlu Stream, green fences, establishment of fruit walls and industrial heritage route within the İzmir's new urban green corridor can be followed within the section 4.

Finally, non-technical interventions which are the bio-boulevard, education for the food-smart future of Izmir, urban farming educative/participate activities, learning for producers, the support for agricultural cooperatives and community-supported urban farming practices, engagement portal, bio-blitz event, the development of Izmir bio-diversity atlas, support to citizen project of NBS and city mentoring strategy can be followed within section 5.

In conclusion, the importance of the report is that defining each SUBDEMOs and interventions in detail, will help the project team when doing the construction works. It will be a guideline when replicating similar solutions to other parts of the city to increase the resistance against climate change.

1 Introduction

The technical specifications of İzmir document mainly consists of brief descriptions, location information, technical design details, operation and maintenance considerations and economic specifications of NBSs in Izmir.

The most important detail needs to be taken into consideration about this document is that it reflects the current situation and design details of Izmir's demo areas and planned interventions. It can be easily investigated that there are some changes in decisions given in previous documents in terms of implementation areas (e.g. the car park area of Vilayetler Evi has been added), scale of the implementations (e.g. the length of cycle and pedestrian route has been changed) and the breakdown of the budget (e.g. added equipment, changed scale of interventions).

The design stage is still continuing for some of the interventions but the details of all interventions given in the document with final decisions. It was not possible to give much details and breakdown of the planned budget under the economic specifications subsections of NBSs within the context of this document and reasons of the situation explained in detail in concluding part (chapter 6) of this report.

1.1 Purpose and Target Group

As well as providing the current situation and design details of NBSs in Izmir's demo areas, this report has become a basis for following studies especially for the tendering process which will be carried out following months of this year and tendering documents which will be prepared during the process.

One of the other purposes of the document is strengthen the accordance between Turkish partners as they are all parts of the design phase of interventions. During the preparation of the document many meetings, bilateral discussions, collaborative studies between different teams, audio calls and demo-site visits have been carried out and all partners provide their contributions by taking the advantage of this collaboration. The municipality team that has the key role during the implementations had the chance to collect and evaluate the opinions of specialists from various academic fields.

The document brings the information in terms of technical design, location, expected impacts and related KPIs of NBSs together in compliance with its main purpose.

1.2 Contribution of partners

Contribution of partners can be followed from Table 0-1: List of versions. The preparation stage of the document was the period that the collaboration between partners has reached its highest level since the beginning of the project.

1.3 Relation to other activities in the project

WP1 - D1.1 - NBS Catalogue: During the preparation of this document the information given in D1.1 and outcomes of the D1.1 used as resource.

WP4 - D4.1 & D4.2 - Diagnosis Report on Izmir & Baseline Definition of Izmir: Those deliverables provide information during the preparation of general descriptions of chapters and subsections under the sections of NBSs. Besides this, those deliverables give the possibility of comparison of the previous decisions with updated decisions.

WP5 - D5.1 - Technical KPIs definition: With the information has been collected within the studies of D5.1 provide information to the related KPIs parts of the NBSs.

2 Technical and Economical Definition of the Interventions - SUBDEMO - A

Sub Demo A will be deployed in the central area of Karşıyaka Metropolitan District characteristic of highly-urbanized areas (see Figure 2-1). It includes different transportation related locations (car parking areas and on-street parklet areas) that will reduce maximum/average temperatures and will reduce air pollutants. Car parking areas will be deployed in different locations with different building density levels in Karşıyaka and Çiğli (in Sasalı Natural Life Park) in order to illustrate peculiarities of urban heat island effect.

Figure 2-1: Sub Demo A: Karşıyaka Metropolitan District

Table 2-1: List of interventions in Sub-Demo A

Re-naturing urbanization	Water interventions	Singular Green Infrastructures
Arboreal areas around Car Park Areas		Smart Soil (Biochar) into Green Shady Structures
Installation of parklets		Green Covering Shelter for car parking area
		Green Permeable Pavement Around Car Parking Area
		Green Shady Structures for car parking area

Besides those interventions there are non-technical interventions going to implemented in related areas with Sub-Demo A. These non-technical interventions explained in detail in section 5 of this deliverable.

2.1 Arboreal areas around Car Park Areas

2.1.1 General Description & Purpose of the NBS

In the case of Izmir demo, in order to strengthen the cooling effect of the green-resting units and green shady structures, some wide canopy and tall trees will be planted around them. These trees will provide shady spaces for city dwellers especially in hot summer months, habitat for insects and birds and also serve as stormwater interceptors.

Related KPIs: a) Carbon sequestration in vegetation, b) Pollutant's removed by vegetation (in leaves, stems and roots) and c) Increase in shadow surface

Expected impacts; a) Increased carbon sequestration and pollutant's removal, b) A number of co-benefits including stormwater run-off mitigation, microclimate regulation through shading and evaporation.

2.1.2 Location

This NBS will be implemented in three different locations. One of the locations is Girne Avenue which the parklets will be implemented and the detailed investigation of this location can be found in section 2.2.2. The other location for arboreal areas is around the car parking areas in Sasalı Natural Life Park and Vilayetler Evi. Detailed explanation and figures of these areas can be found under the section 2.4.2.

2.1.3 Technical Specifications

Around the parklets and green shady structures, 26 trees will be planted for supporting the cooling affect.

Figure 2-2: A view for arboreal areas around a parklet

Trees which are going to be planted for this NBS, needs to meet some specific requirements and those requirements are indicated below:

- At least 5 m height
- The body circumference should be at least 26-32 cm

• Smooth body, healthy

• Petal height 3.0 m and up

• With a full petal structure,

• Grounded, stayed in the pot for at least 6 months, and roots needed to be formed.

Considering climatic and geographical conditions of related locations which explained before in deliverable D4.1 Report on Diagnosis of Izmir, 3 species for trees are recommended namely as;

- Ginkgo biloba
- Tilia argentea
- Liriodendron tulipifera

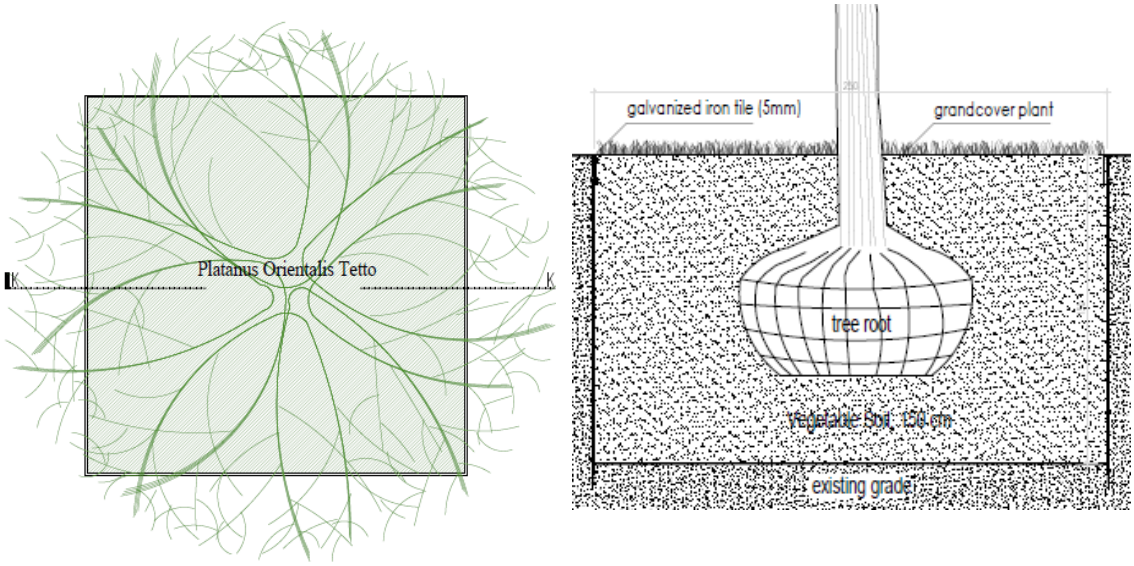


Figure 2-3: Plan view of trees and section view of tree roots

During planting trees, to fix the root bale of trees steel stretchers are going to be used as anchoring system. Stainless steel plates which will be type 316 according to AISI (American Iron and Steel Institute) and will be evaluated according to TS EN 10088 - 1, are going to be used as stainless compounds. For the galvanized steel compounds hot-dip galvanized coating which will have at least 85µm thickness and will be evaluated according to TS EN ISO 1461 will be used.

The trees will be fixed on free surface of soil with anchor root fixing system and steel stretchers from the body of the trees. The temporary stainless-steel stretchers will be fastened to the main body of the trees at 200-250 cm height from soil surface. There will be weekly controls on tightness of the stretchers after irrigation. Measures will be taken to prevent damage of steel equipment on the body of trees.

2.1.4 Operational and Maintenance Considerations

Operational and maintenance aspects of this NBS will be executed periodically by the Directorate of Parks and Gardens of Izmir Metropolitan Municipality (IMM). Details of the operational and maintenance aspects will be determined after detailed investigation of the implementation. However, it is already determined that depending on the species of plants

within the context of this, pruning works and controls of the irrigation system will be taken into consideration in different periods of a year.

2.1.5 Economic Specifications

Cost of plantation of 26 trees: 10.000€

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

2.2 Installation of Parklets

2.2.1 General Description & Purpose of the NBS

Parklets, as a part of Sub Demo A, are on-street units with siting equipment and plant containers. They are primarily designed to increase the amount of carbon sequestration as well as pollutant's removal with their plant cover. As some co-benefits, they are expected to attract some people to spend some time in a green space on a busy and dense urban fabric in Karşıyaka. They may also serve as somewhat cool spots through shading.

Air pollution is one of the main problems of heavily urbanized locations and Karşıyaka is not an exception. It has been experiencing air pollution especially in winter months owing to fossil fuels. Although natural gas has been used for the heating, there are still fossil fuel using neighborhoods in Karşıyaka and Çiğli districts. The air pollutant measurements indicated that especially December, July and August in 2016 are the worst months in terms of air quality. The air pollutants measured in Karşıyaka are CO, SO_2, PM_{10}, NO_2, NO_x and NO.

Related KPIs: a) pollutants removed by vegetation (in leaves, stems and roots) (kg ha^{-1} $year^{-1}$), b) carbon sequestration in vegetation c) Increase in walking and cycling in and around areas of interventions d) Perceptions of citizens on urban nature (from grey to green)

Expected impacts: a) reduction of air pollutants through increased deposition, b) a number of co-benefits including, microclimate regulation through shading, habitat and food provision for biodiversity, and recreational and social ecosystem services, c) increase in community ties and creates public interaction opportunities.

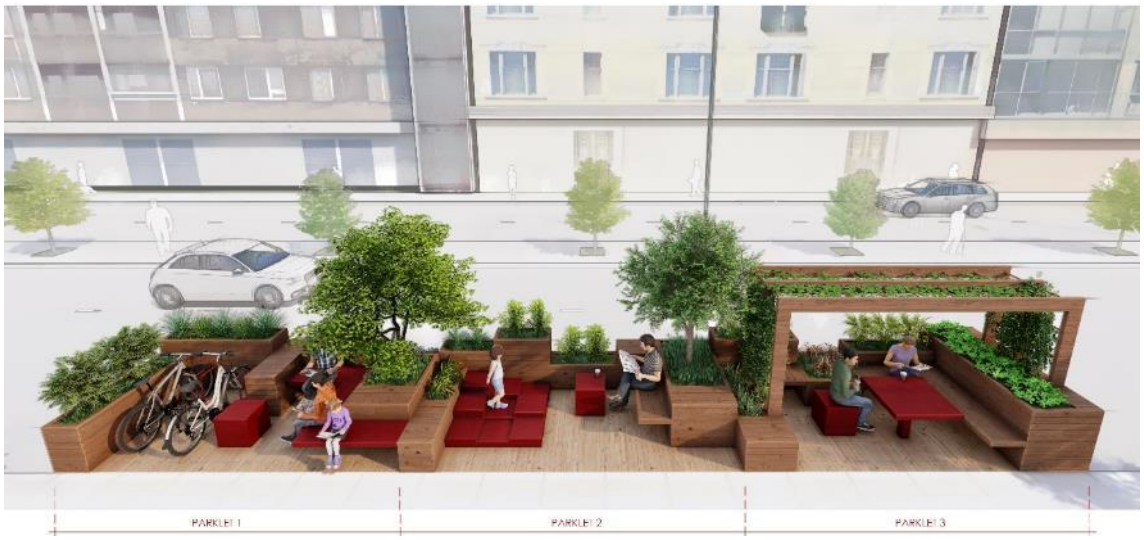


Figure 2-4: General View for Parklets

2.2.2 Location

Parklets will be deployed in Girne Avenue, which is one of the crowded shopping streets in highly urbanized Karşıyaka Metropolitan District (Figure 2-5) Girne Avenue functions as a main artery between İzmir-Çanakkale Highway, Karşıyaka Coastal Boulevard and Karşıyaka-Bostanlı Promenade. It is also connected to tram system. Girne Avenue is surrounded by high-rise buildings on both sides. There is always a busy vehicle and pedestrian traffic flowing both ways throughout the day.

Figure 2-5: Girne Avenue and location of green parklets

2.2.3 Technical Specifications

Parklet units of 4 will be installed in two different sites. It will provide approximately 12,5sqm (an area using for 1 on-street car parking slot) more green areas and 12sqm shadow areas for each parklet. As the coverage material, iroko deck and acrylic solid surface will be used. Pine tree will be planted around parklets. Inside parklets, suitable trees that can live in a pot will be used and possible species are explained under technical definition section of this NBS. The parklets shown with their technical drawings in the figures below will be installed as; one unit for parklet #1, one unit for parklet #3 and 2 units for parklet #2.

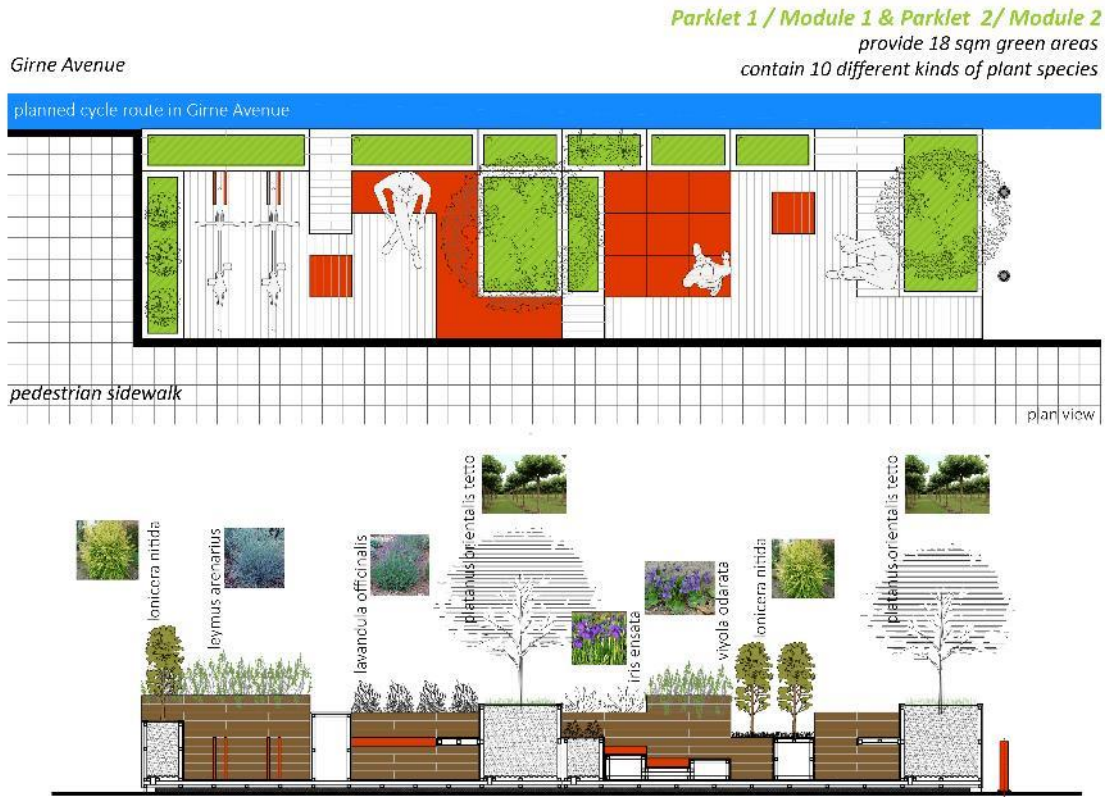


Figure 2-6: Technical Drawing of Parklet modules #1 & #2

At the beginning of the implementation, the list of materials to be used in the project will be provided by the contractor with the material approval certificates. Then, materials to be supplied will be checked for compliance with the technical specifications. After the confirmation of the suitability of the materials, the necessary procedures for ordering the materials will start.

Firstly; the production of iron constructions will be placed on the floor of the flowerpot, living unit and floor covering will start. During the manufacturing process, the conformity of the thickness and production measures should be checked and confirmed by the control team.

In the meantime, for the drip irrigation system to be located in the flower pots, the piping infrastructure line connection will be supplied from the irrigation line in the traffic island placed at the centre of the street to the parklets.

After the production of the iron construction was completed, installation works will start in the area. First of all, 5 cm thick concrete production will take place on the road line and the

construction will be mounted on the concrete to ensure the integrity of the pavement with the road surface.

After the installation of the iron construction, the sheet metal forming the inner surface of the pots will be assembled. Simultaneously, the wooden dials of the pots will be anchored to the iron construction.

During the installation of pot coating, insulating materials, herbal soil and plants are going to be supplied, controlled and planted in the field. Planting will start after confirmation of conformity of material and plants.

The plants will be planted in suitable pots in terms of number and material on the basis of the Landscape Project. Then, the drip irrigation line will be completed and activated.

Finally, elements such as seating units and tables will be produced and installed in the units.

Figure 2-7: Technical Drawing of Parklet modules #3 & #4

2.2.4 "Operational and Maintenance Considerations

Operational and maintenance aspects of this NBS will be executed periodically by the Directorate of Parks and Gardens of IMM. Details of the operational and maintenance aspects will be determined after detailed investigation of the implementation. However, it is already determined that depending on the species of plants within the context of this NBS pruning works and controls of the irrigation system will be taken into consideration in different periods of a year. Besides the maintenance works on plants, there will be varnishing, painting etc. works for the material of the parklets. Again, period of these works will be determined after implementation.

2.2.5 Economic Specifications

Cost of installation of 4 parklets in Girne Avenue: 21.000€

- Parklet 1: 5.000 €
- Parklet 2 (2 units): 5.250 x 2= 10.500 €
- Parklet 3: 5.500 €

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in public documents before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

2.3 Smart Soil (Biochar) into Green Shady Structures

2.3.1 General Description & Purpose of the NBS

The significance of green shady structures in urban areas has steadily increased over the past 15 years. The benefits of green shady structures with smart soils are measured in environmental, economic, and aesthetic or cultural ways. The environmental benefits include conserving water, reducing interior noise pollution, reducing the urban heat-island effect, improving urban air quality through carbon dioxide-oxygen exchange, and creating habitats for a diversity of birds, insects, etc. It means less emissions of greenhouse gases mitigating climate change, as well as reduced air pollution.

Green shady structures that cover of bus stations or car parks etc. which have vegetative layer grown on it. Smart soil which explained in detail under section 3.1.1, is going to be used not only in these areas but also in Bio-boulevard and other green infrastructures (GI). In this way, smart soil will reduce the heat island effect as well as carbon emissions besides improving urban air quality through carbon dioxide-oxygen exchange and creating little ecosystems by increasing green areas in cities are the main expected impacts of this action.

2.3.2 Location

The location of the implementation of smart soil in green shady structures, which designed together with the green covering shelter, will also be placed in car parking lot of Vilayetler Evi and selected parts of car parking lot of Sasalı Natural Life Park explained in detail in section 2.4.2.

2.3.3 Technical Specifications

This NBS is directly related to “smart soil production” and “Green Covering Shelter for car parking area construction” actions. After smart soil production, this material will be applied to create fertile medium for vegetation between green shady structures and covering shelters. Smart soil will be providing a growing medium for the plants. Each green shady structure will be designed to contain at least 10% biochar and 110 cm smart soil depth. And also, composite fertilizer will be used for the mineral fertilizer application in the growth medium.

Characteristics of plant species, installation operating schemes, technical drawings and plans are explained in the “Green Covering Shelter for car parking area” in section 2.5.

It is aimed to produce 240 kg of biochar per day by using 400 kg of pruning waste by smart soil production unit and this will be implemented into green shady structures with the mixture contains 230 kg sewage sludge + 8 kg 15-15-15 fertilizer + 1.5 kg urea fertilizer.

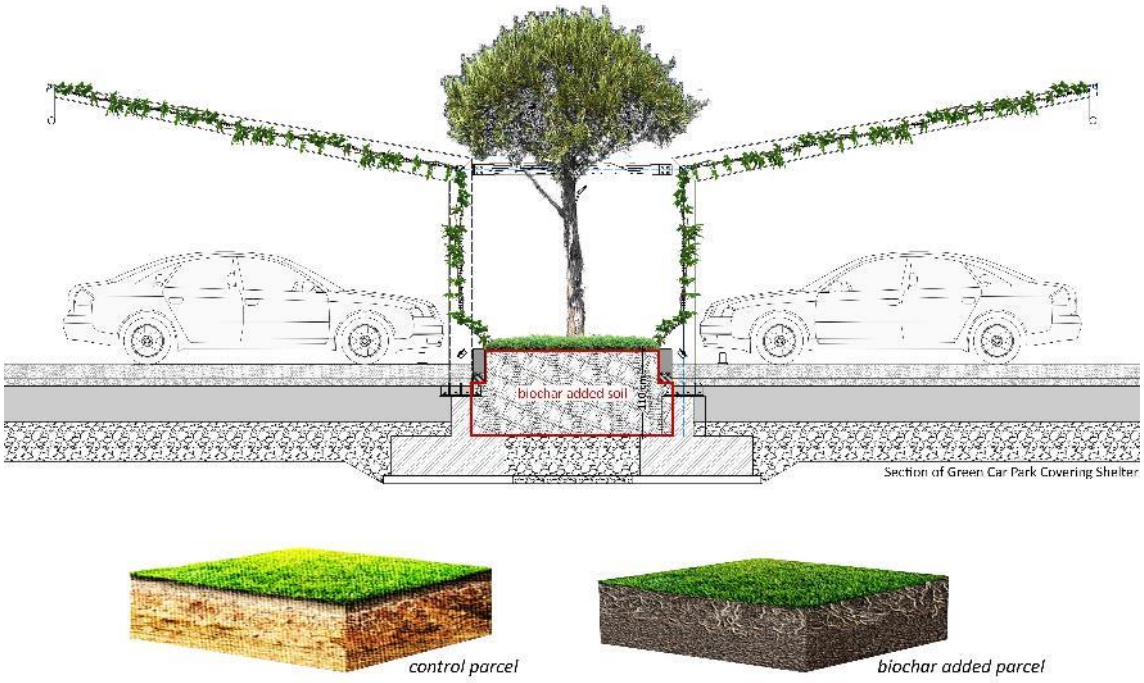


Figure 2-8: A detailed view of implementation area for smart soil (biochar)

2.3.4 Operational and Maintenance Considerations

Smart soil layer and surface should be checked periodically. Also, the smart soil layer thickness should be checked after a long period of rains. Weeds should be removed as they may entail a germination and growth problem for other plants. Growth conditions of plants should be checked periodically.

It is a relatively new concept to use biochar as soil amendment and for climate change mitigation. For this reason, the national and supranational legislation in the EU is not yet adequately prepared to regulate both the production and the application of biochar. Driven by this "regulatory gap", voluntary biochar quality standards have been formed in Europe with the European Biochar Certificate, in the UK with the Biochar Quality Mandate and in the USA with the IBI Standard which is intended to be used internationally. In parallel to this, biochar producers and biochar users in a number of EU countries were partly successful in fitting the new biochar product into the existing national legislation for fertilisers, soil improvers and composts. The intended revision of the EC Regulation 2003/2003 on fertilisers offers the opportunity to regulate the use of biochar at the EU level[2].

[2] Sebastian Meyer, Lorenzo Genesio, Ines Vogel, Hans-Peter Schmidt, Gerhard Soja, Edward Someus, Simon Shackley, Frank G. A. Verheijen & Bruno Glaser (2017) Biochar standardization and legislation harmonization, Journal of Environmental Engineering and Landscape Management, 25:2, 175-191, DOI: 10.3846/16486897.2016.1254640

2.3.5 Economic Specifications

Cost of Smart soil into Green Shady Structures: 33.600€

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in public documents before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL).

2.4 Green Permeable Pavement Around Car Parking Area

2.4.1 General Description & Purpose of the NBS

The problem of urban heat island is becoming more important in recent years due to the increase in impervious surfaces resulting from urbanization in Karşıyaka. Conventional pavements such as impervious concrete and asphalt used in many parts of the city, can reach quite high surface temperatures in summer. Accordingly, large impermeable surfaces such as parking lots, which are recognized as thermal hot spots in cities, also affect the air temperatures negatively.

Green Permeable pavements allow air, water, and water vapor into the voids of a pavement, keeping the material cool when moist. These pavements will be used to store less heat on the surface and to have lower surface temperatures compared with conventional products. They will help to solve the problem of urban heat islands, resulting from the increasing temperatures of the paved surfaces in cities. Green Permeable pavements may include conventional asphalt pavements, conventional concrete pavements, non-vegetated permeable pavements and vegetated permeable pavements.

In the case of Izmir demo, conventional pavements will be replaced with vegetated permeable pavements in parking lots as a part of Sub-demo A.

Related KPIs: a) decrease in mean or peak daytime local temperatures (°C) b) increase in outdoor thermal comfort (°C) c) heat wave risks (number of combined tropical nights (>20°C) and hot days (>35°C)

Expected impacts: a) reduction of absorption and retention of heat with highly reflective or permeable surface materials, b) reduction of surface temperatures by increasing solar reflectance of the surfaces, and accordingly decreasing the air temperatures in summer time, c) resurfacing with permeable pavements will reduce the heat of surface by about 4°C to 10°C and it also will increase car parking cover durability and d) in addition, new draining will be created.

2.4.2 Location

Green Permeable pavements will be installed in two parking lots that are recognized as thermal "hot-spots" in cities. One of them is the parking lot of Vilayetler Evi (Figure 2-9a). It is located in a very dense urban fabric and completely exposed to adverse effect of sun. Other parking lot is situated adjacent to Sasalı Natural Life Park (Figure 2-9b) in a suburban landscape. In spite of the lightly settled character of the region, parking lot occupies quite a large area completely covered by impervious surfaces and suffers from lack of sufficient trees and shading. That has resulted in a significant increase in surface temperatures because of excessive heat absorbed by the impervious surfaces. Thus, some parts of the conventional pavements in the site will be replaced with vegetated permeable pavements.

Figure 2-9: a) Parking lot of Vilayetler Evi b) Parking lot of Sasalı Natural Life Park

2.4.3 Technical Specifications

As mentioned in general description section, permeable pavements will be implemented with removing conventional pavements from the ground of selected areas explained in location section of this NBS. Below, the detailed view of the pavement product planned to be implemented (Figure 2-10) and examples of pavements implemented before (Figure 2-11) can be found in different figures.

The concrete to be used in this NBS application must comply with TS EN 206 and TS 13515 Standards. In permeable surfaces, fine aggregate (sand etc.) should not be used or should be used in very small amounts. The use of fine aggregates increases the compressive strength and durability properties of the concrete but can reduce the permeability performance. When designing concrete, fine aggregate usage and quantity should be decided according to the strength properties expected from permeable concrete. In general, permeable concrete should contain a gap structure in the range of 15-35%. The factor determining the establishment of suitable cavity system in hardened concrete is the type and form of aggregate.

In order to ensure structural integrity and durability of the transmission concrete areas, surfaces of 25m^2-50m^2 should be designed as separate surfaces. The aspect ratio of these parts can vary between 1-2.5. Furthermore, the length of each surface must not exceed 25 times the thickness of the coating. practical applications like, expansion joints, cladding stones, bricks etc. can be used as a barrier. Water permeability of the permeable surfaces may be expected to be between 120-320 L / m^2 / minute. Typically, 200 L / m^2 / minute can be selected in the design.

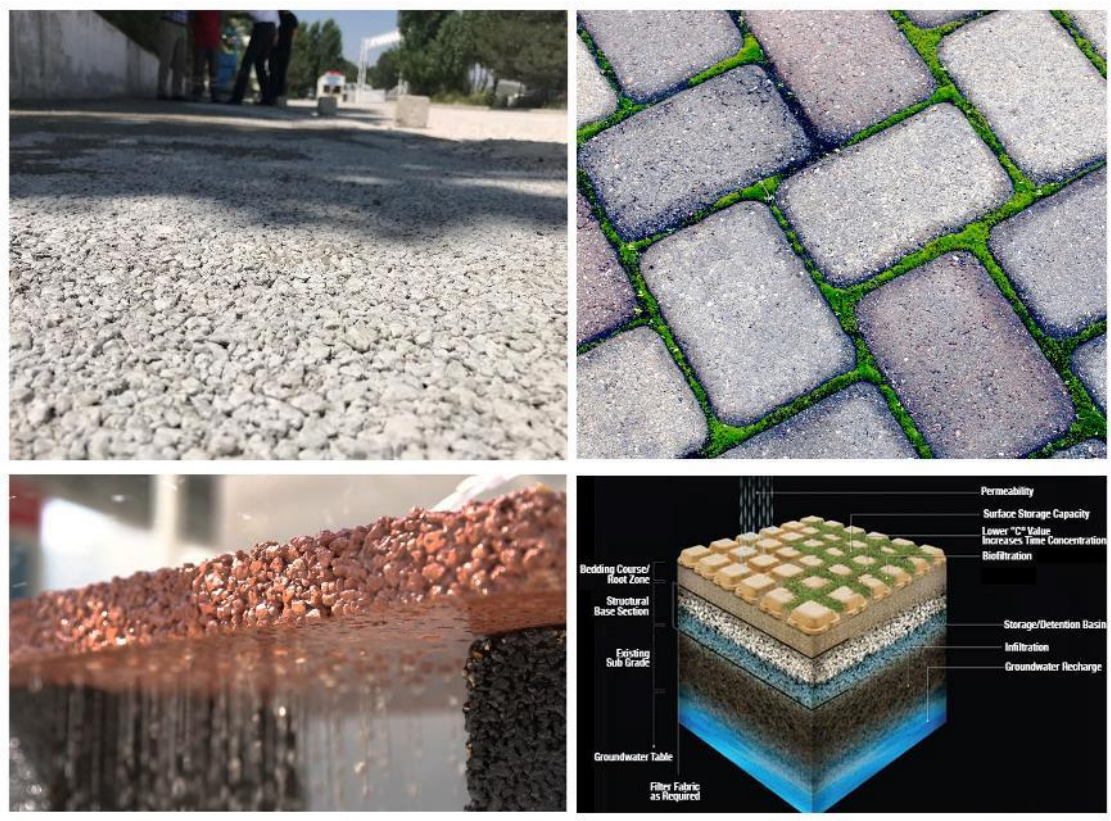


Figure 2-10: A detailed figure of pavement product[3]

Figure 2-11: Examples of permeable pavements[4],[5]

[3] Graphic courtesy of Soil Retention Products, Inc (https://continuingeducation.bnpmedia.com/article_print.php?C=969&L=184 , 2018

[4] Subramanian, N. (2014). Cool Pavements-Why and How? https://www.sefindia.org/forum/viewtopic.php?p=64350

[5] https://paverscolorado.com/services/commercial-pavers/

2.4.4 Operational and Maintenance Considerations

Maintenance: Applying light-colored coating to increase reflectance. Pruning vegetation which grows in permeable paving. These maintenance works will be done with the collaboration of Directorate of Technical Works and Directorate of Parks and Gardens of IMM.

2.4.5 Economic Specifications

Permeable cement concrete: €45 /sqm, Concrete lattice: €10 /sqm

Cost of Permeable Pavement: 90.000€

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions within public documents before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

The period of recovery of the initial economic investment of the NBS is between 0 and 5 years.

2.5 Green Covering Shelter for car parking area

2.5.1 General Description & Purpose of the NBS

As a part of Sub-demo A, green covering shelter will be installed in the parking lots of Vilayetler Evi and Sasalı Natural Life Park to decrease temperatures and increase pollutant's removal with its planted cover. It is designed to integrate specific vegetation with a minimum maintenance, and their structural features allow providing water for plants, humidity for the ambient, shade for citizens. At the same time, it will capture CO_2, reduce surface temperatures by preventing sunlight from reaching the surface. In the summer, green covering shelter will shade the parking lot and, through the process of evapotranspiration will provide cooling.

As in many big cities of the World, Izmir's Karşıyaka district underwent significant urbanization and lost much of the open-green spaces, consequently the average summer temperatures have been on the rise over the past decades. These high summer temperatures have been affecting the quality of life negatively in the city.

Related KPIs: a) decrease in mean or peak daytime local temperatures (°C) b) increase in outdoor thermal comfort (°C) c) heatwave risks (number of combined tropical nights (>20°C) and hot days (>35°C), d) increase in shadow surface (sqm)

Expected impacts: a) they will reduce ambient temperature in about 2-4 °C and NO_X emissions by less than 1% and b) increase in plant cover and shadow surfaces and c) enhancing biodiversity.

2.5.2 Location

Green covering shelters will be built in parking lot of Vilayetler Evi Figure 2-9a) and parking lot of Sasalı Natural Life Park Figure 2-9b). The former is in a very dense urban fabric and completely exposed to adverse effect of sun. The latter is situated adjacent to Sasalı Natural Life Park in a suburban landscape.

Figure 2-12: Current situation in the locations selected for this NBS

2.5.3 Technical Specifications

Green covering shelters will be installed as an extensive roof garden with low weight, low capital cost, low plant diversity, and minimal maintenance requirements. Due to the shallowness of the growing medium and exposure to sunlight all day, plants must be low and hardy, drought-tolerant and indigenous. In accordance with the climate conditions of Karşıyaka, mixture of grasses, mosses, sedums, sempervivums, festucas, irises, and wildflowers will be planted. Implementation area will be 1164 sqm in Sasalı Wild Life Park and 286 sqm in Vilayetler Evi car park area. In total it will be 1450 sqm total implementation area.

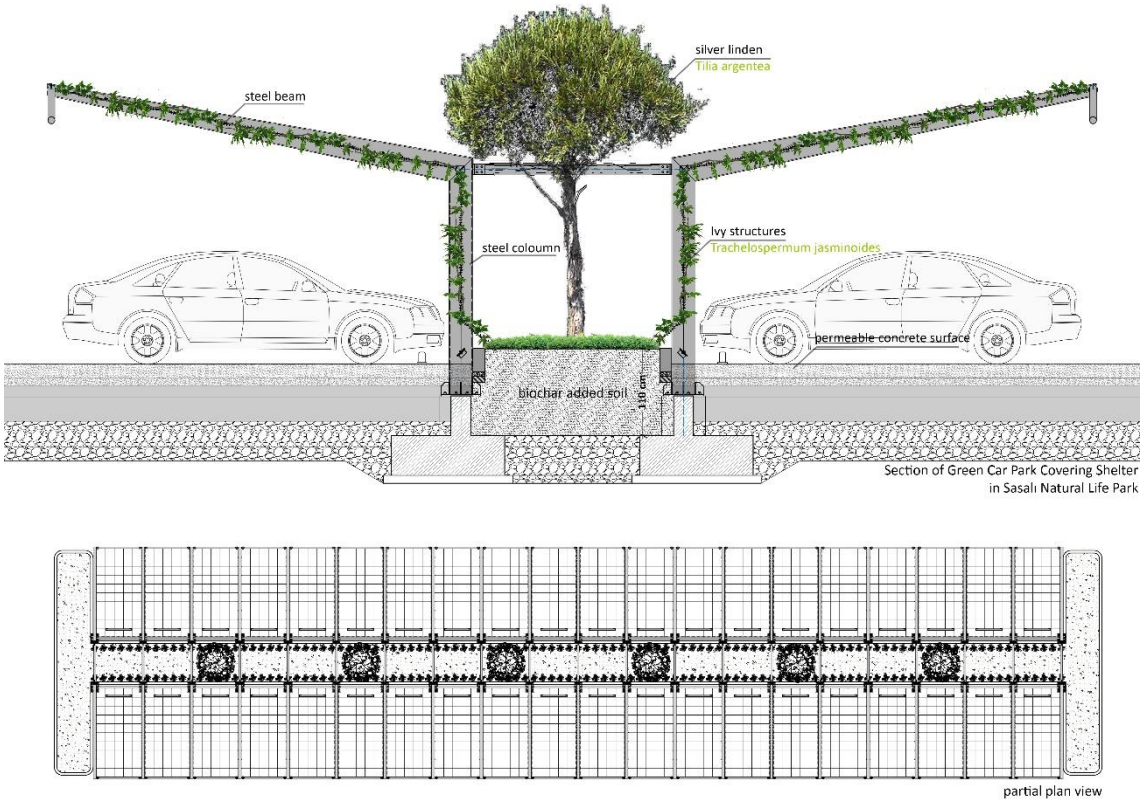


Figure 2-13: Green Covering Shelter for car park section

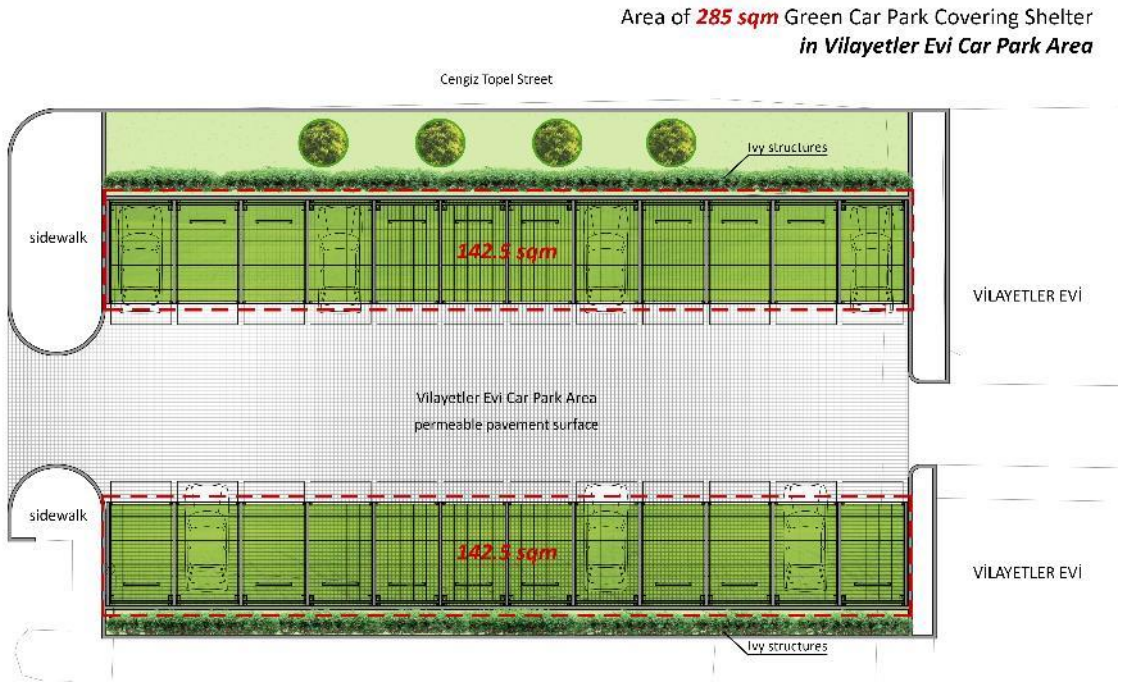


Figure 2-14: Position of covering shelters in Vilayetler Evi

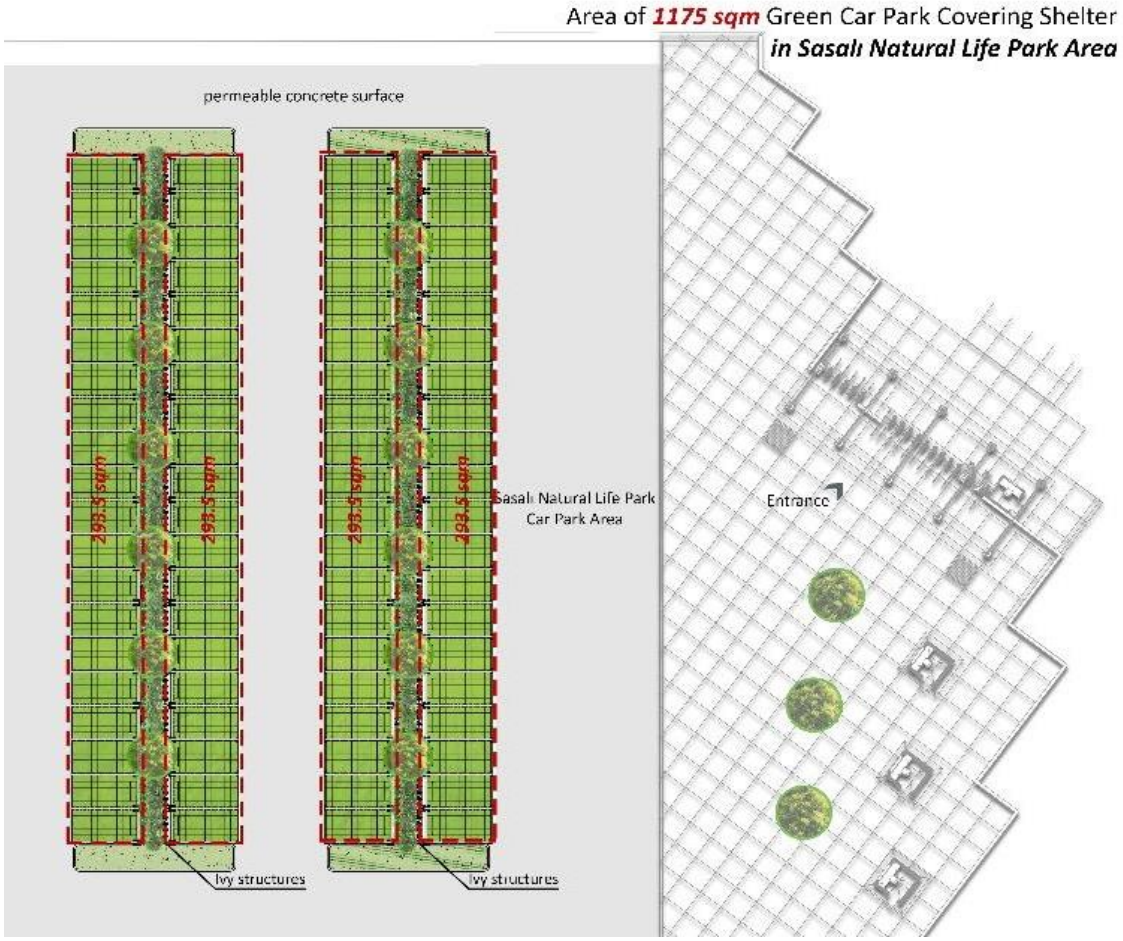


Figure 2-15: Position of covering shelter in Life Park Area

2.5.4 Operational and Maintenance Considerations

Operational and maintenance aspects of this NBS will be executed periodically by the Directorate of Parks and Gardens of IMM. Details of the operational and maintenance aspects will be determined after detailed investigation of the implementation. However, it is already determined that depending on the species of plants within the context of this NBS pruning works and in the case of having irrigation, periodic check of the system will be taken into consideration in different periods of a year. Besides the maintenance works on plants, there will be varnishing, painting etc. works for the material of the green shady structures. Again, period of these works will be determined after implementation.

2.5.5 Economic Specifications

Cost of Green Covering Shelter for car parking area (1450 sqm): 305.000€

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in public documents before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

2.6 Green Shady Structures for car parking area

2.6.1 General Description & Purpose of the NBS

Green Shady Structure will be designed as part of the urban heat island reduction strategies in the selected parking lots as a part of Sub-demo A. It will cover the 2 sides of green car park areas by using fast-growing creepers and climbing plants (adapted to climate conditions) with the usage of perennial deciduous species, which allow pass the sunlight in wintertime. It will help to minimize of in-car temperature through shading.

Related KPIs: a) decrease in mean or peak daytime local temperatures (°C) b) increase in outdoor thermal comfort (°C) c) heat wave risks (number of combined tropical nights (>20°C) and hot days (>35°C) d) increase in shadow surfaces

Expected impacts: a) increasing shadow surfaces b) reducing ambient temperature and c) enhancing biodiversity

Figure 2-16: Example for the implementation of Green Shady Structures

2.6.2 Location

This structure, which will be designed together with the green covering shelter, will also be placed in parking lot of Vilayetler Evi and parking lot of Sasalı Natural Life Park. Detailed explanation and maps of the location given in section 2.4.2.

2.6.3 Technical Specifications

The ivy structures (ivy plant species) designed to be planted 3 roots for each 1 m length of the wall of the green covering shelter. There are some recommended species for ivy structures:

- Lonicera etrusc
- Jasminum officinale
- Plumbago capensis

- Trachelospermum jasminoides
- Clematis cirrhosa

The selected species of ivy structure are given in Figure 2-17.

Those species are going to be planted by investigating different conditions of green covering shelter such as: the angle of sunlight, sun/shadow ratio, amount of space for plant etc.

A technical drawing below shows the implementation details of green shady structures.

Figure 2-17: Technical drawing for green shady structures

2.6.4 Operational and Maintenance Considerations

Operational and maintenance aspects of this NBS will be executed periodically by the Directorate of Parks and Gardens of IMM. Details of the operational and maintenance aspects will be determined after detailed investigation of the implementation. However, it is already determined that depending on the species of plants within the context of this NBS pruning works and periodic check of the irrigation system will be taken into consideration in different periods of a year.

2.6.5 Economic Specifications

Cost of Green Shady Structures: 10.000 €

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in public documents before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362TL)

3 Technical and Economical Definition of the Interventions - SUBDEMO - B

In the heart of Sub Demo B there is 'Sasalı Natural Life Park' designed by Izmir Metropolitan Municipality and was recently considered to extend its area of influence through new ecologically-sensitive developments (see **¡Error! No se encuentra el origen de la referencia.** & **¡Error! No se encuentra el origen de la referencia.**). This thematic park is interface between urban and natural areas and ideal for developing climate-smart urban farming practices in a special precinct within the Park. Sub Demo B is also supported by non-technical interventions regarding urban farming and bio-diversity supporting activities.

Table 3-1: List of interventions in Sub-Demo B

Re-naturing urbanization	Water interventions	Singular Green Infrastructures
	Grassed swales and Water Retention Ponds around Bio-boulevard	Smart soil production in climate-smart urban farming precinct
		Natural pollinator's modules
		Climate-smart greenhouse in urban farming precinct
		Biofuel production unit
		Development of Smart soils from mud plant, to use in urban farming

Besides those interventions there are non-technical interventions going to implemented in related areas with Sub-Demo B. These non-technical interventions explained in detail in section 5 of this deliverable.

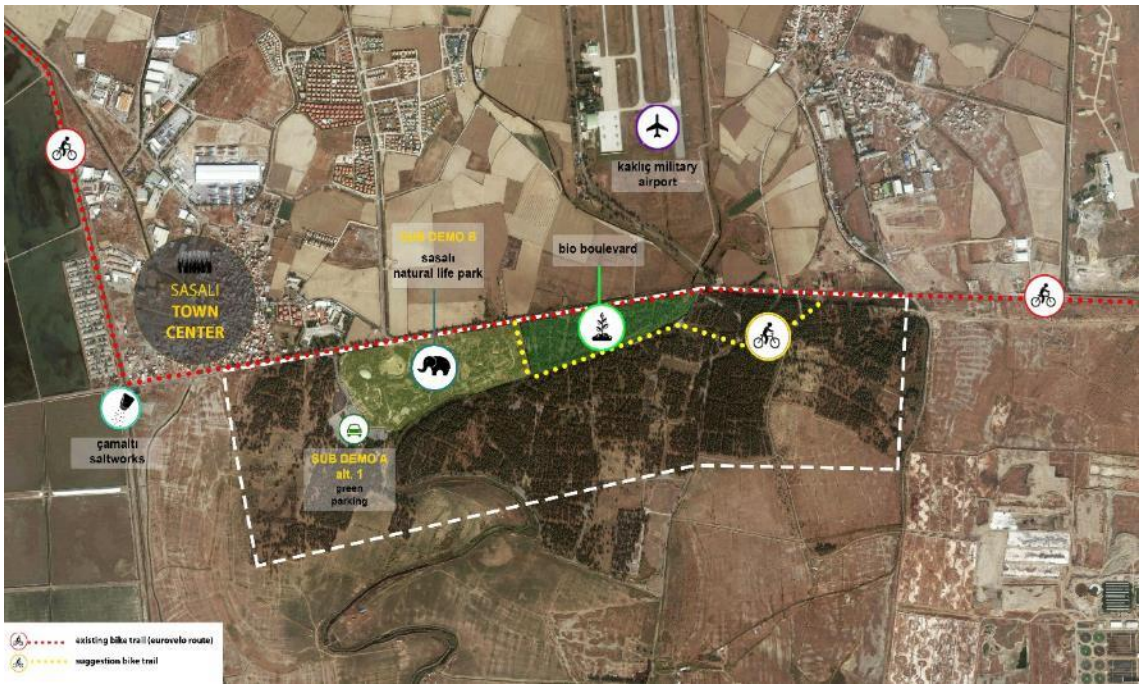


Figure 3-1: Location of Sub Demo B

Figure 3-2: Example Illustration for Climate Smart Urban Farming #1

Figure 3-3: Example Illustration for Climate Smart Urban Farming #2

3.1 Smart soil production in climate-smart urban farming precinct

3.1.1 General Description & Purpose of the NBS

A relatively little-known substance called 'biochar' is beginning to attract a great deal of attention in worldwide environmental circles, and it could very well soon become an important element in the green regeneration and a key player in the fight against climate change. Moreover, it is a fact that there is more carbon in the soil than in the atmosphere and all of plant and animal life combined. By returning carbon to the soil on a massive scale, scientists and researchers believe that a solution to climate change exists today right under our feet. This is where biochar could soon begin playing an important role in soil and water remediation, as well as in the fight against climate change. Biochar is essentially a form of charcoal made from the partial combustion of organic materials through pyrolysis, which is the direct thermal (at temperatures varying between 500 and 600 ^{0}C) decomposition of biomass in the absence of oxygen, to obtain an array of solid (biochar) product. It contains high levels of organic carbon and enriches soils by adding nutrients such as potassium and calcium and boosting the soil's ability to retain water and nutrients[6].

These characteristic features of the biochar are supported by the fact that microbial decomposition is more stable than other organic materials in the soil due to their specific physical and chemical properties, their low solubility and specific chemical structure as well as their high exchange capacity. For this reason, the use of biochar as one of the applications that would increase the amount of organic matter in the soil with a sustainable physical and chemical regulatory task and lead to a minimum amount of CO_2 release in the atmosphere has gained importance in Europe in recent years[7];[8]. As a result, the application of biochar to the soils appears to be one of the ways of atmospheric CO_2 sequestration. In this process, carbon is separated from its rapid ecological cycle and participates in a much slower and more stable biochar cycle[9]. Within the study, the construction of a strategic pathway to utilize pyrolysis technology and biochar use in agriculture will be actualized with potential and feasible utilization techniques. The latest studies show that the addition of biochar improves crop yields, especially in poor soils, which could go a long way to improving agricultural productivity in places where the soil has been degraded as a result of centuries of uninterrupted farming. In climate-smart urban farming precinct there are smart soil production area targeting dense urban areas, poor with soil and leftover spaces near urban areas. This type of soils has a combined or individual

[6] www eco-ouest.com [accessed 12 July 2018]

[7] Kimetu, J.M., Lehmann, J., Ngoze, S.O., Mugendi, D.N., Kinyangi, J.M., Riha, S., Verchot, L., Recha, J.W. and Pell, A.N., 2008, Reversibility of soil productivity decline with organic matter of differing quality along a degradation gradient. Ecosystems, 11(5), pp. 726-739.

[8] Steiner, C., Teixeira, W.G., Lehmann, J., Nehls, T., de Macêdo, J.L.V., Blum, W.E. and Zech, W., 2007. Long term effects of manure, charcoal and mineral fertilization on crop production and fertility on a highly weathered Central Amazonian upland soil. Plant and soil, 291(1-2), pp.275-290.

[9] Lehmann, J., 2007, 'Bio-energy in the black', Frontiers in Ecology and the Environment, vol 5, pp. 381–387.

application of different types of biochar. With this NBS there are water and carbon savings per unit area and eliminated discontinuity risk of agricultural production due to climate change.

Expected Impact: As a result of this field applications, the physical (i.e. surface area and porosity, bulk density) and chemical (i.e. nutrient content, cation exchange capacity, pH value, and carbon content) properties of the soils are improved; the initially increased microbial activity becomes stabilized after a while which will cause the amount of organic matter to increase over time due to the degradation process slows down; decreases in the CO_2 emission by biodegradation, decreases in the nitrous oxide emission by denitrification and reduction of methane release by methanogenesis at a rate of 5%, 5%, 1% respectively, are expected during the experimental period.

3.1.2 Location

The field experiment will be carried out for two years in an agricultural soil in Sasalı Natural Life Park (Sub Demo B). The experimental soil will be classified and some physicochemical properties will be determined at the beginning of the experiment. The Menemen Plain, where the research area is located, has a Mediterranean climate, with hot dry summers and cool rainy winters. According to long-term (55 year) climate data, mean total annual precipitation is 525.3 mm. Approximately 50% of this precipitation occurs in winter, 25% in spring, 23% in autumn and 2% in summer. The mean temperature is 16.9°C, mean relative humidity is 57.5%, and mean annual evaporation is 1532.1 mm (Anonymous 2009).

3.1.3 Technical Specifications

It is aimed to produce 240 kg of biochar per day by using 400 kg of pruning waste.

Figure 3-4: Smart Soil Production Unit

Emission of GHGs will be measured using a closed chamber soil trace gas flux monitor (Innova 1512 AirTech Instruments, Ballerup, Denmark) with internal filters for water vapour, and particulate and optical filters for CO_2 (UA0982), CH_4 (UA0969) and N_2O (UA0985). The CO_2, CH_4 and N_2O detection limits specified for the analyser were 1.5, 0.4 and 0.03 ppm, respectively, while the precision is 1% of measured values according to the specifications of the manufacturer. Emission rates at the different events will be determined after discounting the concentration of each gas in the inlet air to the outlet air in INNOVA data. The GHG fluxes will be measured every morning (between 8.00 and 10.00 am) in all plots and in situ in a static

chamber (14.2 l, 710 cm^2) using the gas analyser. It will be programmed to take 7 measurements over a 12-min period. The GHGs will be sampled once a day during the first 8 d of experimental period, every two days for the following three weeks and then every ten days until the end of the experiment. To minimise the influence of ambient air on the gas concentrations, measurements will be always done at the same time in each measurement day. To get the cumulative GHGs emissions, daily fluxes from contiguous measurements will be averaged and multiplied by the interval between sampling periods. In order to evaluate the effect of the different treatments on total GHG emissions, the measured emissions were converted into CO_2-equivalents according to the IPCC GWP factors of 28 and 265 times as much as CO_2 for CH_4 and N_2O, respectively[10].

The production area will be a 150 sqm container unit. It will include a store, a machine room and a WC.

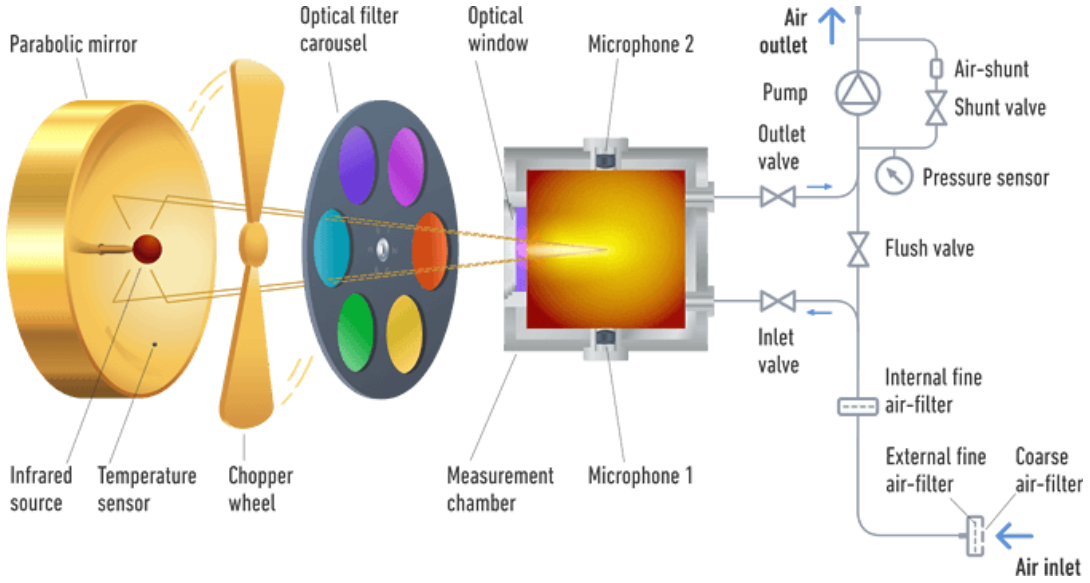


Figure 3-5: Schematic view of Photoacoustic Gas Monitor instrument

[10] IPCC, 2013: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324

Figure 3-6: Figure of Photoacoustic Gas Monitor instrument

3.1.4 Operational and Maintenance Considerations

The maintenance of the Photoacoustic Gas Monitor instrument, where carbon stored will be measured, should be done at least once a year by technical service of the equipment. The maintenance operation and its recordings will be under the responsibility of Directorate of Parks and Gardens of IMM.

3.1.5 Economic Specifications

Cost of Smart soil production unit in climate-smart urban farming: 85.000 €

Purchasing smart soil for open agricultural land (800 sqm): 8.500 €

Purchasing Innova 1512 AirTech Instrument: 37.000 €

Total cost: 130.500 €

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in a public document before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

3.2 Natural pollinator's modules

3.2.1 General Description & Purpose of the NBS

The presence of pollinating insects visiting different flowers is indicative of pollination. Increased habitat and shelter for pollinators in an NBS may contribute to increased abundance of pollinators in the wider urban area and provide stepping-stone or corridor from one urban green area to another.

Pollinator's modules or houses are proposed to attract more pollinator insects by proving shelter. Modules are uniquely designed for this purpose and placed in the settings where many pollinator friendly flowering plants are abundant. Although the primary purpose with these modules is attracting more pollinator's species to increase biodiversity, getting people' attention to biodiversity issues should be considered as a co-benefit.

Related KPIs: a) Pollinator species increase

Expected Impacts: a) increased richness and abundance of pollinating species and enhanced biodiversity, b) increased community engagement

3.2.2 Location

Natural pollinator's modules or houses are placed in of Karşıyaka-Mavişehir (Sub-demo C) Bio-boulevard in Çiğli-Sasalı region is the locations where the pollinator's modules are installed. The location of the area can be seen as a bio-boulevard section of Figure 3-1: Location of Sub Demo B. The area that encompasses the bio-boulevard shows a rural and natural character. Since the boulevard, as a learning lab, has been designed in a way that it is considered the epicentre of several activities including a path to learn urban bio-diversity, climate change effects and sustainable stormwater management, the modules will play an important part in this process.

The figure below shows the implementation plan for the modules at selected location.

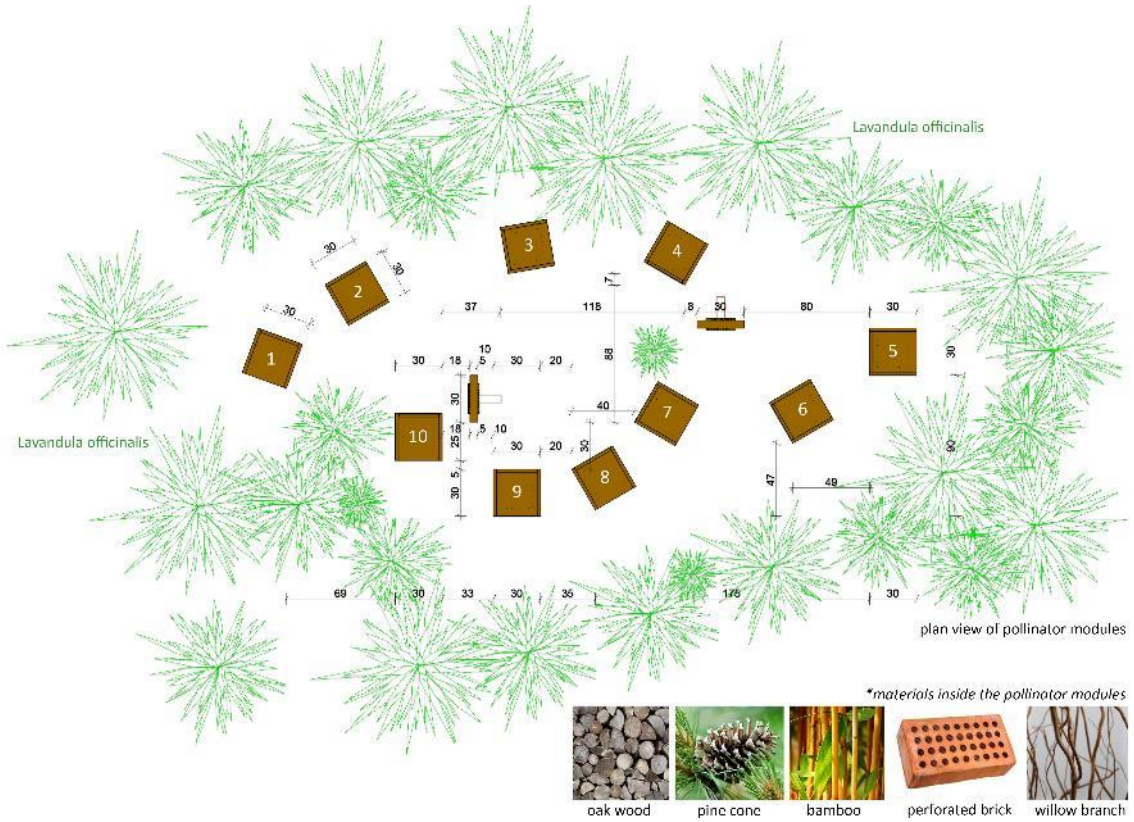


Figure 3-7: Implementation plan for pollinator modules at selected location

3.2.3 Technical Specifications

There will be 10 natural pollinator modules alongside Bio-Boulevard in climate-smart urban farming precinct. These pollinator-nesting blocks (also called pollinator houses, bee houses or bee hotels) will support biodiversity by creating wildlife friendly spots and areas.

To increase the efficiency of pollination in those 10 natural pollinator modules plant species which are going to be used in these modules are listed below:

- Lavandula officinalis
- Lonicara tatarica
- Abelia grandiflora
- Forsytia intermedia
- Buddelia davidii
- Callistemon laevis
- Pittosporum tobira
- Lantana camara
- Syringa vulgaris

Early prototypes of pollinator units will be obtained at the end of İzmir Green Infrastructure Design Atelier which will be held at the end of September 2018 at FabrikaLab İzmir operated by IMM.

Figure 3-8: Pollinator Units

3.2.4 Operational and Maintenance Considerations

Operational and maintenance aspects of this NBS will be executed periodically by the Directorate of Parks and Gardens of IMM. Details of the operational and maintenance aspects will be determined after detailed investigation of the implementation. However, it is already determined that depending on the species of plants within the context of this NBS pruning works and in the case of having irrigation, periodic check of the system will be taken into consideration in different periods of a year. Besides the maintenance works on plants, there will be varnishing, painting etc. works for the material of the natural pollinator houses. Again, period of these works will be determined after implementation.

3.2.5 Economic Specifications

Cost of Natural Pollinator's modules (total 20 modules around urban farming precinct and new green corridor): 24.000€

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

3.3 Development of Smart soil from mud plant, to use in urban farming

3.3.1 General Description & Purpose of the NBS

Wastewater treatment processes generate highly biodegradable solid wastes. As their fate is an environmental issue of great concern, public administrations promote a sustainable management of urban wastes. Improving the agricultural value of a semi-arid soil by addition of sewage sludge may cause negative ecological impact to terrestrial ecosystems and pose a human health risk. Potential hazard of sewage sludge application assessment based on the soil physicochemical analysis do not evaluate clearly possible toxic effects to soil microflora. Because the sewage sludge can be treated by several ways and used for several purposes. In general, sewage sludge disposal is of major concern for the quality of the receiving soils. In this study, anaerobically digested sewage sludge ecotoxicological assessment was based on the bioassays with soil microbial activity and the productivity of energy plants. Finally, in order to sustain soil fertility in the Mediterranean biodegradable conditions where the soil organic matter content is below 1%, the applicability of sewage sludge at appropriate rates is a highly valuable waste management strategy. In this study, microbiological parameters of the soil will be used to demonstrate quickly and clearly both the appropriate application rates and the ecological effects of the treated sewage sludge.

Expected Impacts: The application of sewage sludge will improve the physical and chemical characteristics of the soil, and generally support microbial growth and activity. Depending on the application doses of the treated sewage sludge; a) 1% of the organic carbon content of the experimental soil; b) 10-50% of microbial activity and c) 5% of energy yield, are expected to increase.

3.3.2 Location

The Biochar Production Unit will be located on a 6x15m area in Municipality's Arboreal site.

3.3.3 Technical Specifications

Material

The raw materials/wastes which will be used in biochar production should be considered expediently for different purposes of application. Briefly; (a) mitigation of CO_2 emission, (b) increasing/sustaining soil quality (or not to harm it) and (c) proper waste management techniques may be asserted as main and commutual purposes. This simultaneous mutuality between the purposes makes the selection of raw materials is based on two priorities; the first is possible carbon content and stability of end-product biochar, also with the consideration of nutrient load and reclamation capability, the second is the current quantity and usage fields of the wastes or materials.

Accordingly, pruning wastes originating from the parks and recreation places of IMM with highly cellulosic, ligneous or lignocellulosic structure may be considered as a sustainable resource with high stable carbon content. On the other hand, poultry manures, industrial or domestic sludges or other organic refusals which may have inherent toxicity risk and contain high concentrations

of phenolic compounds that are phytotoxic and difficult to biodegrade are other common alternatives which after pyrolysis, may act as a nutrient enricher and soil conditioner.

After the study, combined or individual applications of different types of biochar will be evaluated with regards to mitigation of global warming and sustainable soil quality and health.

Methods

The field experiment will be carried out for two years in an agricultural soil in İzmir. The experimental soil will be classified and some physicochemical properties will be determined at the beginning of the experiment. The Menemen Plain, where the research area is located, has a Mediterranean climate, with hot dry summers and cool rainy winters. According to long-term (55 year) climate data, mean total annual precipitation is 525.3 mm. Approximately 50% of this precipitation occurs in winter, 25% in spring, 23% in autumn and 2% in summer. The mean temperature is 16.9°C, mean relative humidity is 57.5%, and mean annual evaporation is 1532.1 mm (Anonymous 2009).

The sewage sludge will be used in the experiment will take from the Çiğli Wastewater Treatment Plant of IMM, stabilized in anaerobic conditions and converted to granules of 90% dryness. Soil plots will be either unamended (SS0) or amended with SS at rate of 30 t ha-1 on a dry weight basis. After application of the SS to the surface of the soil in the experiments, the soil will be mixed to a depth of 15 cm using a rotary tiller. Test plant to be used in experiment will be an energy crop.

The experiment followed a split-plot design with two planted systems as main plots (planted soil: PS, and unplanted soil: UPS) and two organic amendments treatments as subplots, where 25 t dry matter ha^{-1} will be applied either as organic waste biochar (BOW), composted organic waste (COW), or fresh organic waste (FOW). A treatment without organic amendments will be used as unfertilized control (CTR) and fertilized control (FCTR). The total experimental area will be 864 sqm (18x48 m). Test plant to be used in experiment will be maize (Zea mays L.). All treatments were conducted in four replicates. GHGs emissions will be determined by using static chambers.

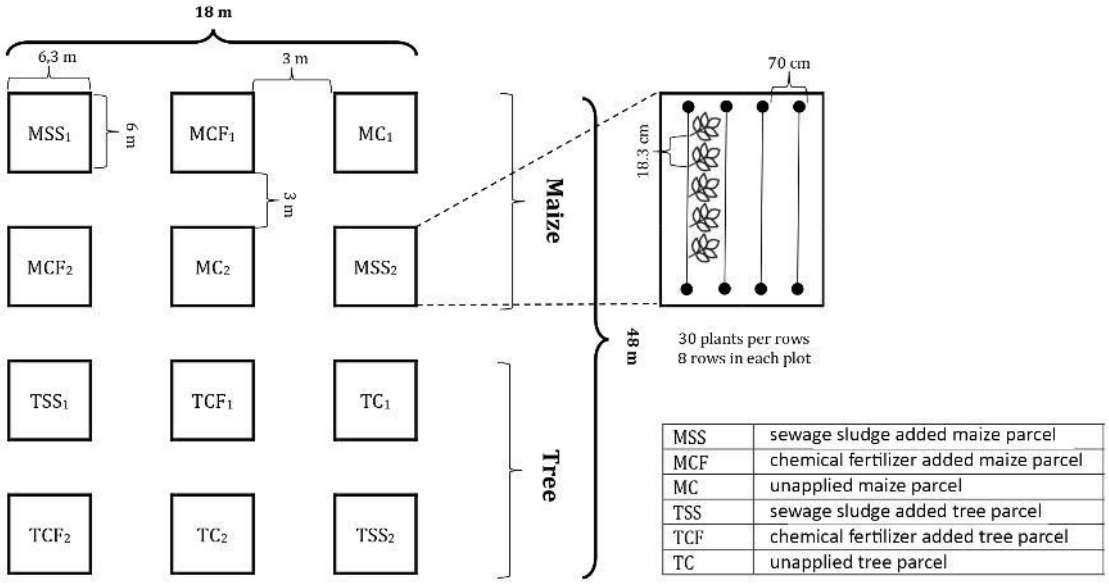


Figure 3-9: Application plan on experimental field

Approximately 1 t ha-1 15-15-15 composite fertilizer will be used for the mineral fertilizer application in the maize experiment. After application of the organic and inorganic materials to the surface of the soil in the experiments, the soil will be mixed to a depth of 15 cm using a rotary tiller. Maize will be sowing took place on the same day, on all experimental plots after the application of treatments. Seeds will be sown in rows 70 cm apart, at 18.3 cm intervals, using a seed drill. The planting will be done in 2 rows in the plots and 15 plants in each order. As mineral fertilizer plots, 150 kg ha^{-1} urea fertilizer (46% N) will be applied as a top dressing. In the maize experiment, drip systems will be set up for irrigation purposes, and irrigation will be carried out according to the moisture of the soil.

3.3.4 Operational and Maintenance Considerations

Periodic maintenance of the drip irrigation system will be carried out. Damaged pipes should be repaired or replaced if necessary.

Special attention is required to electrical devices and other elements.

3.3.5 Economic Specifications

Cost of Smart soils from mud plant: 55.000€

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

3.4 Grassed swales and Water Retention Ponds around Bio-boulevard

3.4.1 General Description & Purpose of the NBS

Grassed swales will be installed in Bio-Boulevard (Sub Demo B) as a system that slow down and collect surface runoff directed from impervious surfaces mainly and function as a collector for a while until the soil is ready to infilter the water again. Most of all collected stormwater is expected to drain away through the soil within several hours or days.

The swales will be vegetated with flood tolerant and native plants. Cleaning the collected water via bio filtering by these plants before allowing it to be released back into the groundwater system is one another purpose of this NBS.

Swale systems are planned as a part of a theme route explaining biodiversity and impacts of climate change on nature due to their characteristics of enhancing biodiversity by vegetation consisting of and managing the stormwater.

Related KPIs: a) run-off coefficient in relation to precipitation quantities, b) total amount of carbon stored in vegetation, c) increased connectivity to existing GI and d) pollinator species increase (number)

Expected impacts: a) water quality improvement, b) flood risk reduction, c) local biodiversity enhancement, d) provide habitat for urban wildlife, e) offer recreational opportunities and f) raise awareness

3.4.2 Location

Grassed swales will be placed in bio-boulevard (Sub-demo B) in Çiğli-Sasalı region. The area shows a rural and natural character with eucalyptus species besides herbaceous plants covering the area. The area is abandoned to its own natural dynamics currently with its location just next to the Sasalı Natural Life Park and no entries are allowed for visitors.

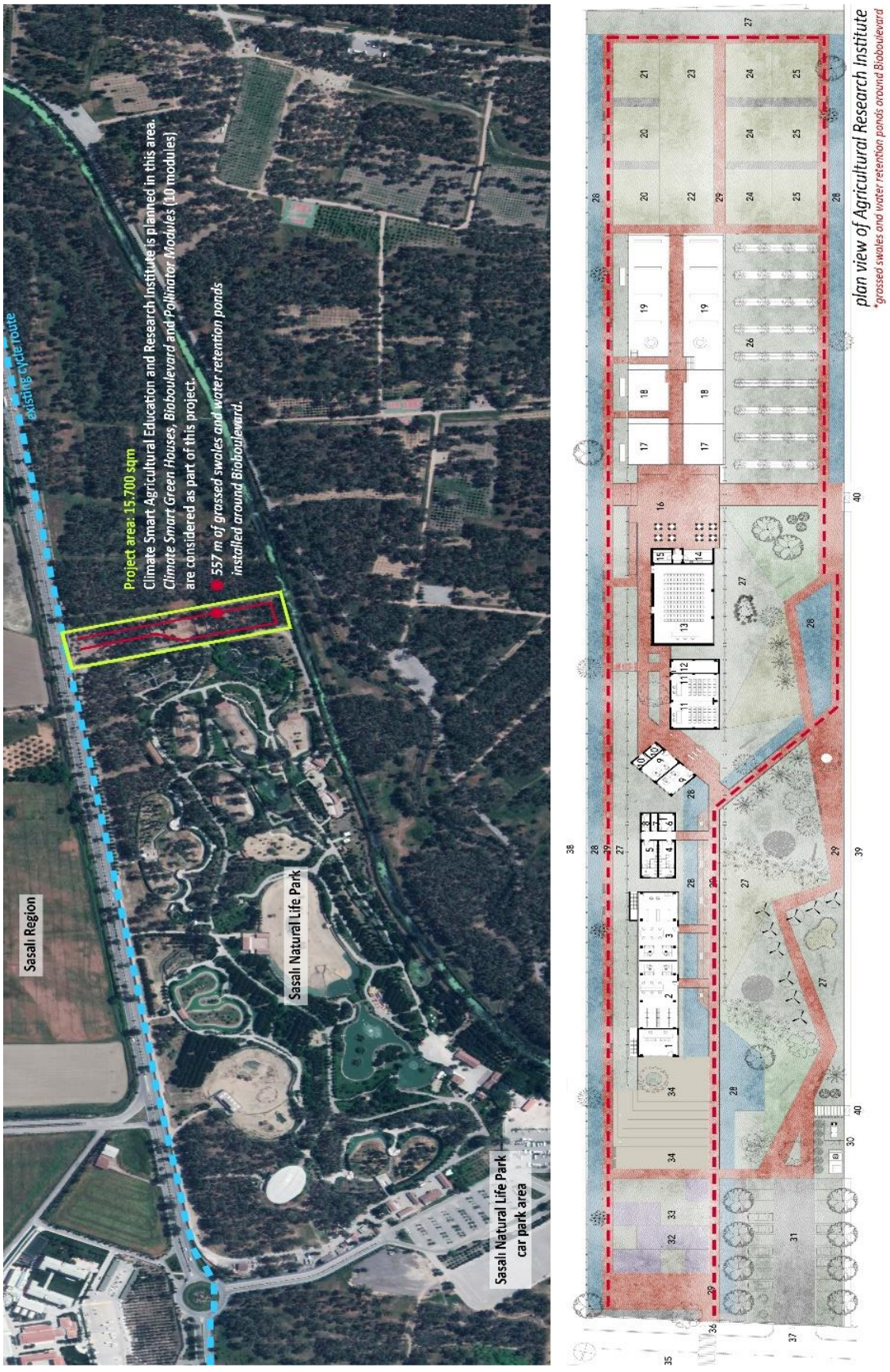


Figure 3-10: Location and selected area of Bio-boulevard

3.4.3 Technical Specifications

Throughout the bio-boulevard where NBSs are applied, some applications known as GI techniques will take place. Particular attention is given to the choice of permeable surface materials, and landscape design has been developed in this direction. The natural and porous structure of the brick dust was found suitable for walking side and brick dust was used as the main material on the walking side.

Bioswales basically targeting to gather the rainwater and surface waters in the surrounding area, filter the water through plants and provide an additional source to groundwater. Because the project area is located in the rural surroundings, the surface waters to be accumulated in the roof area of the architectural structures of approximately 700 sqm will be integrated into bioswales with the approach of 'rain garden' in order to provide contribution to the surface waters. The bioswale routes, which are designed in three separate parts, expand to leakage ponds in some places.

It has been decided to take the Eugene Stormwater Management Manual (2014) as reference for the creation of the bioswale system section. Because of this 3: 1 side slopes, 30 cm plant soil mixture, 5 cm mulch on the surface are used. Drainage was proposed as an infrastructure system in order to prevent the ground water level from getting higher in the project area and to prevent damage to the bioswale plantation caused by extreme rainfall during flood situations. This system has no network connection so it is much more effective than conventional drainage systems in order to collect the rainfall under extreme conditions and prevent water deposits on surface. Because there is no bottom cover of the system, the water coming to the drainage system is brought to the ground water.

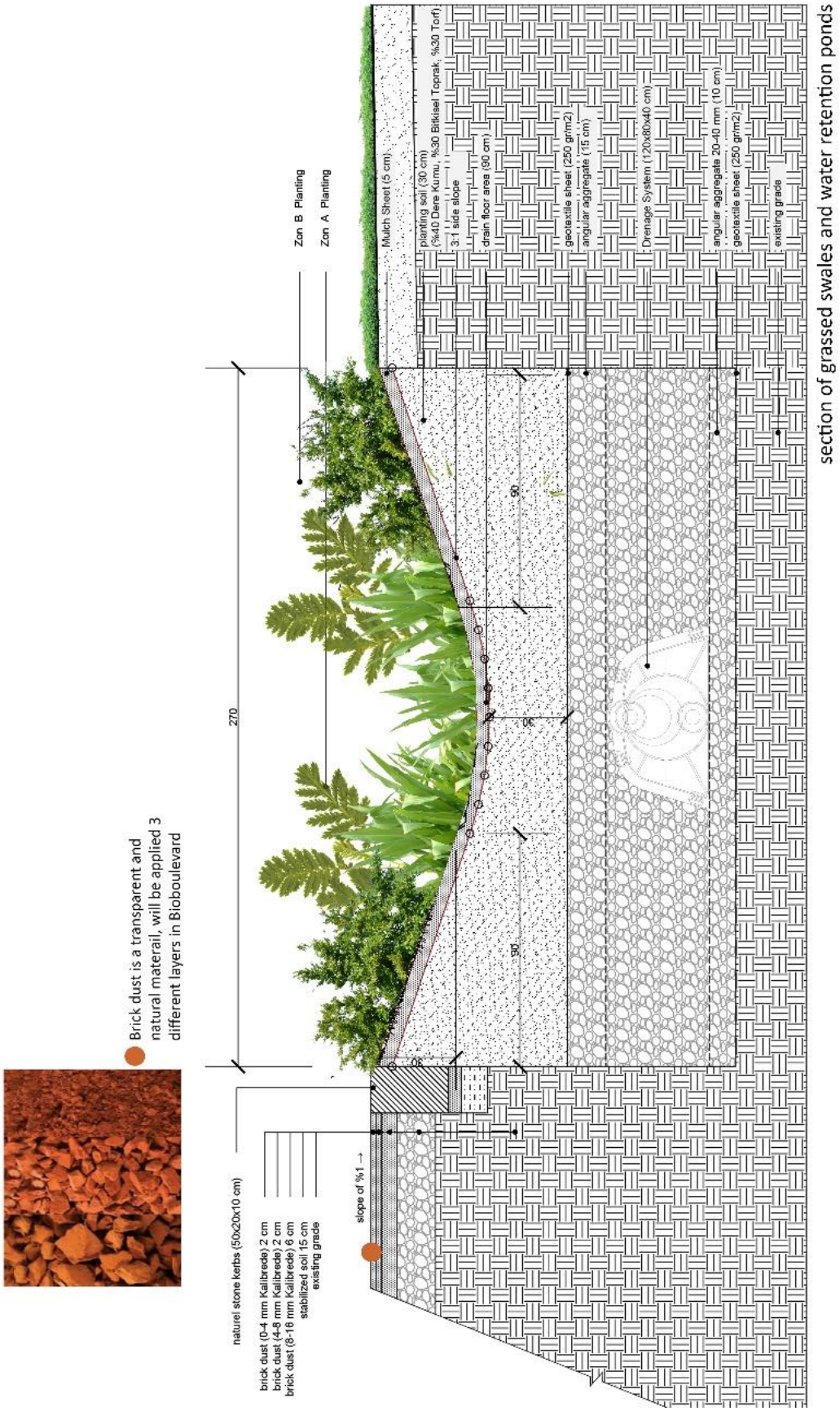


Figure 3-11: Section of Bioswale

The length of the bio-boulevard will be 557 m. Detailed explanations of the materials and plant species going to be used for this NBS are explained in the Table 3.2 and Table 3.3 below:

Table 3-2: Detailed explanations/figures/locations of the materials going to be used in bio-boulevard

NAME OF THE MATERIAL	PROPERTIES OF THE MATERIAL	FIGURES	LOCATION
BRICK DUST	Because it is a transparent and natural material, selected brick dust will be applied in 3 different layers and applied to the area with minimum intervention. In the project area, brick dust was used in two different applications. In the first application, it was used as a stabilizer on the existing floor and in the second application it was preferred as the covering material on the elevated platforms.		Bio-boulevard
GRASS / GRAVEL HOLDING MODULE	As an alternative to hard flooring, a polypropylene grass and gravel retainer grid is proposed for parking spaces. The grass holder grille is available with both grass and gravel, allowing the ground to be stabilized, walked and driven on. Protecting grass roots in the module also helps to form long-lasting green tissue.		Parking Lots
TUMBLED GRANITE	It is preferred because it creates permeable, decorative texture in planted areas.		In front of greenhouse
CORTEN BOUNDARY	It shows high resistance to weather conditions with its oxidized natural appearance. It is used as limiting material in planted landscaping areas with Corten steel tile wool. The Corten steel will be secured with metal piles to the limiting earth surfaces.		Brick dust - planted areas boundaries

ANDESITE BORDURE	The andesite stone, which has a speckled, abrasion-resistant and non-slip structure, has been chosen as the border material between the bioswale and the walkway in the project area. The andesite border, which is to be laid as a nodule by walk, has been chosen to be more durable and long lasting in the bioswale area compared to metal restraining materials.		Bioswale – Brick Dust boundaries
ALIMINIUM BOUNDARY	It is used as a limiting material between different surface materials such as grass, tree bark, slag, gravel. The preferred aluminium restraint is used to create clean bonding details and is connected to the ground floor with metal piles because it is lighter than steel and more flexible during the application phase.		Combinations of Herbal Materials in Different Textures
TREES AND TIMBER	Partial bodies of eucalyptus trees will be displayed at some points in the project area, and logs and timber will be used in step stones, children's playground and urban facilities.		Planted Area
BIOCHAR	Carbon-rich biochar is obtained by pyrolysis of plants and other organic wastes at high temperature in a low-oxygen environment. It increases productivity with high values of P, K, Mg and Ca, but it also increases the water holding capacity of the soil.		Smart Soil Applied Agricultural Field
MALCH	Pine bark and slag were used to create permeable surfaces in different textures in planted landscape areas.		Planted Area

DRAINAGE	Drainage is considered as a flood prevention infrastructure system in the project area where extreme rainfall is high and groundwater is high. Precipitation and surface waters will be collected in the drainage system placed under bioswale after biological treatment and the treated water will be brought to groundwater.		Infrastructure

During the material selection stage, ecological issues were taken into consideration in order to create a sustainable structure and not to disturb the existing natural structure of the region. Materials that provide a permeable surface for feeding groundwater resources and plants with low irrigation need were preferred to not to increase water consumption. For the surface with grass covering and any other section of the structure with irrigation need the rainwater gathered by bioswale will be the main water resource.

Table 3-3: Bioswale Plant List

NO	Species	Latin Name	Sunlight Requirement
1	**Trees**	*Cupressus sempervirens*	Sun / Semi Shadow
2		*Celtis australis*	Sun / Semi Shadow
3		*Koelreuteria paniculata*	Sun
4		*Lagerstroemia indica*	Sun
5		*Pinus brutia*	Sun
6	**Shrubs**	*Arbutus unedo 'Compacta'*	Sun
7		*Mahonia aquifolium*	Semi Shadow
8		*Philadelphus coronarius*	Sun
9		*Spiraea vanhouttei*	Sun / Semi Shadow
10		*Vitexa gnus-castus*	Sun
11	**Perennials & Coverings**	*Acorus calamus*	Sun / Semi Shadow
12		*Arundo donax*	Sun / Semi Shadow
13		*Bromus sipyleus*	Sun / Semi Shadow
14		*Bromus macrocladus*	Sun / Semi Shadow
15		*Carex acuta*	Semi Shadow/Shadow
16		*Cicuta virosa*	Sun / Semi Shadow
17		*Festuca rubra*	Semi Shadow/Shadow
18		*Juncus effusus 'Spiralis'*	Sun / Semi Shadow
19		*Narcissus pseudonarcissus*	Sun /Shadow
20		*Rumex hydrolapathum*	Sun / Semi Shadow
21		*Sedum microcarpum*	Sun / Semi Shadow

NO	Species	Latin Name	Sunlight Requirement
22		*Sparganium erectum*	Sun / Semi Shadow
23		*Veronica anagallis-aquatica*	Sun / Semi Shadow

3.4.4 Operational and Maintenance Considerations

Operational and maintenance aspects of this NBS will be executed periodically by the Directorate of Parks and Gardens of IMM. Details of the operational and maintenance aspects will be determined after detailed investigation of the implementation. There are a lot of different plant species, materials/products and infrastructure equipment within the design considerations of this NBS. Directorate of Parks and Gardens of IMM will work together with specialists and technicians for these plants, materials and equipment. Also, Directorate of Technical Works of IMM will be in maintenance team for the NBS after implementation.

3.4.5 Economic Specifications

Cost of Grassed swales and Water Retention Pounds around Bio-boulevard (557 m): 82.000€

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in a public report before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

3.5 Climate-smart Greenhouses

3.5.1 General Description & Purpose of the NBS

Climate change has been gradually intensifying, due to natural internal processes and such of anthropogenic origin. The unfavorable effects of the climate change occur on a global and regional scale[1]. Significant climatic changes have been observed over the past hundred years. Records show that the mean temperature on earth rose by approximately 0.6 °C during the 20th century. Global warming is one of those environmental issues that are most intimately linked to socio-economic development[2]. The main issue that many countries, the private sector, institutions, etc. must face is how to adapt to the future climate changes that are expected to occur. Turkey is also in a region that is affected by climate change. Indeed, water scarcity can directly increase drought and desertification, cause forest fires, and negatively impact vegetation, human health, ecology, and biodiversity in a number of ways. Agriculture is one of the sectors, which are not only sensitive to global warming (e.g., through atmospheric temperature, precipitation, soil moisture, sea level, and humidity), but also contribute to the occurrence of the climate change[3]. Moreover, climatic changes may impose indirect pressure on the agricultural sector causing social and economic problems. Additionally, climate change affects food supply directly due to the dependence of agriculture on climate.

Climate scientists have determined that climate change will be very effective on Western Anatolia regions in Turkey. West Anatolia provides significantly important part of agricultural production in Turkey. Lack of rainfall and increased temperature along with evaporation rate will cause decrease in quality and amount of irrigation water. In addition to this, another important factor that would affect agricultural crop pattern changes and infertility is expected degradation in the irrigation water and soil quality parameters such as salinity-alkalinity, soil structure deterioration etc. due to insufficient salt washing process of the soil and excessive evaporation. It is expected that all of the problems described above will be in Izmir city and its surroundings lands as well. Despite this situation, people will be in need for nutrition and therefore food production must be continued uninterruptedly. In this case, it is necessary to plan crop production in accordance with expected stress conditions in agricultural lands and to manage the drought. Climate-smart greenhouse can be defined as an approach for transforming and reorienting agricultural development under the new realities of climate change. Climate smart soil and agriculture will be practice in a greenhouse and on field together. This NBS employs greenhouse facilities to illustrate the effects of climate change on urban green vegetation used in urban green areas and farming (for both urban and peri-urban areas). This practice will help to select adequate vegetal species for urban farming and to establish community practices and new social forms of organization.

Figure 3-12: A closer view of Climate Smart Greenhouse

Expected Impacts

Expected impacts from climate smart greenhouse can be analyzed for each application part of the greenhouse.

App1. It is quite obvious that climate change will cause water scarcity. Rapid fall of groundwater level requires the collection of surface waters and primarily usage for vital purposes. However, a significant part of the surface waters collected in dams and ponds are used for electricity generation. The remaining waters need to be shared amongst other stakeholders such as drinking, irrigation, industry and wildlife. In this case, it is necessary to reduce the use of dam waters for electricity generation. Greenhouses need to be heated in winter to prevent plants from freezing and accelerate plant growth. Fossil fuels or electric heaters are still used for this purpose. This section of the Greenhouse includes some applications aimed at reducing energy from the national electricity network. The heating of this part of the greenhouse will be provided by parabolic solar energy. For this purpose, isolated water tanks that store heat during daytime

hours will be used for night heating purposes. The use of Parabolic (concave) type Solar Collector is aimed for heating of 200 sqm size greenhouses. In the parabolic type solar collectors, 0.5 Kw / h thermal power is obtained from 1 sqm reflective surface area. The total reflectance of 6 Parabolic Type Solar Collectors planned to be used in the system mirror area is 24 sqm. The hourly thermal power to be obtained from the 24 sqm mirror surface is 12 Kw/h. Average of the system to be installed based on the daily 7-hour sun exposure data. In this case; an energy gain of 7 hours x 12 Kw / h = 84 Kw / h will be provided and about as the annual basis; 30,240 Kw / h energy will be saved.

The required thermal power for the 200 sqm greenhouse to be heated is 24 Kw/h. Operating principle of the system the thermal energy stored in daytime will be used for heating the greenhouse for 3 hours at night. The total amount of energy consumed per night in heating is 3 x 24 Kw h = 72 Kw/h.

Additional, photovoltaic solar energy system (battery) will be use lightening needs.

In this part of the greenhouse also will be demonstrated usage of sea water contaminated irrigation water for agricultural production after desalination. Due to this process a portable desalination unit will install for this part of greenhouse. Demonstration of the use of sea water will be presented as a solution to the expected water scarcity. The desalination process exemplified in today's desert climate regions, but has never been applied in our country. It will be installed for educational purposes.

App 2. Agricultural areas in the Aegean Region are located in the alluvial valley systems located between the mountains extending perpendicularly to the Aegean Sea in the east-west direction. The western borders of these valleys have in contact with the Aegean Sea. Because of the ground water that moves in the direction of the land from the sea during the summer seasons. The contamination from the sea water to the groundwater causes the salt content increases of the ground water that is using for drinking and also irrigation purposes.

It is expected that changing climatic conditions will significantly affect water availability and food production. It is inevitable that there will be a shortage of fresh water as a result of reduced rainfall, increased temperature and high evaporation ratio within next a few decades. Due to this, it will be necessary to use fresh water more economically. It is expected that climate change will cause also soil degradation and salinization of water quality as well as water shortage. In this case, agricultural production will be shifted from field to greenhouses.

App 2.1. Salty water contamination will be more effective in the coming years due to reduced rainfall. For these reasons it would be useful to use harvest the rain water for both directly use for irrigation and to reduce the salt concentration in the irrigation water. All of the roof of greenhouse will be used to collect (harvest) rainwater to use in agricultural production. Size of the roof of the greenhouse is around the 900 sqm. Assuming an average annual rainfall is 600 mm/year, about 540 m^3 of rain water can be obtained from the roof of the greenhouse. if this practice becomes widespread for the other greenhouses in urban and rural farming, they will provide a significant portion of their fresh water needs.

App.2.2. In the coming decades, open field gardening will become almost impossible due to salinization and structural deterioration of soils depending on expected climate change effects.

During the summer season, depending on the increasing evaporation rate, salt and other residues will accumulate on the soil surfaces. Decreasing rainfall and lack of irrigation water will reduce salt wash (leaching) from topsoil which is very important soil layer for germinating of seed and developing of roots. In this part of Sub Demo B, a new method for preparing soil for the sustainable gardening of saline soils has been proposed. This method will be exemplified in the open field in front of the greenhouse. According to this method, high soil ridges of about 70 cm height will be prepared from the saline ground in order to sapling. In the soil, salted ground water is transported to the surface by pipes which are known as capillary pipes. To stop this transformation, a sandy layer about 20 cm thick will be laid at the bottom of the high soil ridges. And also, before the saplings, a subsurface drip irrigation system will be installed on the ridges against to evaporation of irrigation water.

There are 6995 ha lands almost affected from changed climate condition for last decades and 365ha lands are under high pressure of climate change (source: Land classification of Izmir City, 2013). These lands could be used for horticulture proposes.

App.2.3. The most of saline lands could be used for fruits production. As the agricultural production areas decrease due to the negative impact of climate change, food demand will continue to increase due to the increasing population. Increasing the number of greenhouses to supply the demand for food has been suggested as a solution. In addition, it is necessary to increase the yield from the unit area within the greenhouses. In this project, a vertical farming application will be exemplified to increase the yield of unit area. In this system, which has tables rotating in the vertical direction, 18 times more products can be obtained from the unit side.

3.5.2 Location

Climate smart greenhouse includes 3 production & demonstration parts and located in the eastern part of the Sasalı Natural Life Park (Figure 3-1, Figure 3-13). In addition, an open field agriculture will be demonstrated on salty soils and a seminar room will be design for educative propose.

Figure 3-13: Location and geographical position of the climate smart greenhouse

3.5.3 Technical Specifications

Climate-smart greenhouses will be built in Sasalı Natural Life Park to illustrate the current and future effects of climate change on urban and rural green vegetation. The greenhouses will demonstrate producing agricultural crop continuously under changed climate condition. Urban farming/community practices/new social forms of organization will be illustrated in the climate-smart urban farming precinct in the special precinct of Sasalı Natural Life Park.

Green houses will be cover by polycarbonate material. Each part of the greenhouse is described below;

One part of the greenhouse will be used to demonstrate effects of changed climate condition on soils and plants. Size of the part (Part 1) is 162 sqm (18 m x 9,05m). This part of greenhouse will be used for educative purposes for students and visitors of the natural life park to awareness on climate chancing.

Second part of the greenhouse will be demonstrated parabolic solar heating system and also use of solar energy for lightening. Size of this part also is 162 sqm (18m x 9,05m).

The rest part of the greenhouse will be used for demonstrating other new techniques for agricultural production considering energy and water saving and having much more production per unit area. Within this unit, vertical agricultural production, water harvesting from condensed vapor and hydroponic farming were planned. Beside them, a rain water harvesting system will be constructed on the roof of greenhouse (Figure 3-14, Figure 3-15Figure 3-14: Parcel plan of climate-smart greenhouse).

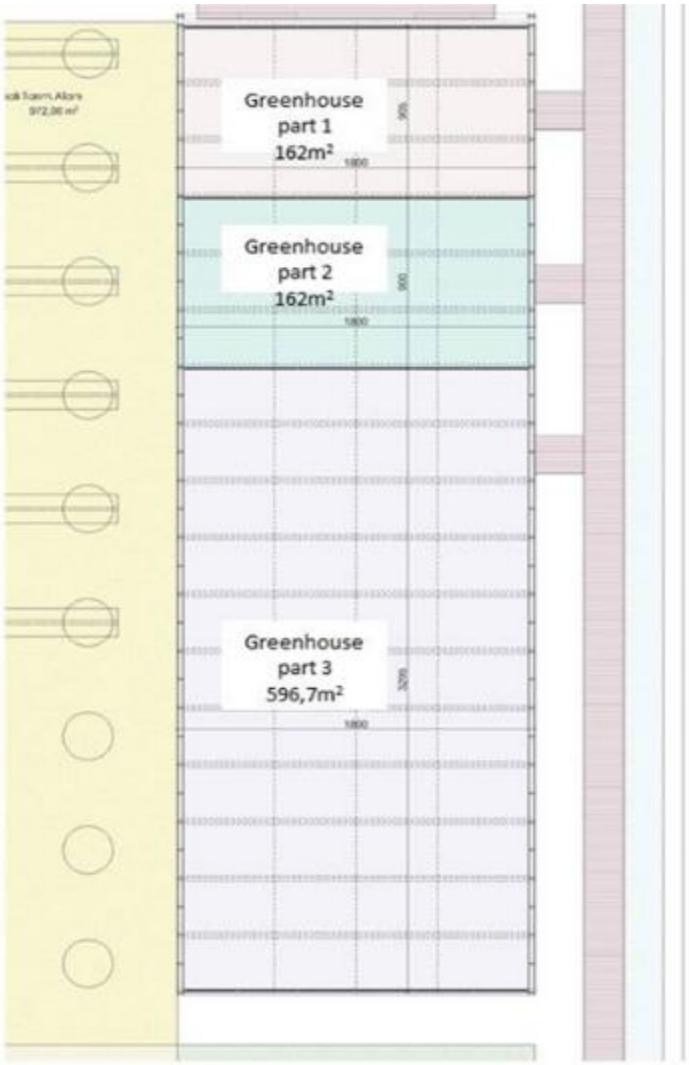


Figure 3-14: Parcel plan of climate-smart greenhouse

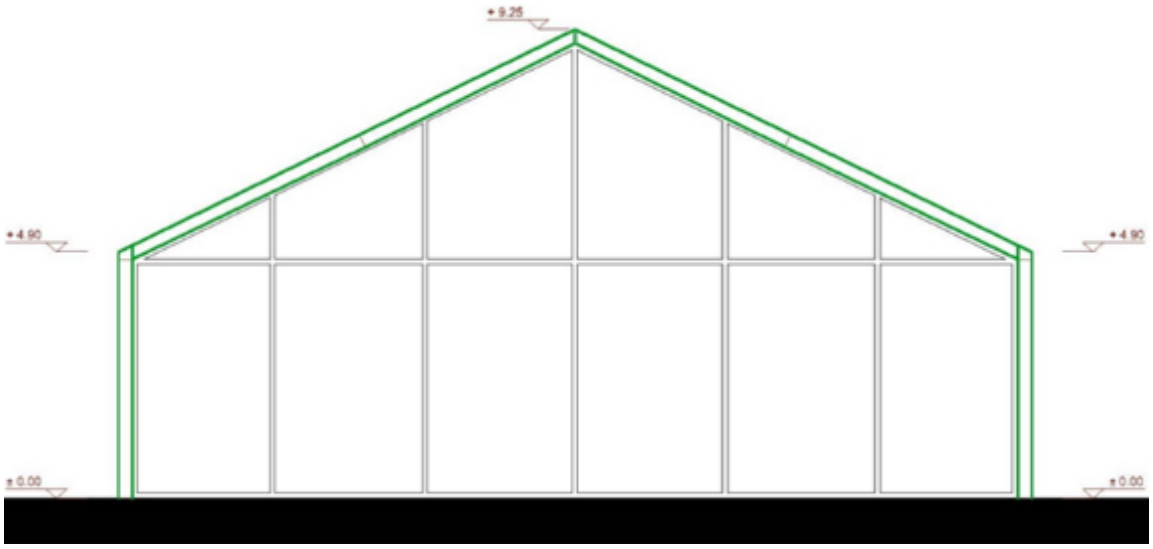


Figure 3-15: Front view of the climate-smart greenhouse project

The area in the greenhouse needs to be used effectively for agricultural production. So, the climate smart greenhouse will include vertical and hydroponic plantation system. In order to save water to be used in the greenhouse, roofing will be made from material that can condense the water vapor. After water vapor is condensed on the greenhouse roof, water will be stored by collection channels and reused in agricultural production. Additionally, a rain water harvesting system will be installing. (Figure 3-16, Figure 3-17).

In order to save energy, parabolic type solar energy collector will be used for heating the greenhouse. Additionally, the photovoltaic solar energy system will be used for lighting (Figure 3-18).

In this project, a vertical farming application will be exemplified to increase the yield of unit area. In this system, which has tables rotating in the vertical direction (Figure 3-19).

Additionally, agricultural production methods will be demonstrated in the soil which becomes saline and alkaline soils in sub-demo B. In order to avoid product yield loss, a spatial seeding type on saline soil will be applied (Figure 3-20).

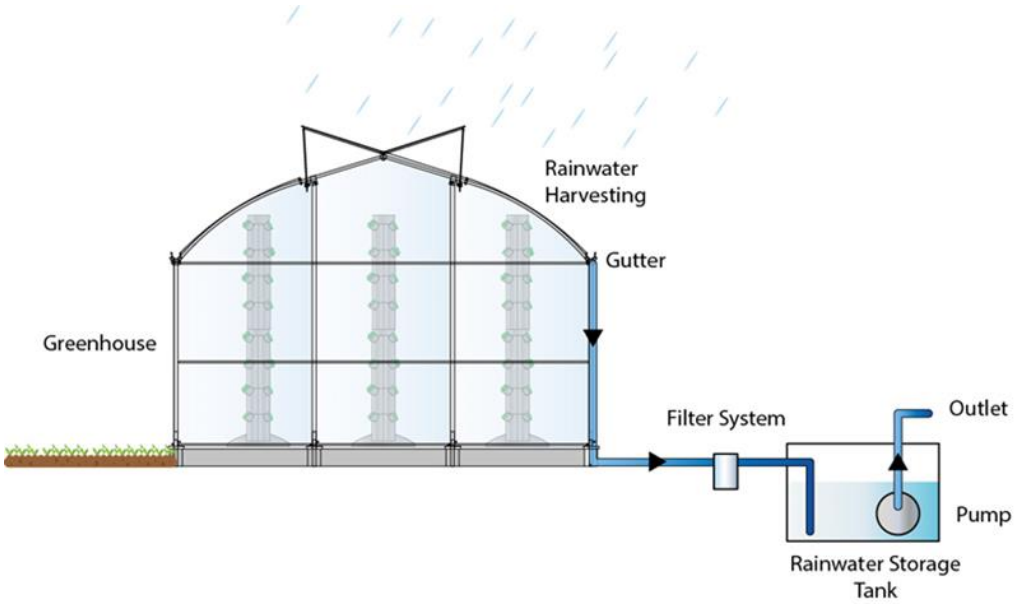


Figure 3-16: Schematic view of rainfall harvesting

Figure 3-17: An example for rainfall harvesting equipment

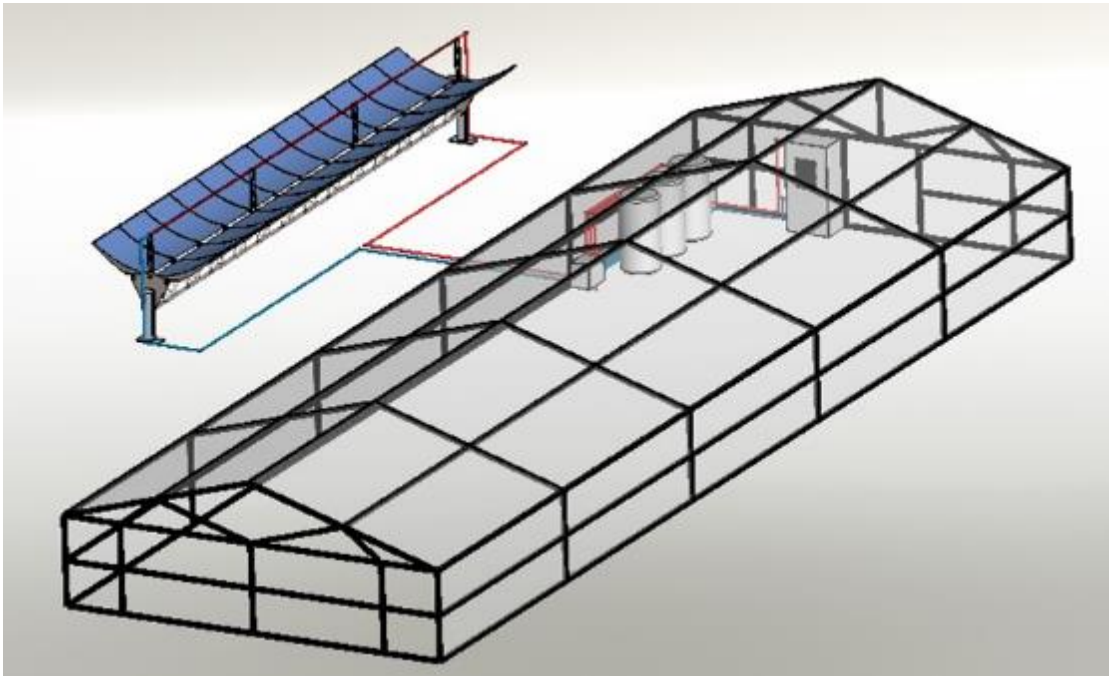


Figure 3-18: Schematic view of parabolic type solar energy collector

Figure 3-19: An example for solar energy collector equipment

Totally 8 vertical farming units will be established within this project. The vertical agricultural system to be established in this project has rotary planting trays (pot) system. Each vertical farming unit has 17 vertical rotating planting trays to obtain sunlight equally and also for watering with necessary nutrient. Watering for the plants will be obtained from a kind of open surface lateral tank that is mounted at the bottom of the system. The irrigation water can be explained also as nutrient solution.

Figure 3-20: Vertical farming in climate-smart greenhouse

Figure 3-21: Schematic view of high ridge seeding system

3.5.4 Operational and Maintenance Considerations

Maintenance of the measuring electronics devices in the greenhouse should be done at least once a year. The heating system, the watering system, the lighting, and the drip irrigation system should be checking every month. The inside and outside of the greenhouse should be cleaned every day. For greenhouse cleaning and safety, a staff member from the municipality must be appointed.

There will be more detailed maintenance considerations after the design process of the NBS finished and initializing the implementation.

3.5.5 Economic Specifications

Cost of Climate Smart Greenhouses (920 sqm): 265.000 €

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in a public document before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

4 Technical and Economical Definition of the Interventions - SUBDEMO - C

Sub Demo C is formed by a 10 km long green corridor from the coastal areas, river beds to highly sensitive nature protection areas (see Figure 4-1). The proposed green corridor includes sustainable transportation options (cycling &walking) and special sections like the Bio-Boulevard that will provide important ecosystem services for urban biodiversity. Sub Demo C also includes non-technical interventions aiming bio-diversity increasing education activities.

Figure 4-1: Sub Demo C: Peynircioğlu Stream and Urban Green Corridor

Table 4-1: List of interventions in Sub-Demo B

Re-naturing urbanization	Water interventions	Singular Green Infrastructures	Non-technical interventions
Cycle and pedestrian route in new Green Corridor	Culvert works for Peynircioğlu Stream	Green fences	Industrial Heritage Route along the Izmir Urban Green Corridor
Planting 4800 Cool & Shady Trees	Green pavements for Peynircioğlu Stream	Fruit walls	
Urban Carbon Sink			

Common non-technical interventions to the three sub-demos are included in section 5.

4.1 Cycle and pedestrian route in new Green Corridor

4.1.1 General Description & Purpose of the NBS

It is planned to be formed a 3 km long new bicycle and pedestrian green route in addition to 10.5 km long existing bike lane. The proposed green route offers a more comfortable, greener and sustainable connection at the northern end of the city. The coastal promenades and linear parks that encompass the Izmir Bay all the all way from north to south would be linked to Sasalı Natural Life Park and Southern Gediz Delta through proposed cycling and pedestrian friendly greener route. The proposed green corridor includes sustainable transportation options (cycling and walking) and special sections like the Bio-boulevard. Although the ultimate purpose of the corridor is to revise and improve the existing route and provide more bike and pedestrian friendly route, it also links several NBSs in the project and serves the purposes of carbon sequestration and pollutant's removal with its tree cover.

Figure 4-2: An example illustration for green cycle and pedestrian route implementation

Related KPIs: a) Carbon sequestration in vegetation, b) Pollutant's removed by vegetation (in leaves, stems and roots) and Cc) Increase in shadow surface

Expected impacts: a) Increased bike and pedestrian mobility, b) More carbon sequestration and pollutant's removal and c) a number of co-benefits including stormwater run-off mitigation, microclimate regulation through shading and evaporation, habitat and food provision for biodiversity, and recreational services d) Installation of new green surfaces.

4.1.2 Location

The route starts from Sasalı Natural Life Park in the Çiğli District and merges into Peynircioğlu Stream and coastal promenade in the Karşıyaka District. In a way, it acts as continuous linkage between two districts and unites rural-natural and urban continuum.

Figure 4-3: Aerial view of cycle and pedestrian route of new green corridor

4.1.3 Technical Specifications

Bicycle and pedestrian green route are the part of green corridor works like linear greenway in the city. It characterized by pathways that provide recreational, public health and well-being opportunities, as well as transportation linkages. It serves to connect cyclists and pedestrians to nature.

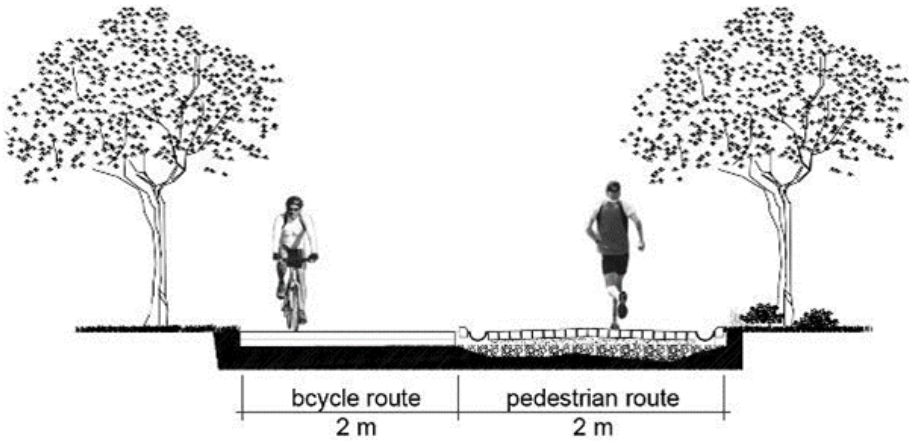


Figure 4-4: Schematic view of cycle and pedestrian route

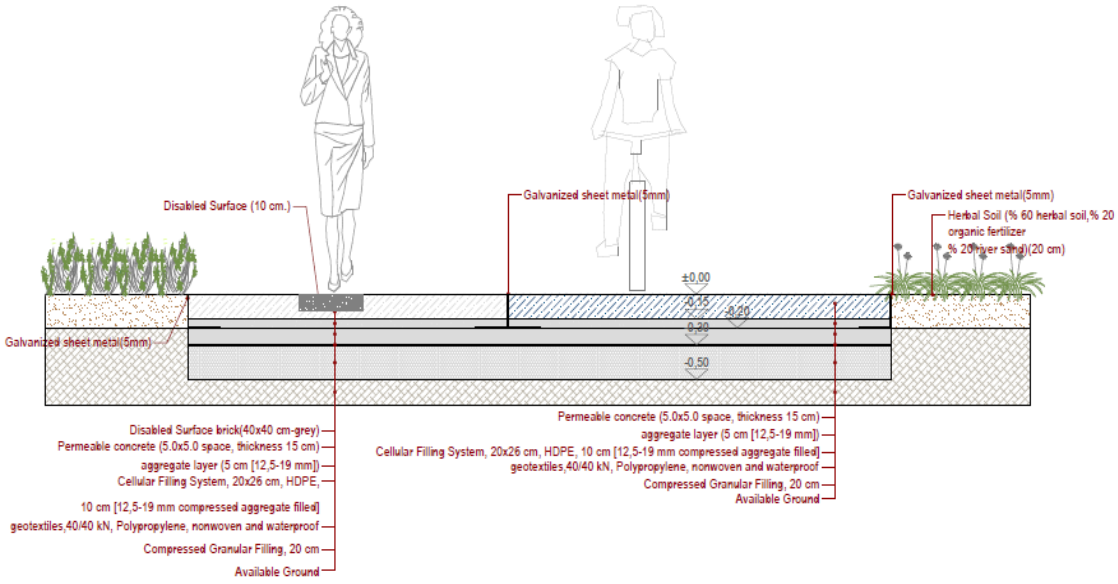


Figure 4-5: Technical details of cycle and pedestrian route

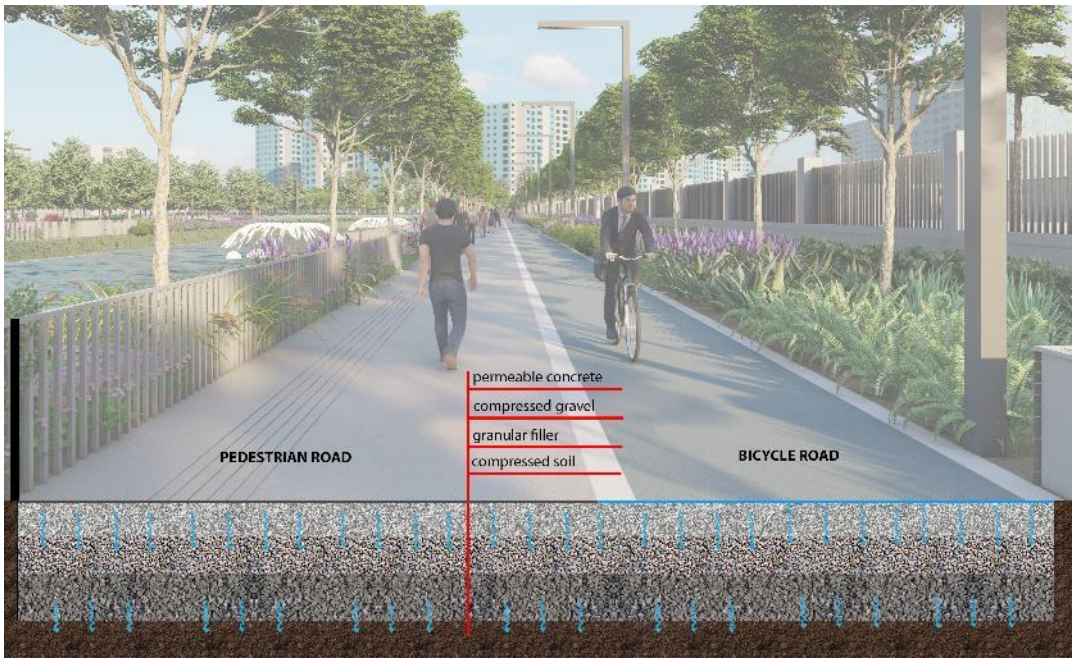


Figure 4-6: Section plan of cycle and pedestrian route

Except the construction works there will be trees plantation works along the route. Below there is a list of recommended trees to be planted:

- Tilia argentea
- Pistacia terebinthus
- Laurus nobilis
- Platanus orientalis
- Quercus cerris

- Ginkgo biloba
- Gleditchia tracantrus inermis
- Gravillea robusta
- Celtis australis
- Jakaranda mimosifolia
- Albizzia julibrissin
- Ceratonia siliqua
- Robinia pseudo acacia
- Sophora japonica
- Morus alba

These tree species will be distributed on this route and also different parts of new green corridor and around Peynircioğlu Stream depending on their special properties. For example, Pistacia terebinthus and Quercus cerris species are resistant against the adverse effects of salty water so they might be planted where ground water is saltier than the other areas of plantation.

4.1.4 Operational and Maintenance Considerations

Maintenance steps for this NBS can be listed as below:

- Clear drainage channels and culverts,
- sweep debris and surface (especially in the fall),
- mow verges,
- cut trees and other vegetation,
- repair / replace damaged / lost signs,
- maintain lighting, furniture, structures if necessary

4.1.5 Economic Specifications

Cost of 3 km cycle route in new Green Corridor: 205.000€

Cost of 1.6 km pedestrian route in new Green Corridor: 85.000€

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in a public document before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

4.2 Planting 4800 Cool & Shady Trees

4.2.1 General Description & Purpose of the NBS

A large number of trees are planted along the new green corridors and Peynircioğlu Stream. The main purpose is to increase the number of wide canopy trees so that carbon sequestration and pollutant's removal level could be maximized. They will improve user's well-being as well as connection to nature. Besides, they will serve as a shady bike and pedestrian route, habitat for insects and birds and stormwater interceptor. Mostly native tree species are preferred because they are already adapted to ecological conditions such as climate and soil regardless of their advantages of attracting birds and insect species.

Related KPIs: a) Carbon sequestration in vegetation, b) Pollutant's removed by vegetation (in leaves, stems and roots) and c) Increase in shadow surface

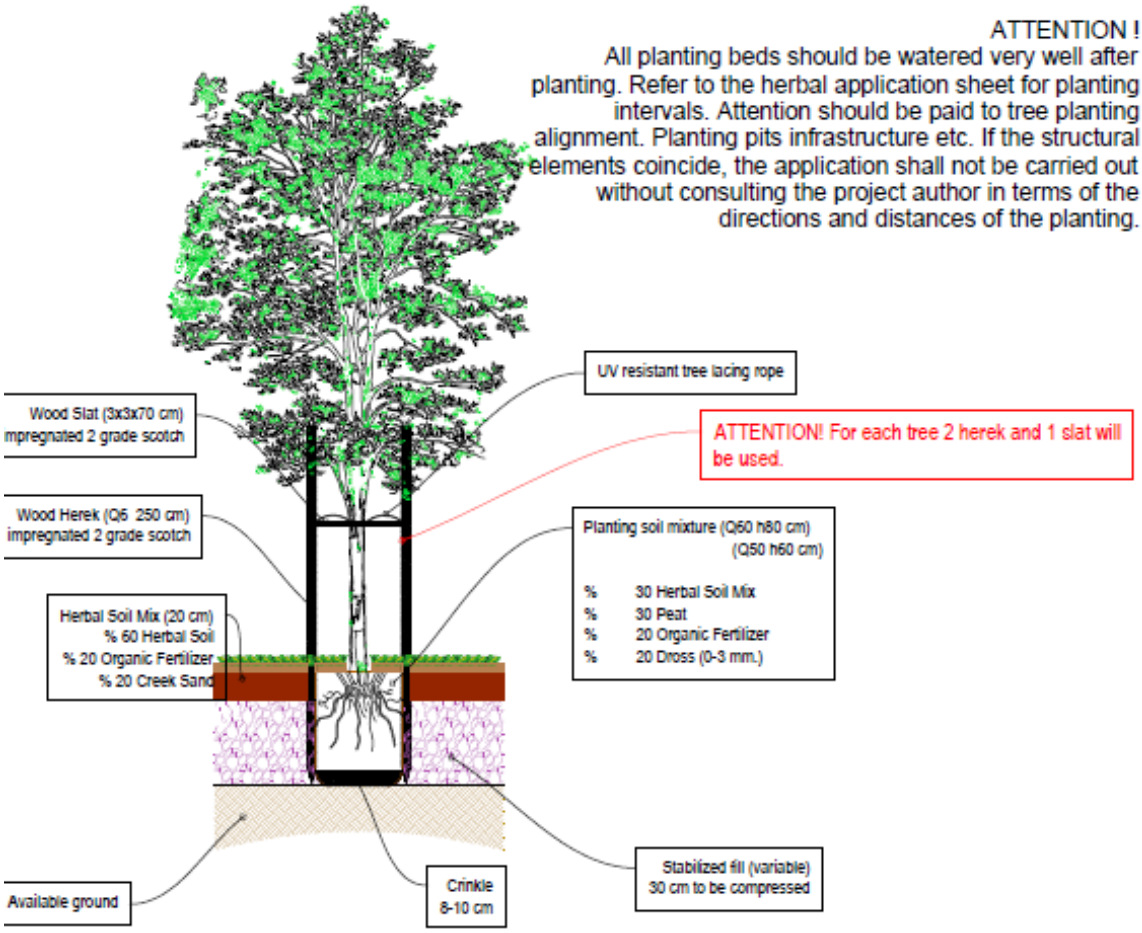
Expected impacts; a) Increased carbon sequestration and pollutant's removal, b) A number of co-benefits including stormwater run-off mitigation, microclimate regulation through shading and evaporation, habitat and food provision for biodiversity, and recreational services.

4.2.2 Location

Trees are planted along a new green corridor between Karşıyaka and Çiğli, and around Peynircioğlu Stream. This corridor starts from Sasalı Natural Life Park in the Çiğli District and merges into Peynircioğlu Stream and coastal promenade in the Karşıyaka District.

4.2.3 Technical Specifications

A schematic view below shows the technical details of planting trees.



The same species of trees;

- Tilia argentea
- Pistacia terebinthus
- Laurus nobilis
- Platanus orientalis
- Quercus cerris
- Ginkgo biloba
- Gleditchia tracantrus inermis
- Gravillea robusta
- Celtis australis
- Jakaranda mimosifolia
- Albizzia julibrissin
- Ceratonia siliqua
- Robinia pseudo acacia
- Sophora japonica
- Morus alba

Will be planted along the new green corridor and around Peynircioğlu Stream. Besides those species there are some specific species might be planted just around Peynircioğlu Stream, which are:

- Elaeagnus angustifolia
- Tamarix symrnensis
- Salix alba
- Salix caprea
- Elaeagnus angustifolia
- Lagerstroemia indica – oya
- Lantana camara
- Nerium oleander – zakkum
- Sedum microcarpum
- Sedum acre
- Sedum reflexum
- Sedum brevifol
- Gazania rigens

Figure 4-7: Distribution of species on different locations

4.2.4 Operational and Maintenance Considerations

Standard maintenance operations (pruning, irrigation etc.) for trees will be continued by Directorate of Parks and Gardens of IMM with technicians and specialists of this Directorate. Because these trees are around pedestrian and cycle routes, intersection areas between trees and people is getting more important. There will be more attention on those trees to protect them from the adverse effects of the human activities on the route and coastline of Peynircioğlu Stream. Another important issue with those trees is protect cyclist from the boughs and leaves of the trees. With taking this into consideration the periods of pruning operations will be set carefully.

4.2.5 Economic Specifications

Cost of Planting 4.800 trees: 204.000 €

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in a public document before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

4.3 Urban carbon sink

4.3.1 General Description & Purpose of the NBS

This is related to planting trees around Peynircioğlu Stream. In the selection process, fast growing and large canopy trees with a large leaf area are mostly preferred, such as *Platanus orientalis, Tilia argentea, Pistacia terebithus, Creatonia siliqua, Lourus nobilis*. The purpose is planting large canopy trees to maximize carbon sequestration. Installation of urban woodland with appropriate species adapted to capture carbon CO_2 maximizing carbon sequestration. The trees will be allocated in specific arboreal series as to form a new urban ecosystem to preserve and improve the biodiversity.

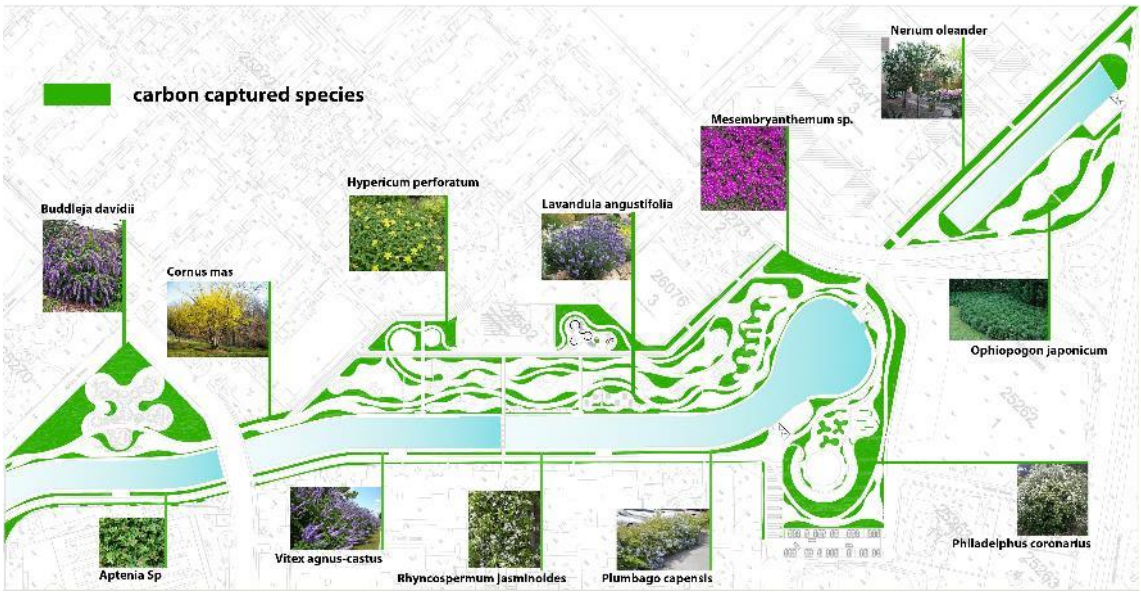
Related KPIs: a) Carbon sequestration in vegetation, b) Pollutant's removed by vegetation (in leaves, stems and roots) and c) Increase in shadow surface

Expected impacts; a) Increased carbon sequestration and pollutant's removal, b) A number of co-benefits including stormwater run-off mitigation, microclimate regulation through shading and evaporation, habitat and food provision for biodiversity, and recreational and cultural services.

4.3.2 Location

The location of the NBS will be the coastline and its surroundings of Peynircioğlu Stream which explained in detail and with figures in introduction of chapter 4.

Also, the figure below shows the planned locations of the species around Peynircioğlu



4.3.3 Technical Specifications

The technical details of planting the species given in the figure below:

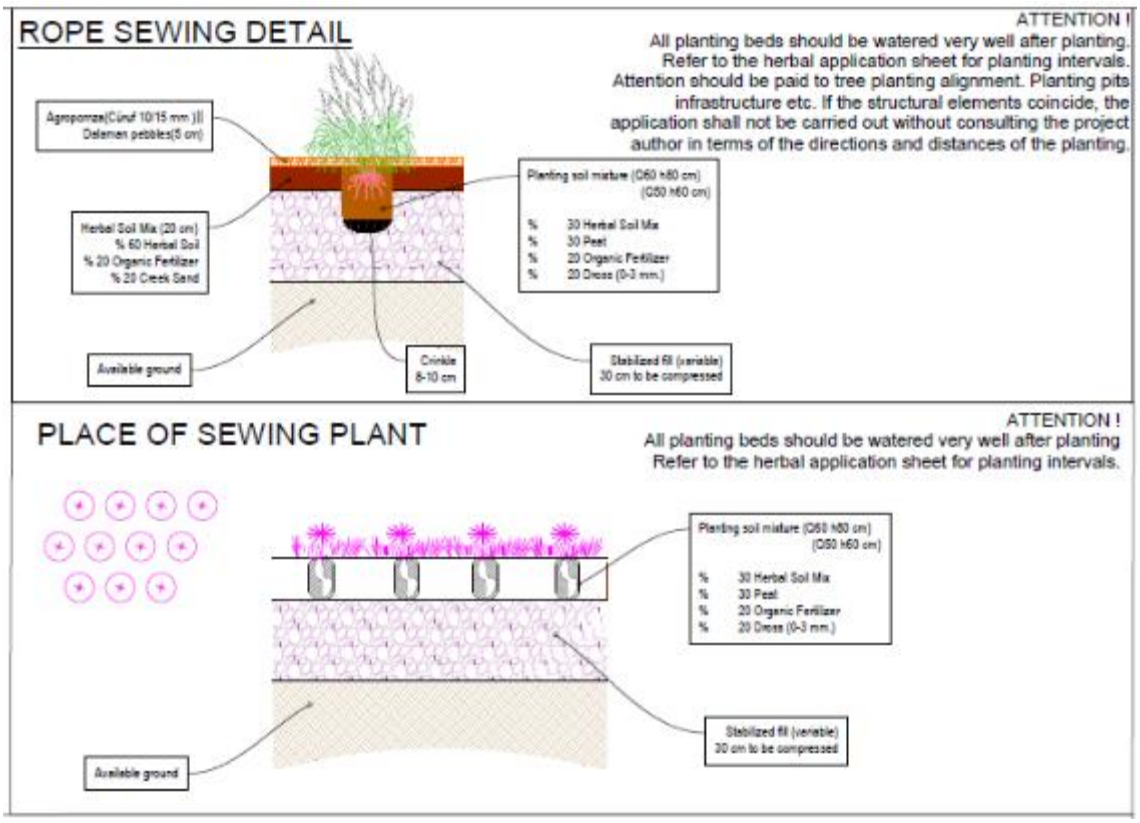


Figure 4-8: Technical details for urban carbon sink

High-pitched trees, shrub groups, ground coverers and endemic plant species will be planted all around the Peynircioğlu Stream as potential green areas. These plants will cover an area of about 10.000 sqm.

The operations in this area are:

- transporting and laying of soil with vehicles
- proper identification and marking of plant sites
- drawing of irrigation lines
- planting and fixing of plant species
- periodical maintenance

4.3.4 Operational and Maintenance Considerations

Standard maintenance operations (pruning, irrigation etc.) for trees will be continued by Directorate of Parks and Gardens of IMM.

4.3.5 Economic Specifications

Cost of Urban carbon sink around Peynircioğlu Stream and new green corridor: 230.000€

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in a public document before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

4.4 Culvert works for Peynircioğlu Stream

4.4.1 General Description & Purpose of the NBS

The Peynircioğlu Stream is completely covered in concrete. Thus, the existing stream corridor is now mostly an open space with little or no vegetation except a linear green space on the western side of the stream. Some parts of the Stream course are filled with seawater because of the elevation difference. The stream is so engineered that it functions like an open concrete drainage channel.

Culvert works will include an approximately 1km length of Peynircioğlu Stream riverbank restoration that will transform the unnatural and impermeable present riverbank infrastructure into a re-natured riverbank with green pavements besides green fences, fruit walls at the edges of the riverbank.

Concrete walls of the riverbank are planning to be replaced by an eco-friendly alternative of terramesh wall which is also easy to construct.

New green areas around the stream are being implemented by so, natural vegetation cover installed will contribute to the number of species as they raise the biodiversity level.

Related KPIs: Run-off coefficient in relation to precipitation quantities (mm/%), Absorption capacity of green surfaces, bioretention structures and single trees

Expected impacts: a) Increase in water retention capacity b) Increase in natural vegetation cover c) Increase in bio diversity d) Increase in public use of the riverside

4.4.2 Location

The location of the NBS will be the coastline and its surroundings of Peynircioğlu Stream which explained in detail and with figures in introduction of chapter 4.

The location of implementation around Peynircioğlu stream will be as shown in the figure below.

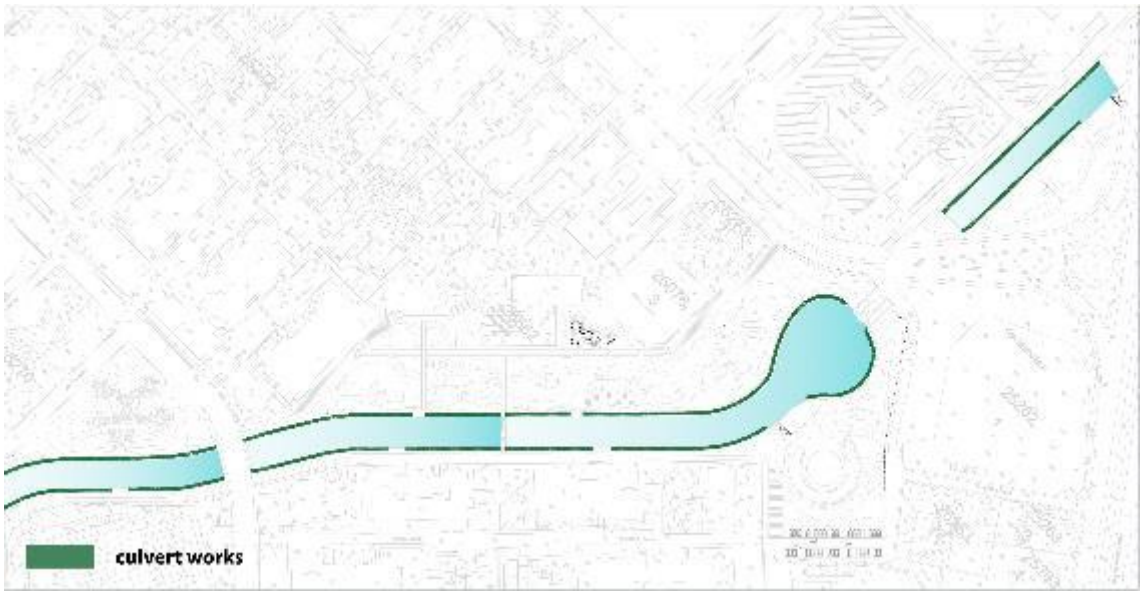


Figure 4-9: Location of the culvert works

4.4.3 Technical Specifications

In this application area, existing concrete surfaces will be cut above the water level and green terramesh wall will be applied to the remaining parts. After that, various related plants will be planted and the impermeable concrete surfaces will be transformed into permeable green surfaces. In this location, there will be plants which resistant to existing salty water of the stream. A detailed figure about how the culvert works will be implemented can be found below (Figure 4-10).

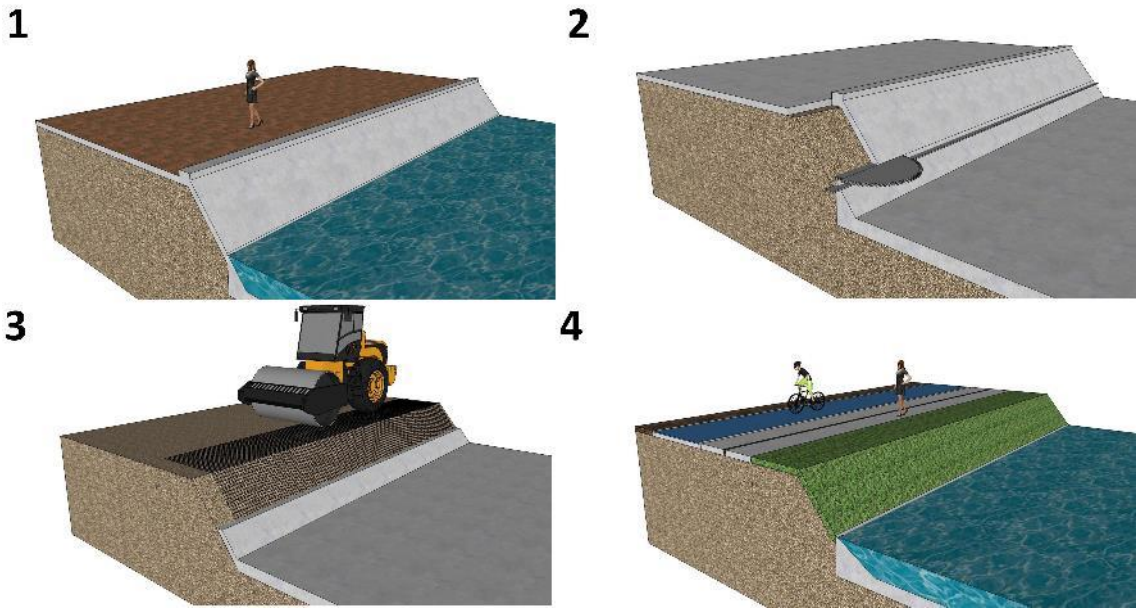
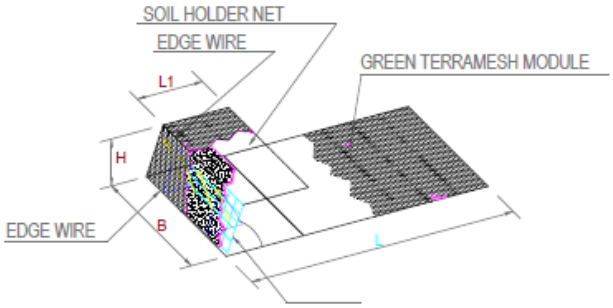


Figure 4-10: Schematic view of culvert works in Peynircioğlu Stream

Figure 4-11: Final view of implementation

For the purpose of the retaining wall, the ground support units with a facade coating used in the manufacture of reinforced concrete structures, 8x10 pore type, 2.20 / 3.20 mm wire thickness and 95% Zn - 5% Al alloy with sloping surface with polymer coating will be used.

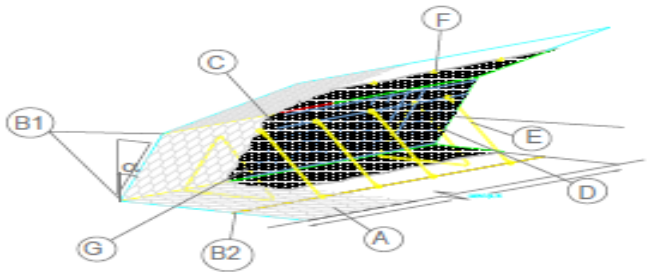


GREEN TERRAMESH DIMENSIONS

	a	H (m)	L (m)	B (m)	PORN TYPE	WIRE DIAMETER	COATING TYPE
GREEN TERRAMESH LIGHT	70°	0.76	3.00	3.00	8 x 10	Ø 2.2 mm/3.2 mm	%95 Zn- %5 Al. PVC Coated Over Alloy

STANDARD DIMENSIONS ACCORDING TO EN 10223-3: 2013 STANDARD.

Figure 4-12: Technical details of terramesh module



A = GREEN TERRAMESH DOUBLE BENDED WIRE NETWORK 8X10 HANDLE TYPE 95% Zn-5% ALL ALLOY, PVC COATED WIRE DIAMETER 82.2 / 3.2mm WIRE IS MADE BY CALCULATION.

B1 = STRENGTHENING RODS ENDİR ARE MANUFACTURED FROM POLYMER COATED STEELS OF 95% ZN-5% AL ALLOY IN 3.4 / 4.4 mm THICKNESS.

B2 = STRENGTHENING RODS ME ARE MANUFACTURED FROM POLYMER COATED STEELS OF 95% ZN-5% AL ALLOY IN 3.4 / 4.4 mm THICKNESS.

C = SOIL HOLDER FİLE

D = STEEL HARDWARE

E = K 8 mm, SUPPORT HANDLE

F = LINKING RING, HAL3.00mm

G = TRIANGLE STEEL BAR Ü 8mm

Figure 4-13: Interior view of terramesh module

4.4.4 Operational and Maintenance Considerations

Details of operational and maintenance considerations will be determined during the implementation with collaboration of Directorate of Parks and Gardens and Directorate of Technical Works of IMM.

4.4.5 Economic Specifications

Cost of Culvert works for Peynircioğlu Stream (1.6 km length): 80.000€

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in a public document before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

4.5 Green pavements for Peynircioğlu Stream

4.5.1 General Description & Purpose of the NBS

In the case of Izmir demo, the main purpose of the green pavement is creating a permeable surface along the riverbank. Conventional pavements such as impervious concrete and asphalt can reach quite high surface temperatures in summer. These surfaces can transfer heat downward to be stored in the pavement subsurface, where it is re-released as heat at night. These effects contribute to the Urban Heat Island effect. Thus, green pavements are very important for the local cooling strategies in a city using the permeable paving materials. Green pavement will be added at the edges of Peynircioğlu Stream.

Related KPIs: a) absorption capacity of green surfaces, b) increased drainage surface, c) Decrease in mean or peak daytime local Temperatures and d) heat wave risks (number of combined tropical nights (>20°C) and hot days (>35°C)

Expected impacts: a) sustainable urban water management by increasing infiltration, enhancing evapotranspiration, providing storage areas for stormwater and removing pollutants and b) amelioration of Urban Heat Island Effect.

4.5.2 Location

The Peynircioğlu Stream flowing in a south-north direction through the high-rise and high-end apartments in Mavişehir Mass Housing Area in Karşıyaka district. Mavişehir is a neighbourhood where mostly residential and commercial land uses such as shopping malls are dominant.

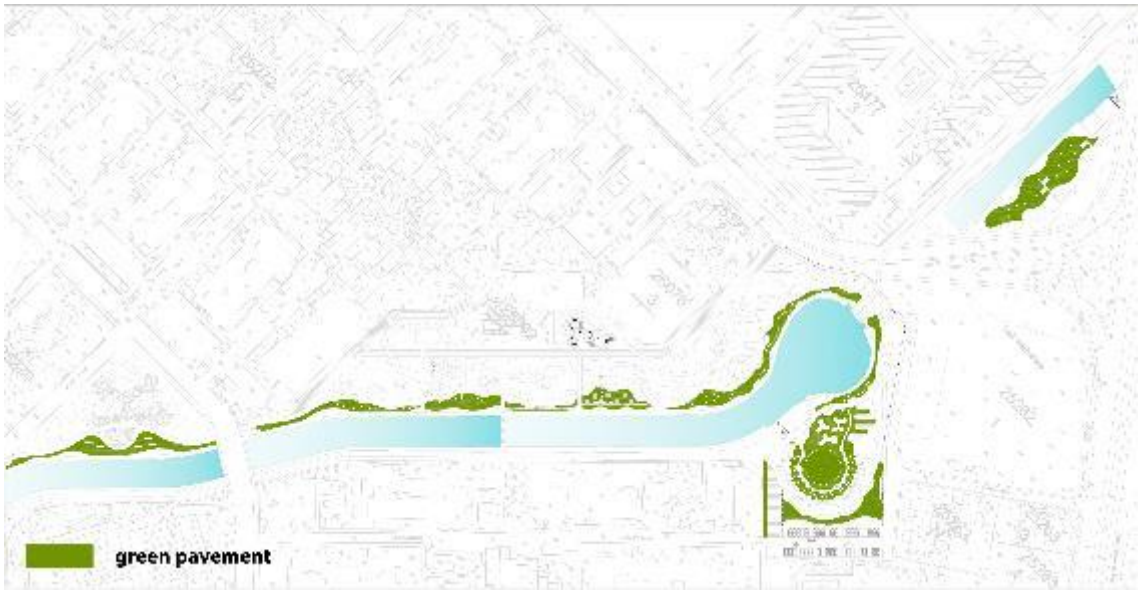


Figure 4-14: Location of green pavement implementation

4.5.3 Technical Specifications

Permeable green pavements will be applied along the stream line. In the mentioned areas, walkable lawns, pedestrian paths made of step stones, permeable wood and concrete surfaces will be implemented. The related area with this NBS is about 10.000 sqm, and recreation areas,

pollinator houses and sections with various plants will be implemented in order to increase the relation of people to the stream.

Figure 4-15: Green pavement

4.5.4 Operational and Maintenance Considerations

Maintenance: Applying light-colored coating to increase reflectance. Pruning vegetation which grows in permeable paving. These maintenance works will be done with the collaboration of Directorate of Technical Works and Directorate of Parks and Gardens of IMM.

4.5.5 Economic Specifications

Cost of Green Pavement for Peynircioğlu Stream (approx. 10.000 sqm): 180.000 €

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in a public document before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

4.6 Green fences

4.6.1 General Description & Purpose of the NBS

Green fences or walls are installed alongside the Peynircioğlu Stream to allow development of new green areas and hence rising bio-diversity since the existing Stream corridor is now mostly an open space with little or no vegetation except a linear green space on the western side of the Stream. Moreover, the Stream is fenced with a metal enclosure on both sites. Existing enclosure will be replaced with green fences or walls to provide more attractive environment both for people and pollinating insects. The green area created by this NBS will be 1600 sqm. Green fences, together with fruit walls and green pavements will become a good example of re-naturing riversides in Izmir.

Related KPIs: a) Pollutant's removed by vegetation (in leaves, stems and roots), b) Pollinator species increase and c) Carbon sequestration in vegetation

Expected impacts: a) Increased biodiversity, b) More carbon sequestration and storage and pollutant's removal, c) Some co-benefits including microclimate regulation through shading and transpiration, habitat for urban wildlife, and recreational services, such as growing grapes, which are typical cultural value of Mediterranean culture of agriculture.

Figure 4-16: Green fence

4.6.2 Location

The Peynircioğlu Stream (Figure 4-14) flowing in a south-north direction through the high-rise and high-end apartments in Mavişehir Mass Housing Area in the Karşıyaka district. Mavişehir is neighbourhood where mostly residential and commercial land uses such as shopping malls are dominant.

4.6.3 Technical Specifications

Three roots of prehensile plant for each square meter will be placed iron metal sheet mast structure. The height of the structure will be 2 meters. Drawings and design details of the NBS will be completed before tendering process and will be available in following months

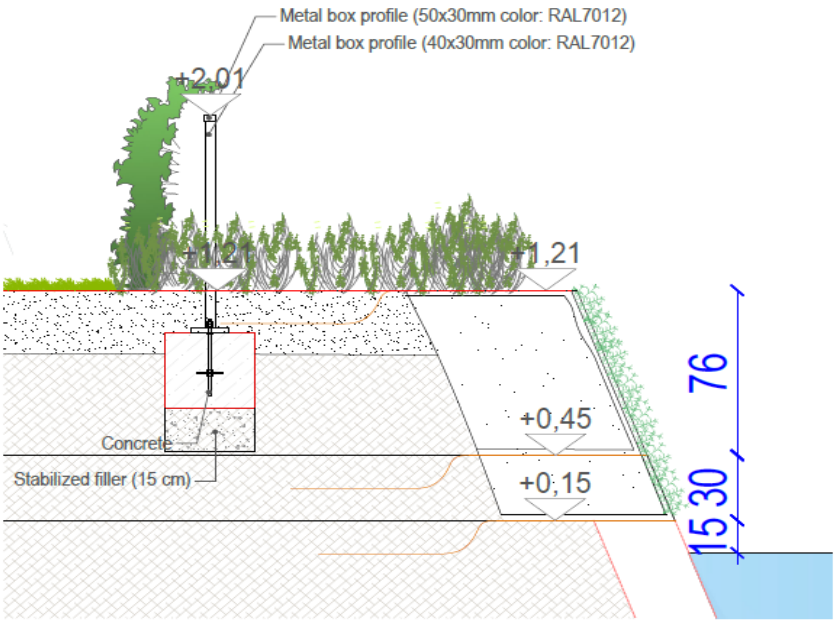


Figure 4-17: Technical details of green fence

4.6.4 Operational and Maintenance Considerations

Operational and maintenance aspects of this NBS will be executed periodically by the Directorate of Parks and Gardens of IMM. Details of the operational and maintenance aspects will be determined after detailed investigation of the implementation. However, it is already determined that depending on the species of plants within the context of this NBS pruning works and in the case of having irrigation, periodic check of the system will be taken into consideration in different periods of a year. Besides the maintenance works on plants, there will be varnishing, painting etc. works for the material of the natural pollinator houses. Again, period of these works will be determined after implementation.

4.6.5 Economic Specifications

Cost of Green fence (1600 m length): 101.000 €

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

4.7 Establishment of fruit walls

4.7.1 General Description & Purpose of the NBS

Fruit walls will be installed alongside the Peynircioğlu Stream to allow development of new green areas and hence rising bio-diversity since the existing river corridor is now mostly an open space with little or no vegetation except a linear green space on the western side of the Stream. Moreover, the fruit walls provide more attractive environment both for people and pollinating insects. The green area created by this NBS will be 1600 sqm. Fruit walls 96 sqm together with green fences and green pavements will become a good example of re-naturing riversides in Izmir.

Related KPIs: a) Pollinator species increase

Expected Impacts: a) Increased biodiversity b) Some co-benefits including microclimate regulation through shading, habitat and food provision for urban wildlife, and recreational services, such as growing grapes, which are typical cultural value of Mediterranean culture of agriculture.

4.7.2 Location

The Peynircioğlu Stream (Figure 4-14) flowing in a south-north direction through the high-rise and high-end apartments in Mavişehir Mass Housing Area in Karşıyaka district. Mavişehir is a neighbourhood where mostly residential and commercial land-uses such as shopping malls are dominant.

4.7.3 Technical Specifications

Three roots of prehensile fruit plant (grape, different kind of berries etc.) for each square meter will be placed iron metal sheet mast structure. The height of the structure will be 1 meter. The list of the possible plants for the fruit walls is given below:

- Vitis vinifera
- Fragaria vesca
- Rubus canescens
- Rubus sanctus
- Citrus fortunella “margarita”
- Morus nigra pendula

The fruit walls will be implemented around Peynircioğlu stream as shown in the figure below:

Figure 4-18: Fruit walls

4.7.4 Operational and Maintenance Considerations

Operational and maintenance aspects of this NBS will be executed periodically by the Directorate of Parks and Gardens of IMM. Details of the operational and maintenance aspects will be determined after detailed investigation of the implementation. However, it is already determined that depending on the species of plants and fruits within the context of this NBS pruning works and in the case of having irrigation, periodic check of the system will be taken into consideration in different periods of a year. Besides the maintenance works on plantation and fruits on the wall, there will be varnishing, painting etc. works for the material of the natural pollinator houses. Again, period of these works will be determined after implementation.

4.7.5 Economic Specifications

Cost of fruit wall (96 sqm): 9.000 € (Detailed cost analysis will be delivered with tender documents.)

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions in a public document before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

4.8 Industrial Heritage Route Along the Izmir Urban Green

4.8.1 General Description & Purpose of the NBS

Salt is considered as white gold. It is essential to life and has been used as a preservative for food and for seasoning since prehistoric times. Sea salterns are integral parts of natural and man-made ecosystems (factory as landscape). Salt production, is the only industrial production activity that supports biodiversity. On the other hand, sea salt production is the common heritage of Mediterranean Basin in where 170 sea salterns have been operated. Izmir's Çamaltı Saltworks is the only one which is coming from Ottoman Period to our times. It is the most important and the biggest saltworks in this category in Turkey[11].

Çamaltı Saltworks with its 'Salt City' and its ongoing manufacturing activity, harmonious relationship with nearby Bird's Paradise area, especially a feeding area for Flamingo Birds, it should be protected as cultural heritage area as a symbol of nature-based industrial production[12]. It is urgent because whether old nature-based production technology is changed the whole ecosystem will be affected in a destructive way.

Figure 4-19: Nature-sensitive manufacturing process of sea salt at Çamaltı Saltworks

Related KPIs: a) Increase in walking and cycling in and around areas of interventions b) Perceptions of citizens on urban nature

Expected impacts: a) Increased bike and pedestrian mobility, b) Installation of new green surfaces, c) increase in community ties and creates green consciousness

[11] Sheridan, I. (2016). Value Assessment at the Intersection of Nature and Industry: Case Of Çamaltı Saltern, Unpublished MSc Dissertation, The Graduate School of Natural and Applied Sciences of Middle East Technical University, Ankara.

[12] Scaramelli, C. (2017). Salt, Seeds, and Flamingos: On the Politics of Infrastructural Ecology in Turkey, EnviroSociety, 23 August. www.envirosociety.org/2017/08/salt-seeds-and-flamingos-on-the-politics-of-infrastructural-ecology-in-turkey.

4.8.2 Location

Among the lots of small and medium sized sea-sourced salt beds, Çamaltı Saltworks is the oldest and the biggest one reaching today. Therefore, when searching the historical traces of salt manufacturing coastal areas between Sub-Demo C and Sub-Demo B can be considered as parts of cultural landscape representing the awareness of sea salt production in the region. This route can also be integrated with existing cycling ways till Çamaltı Saltworks and created an identity of nature-based manufacturing with İzmir's oldest industrial heritage of white gold.

Figure 4-20: Location of Industrial Heritage Route

4.8.3 Technical Specifications

There will be information bulletins and green resting units in chronological order with a thematic manner (i.e. culture-nature relationship, social life in the Saltworks, salt manufacturing process etc.) curated as a symbol of nature-culture harmony on the 3 km long existing cycling ways along the coastline. These green resting units can also be expanded throughout the city especially for the historic cores suffer lack of urban greenery. Early prototypes of these units will be obtained at the end of İzmir Green Infrastructure Design Atelier which will be held at the end of September 2018 at FabLab İzmir.

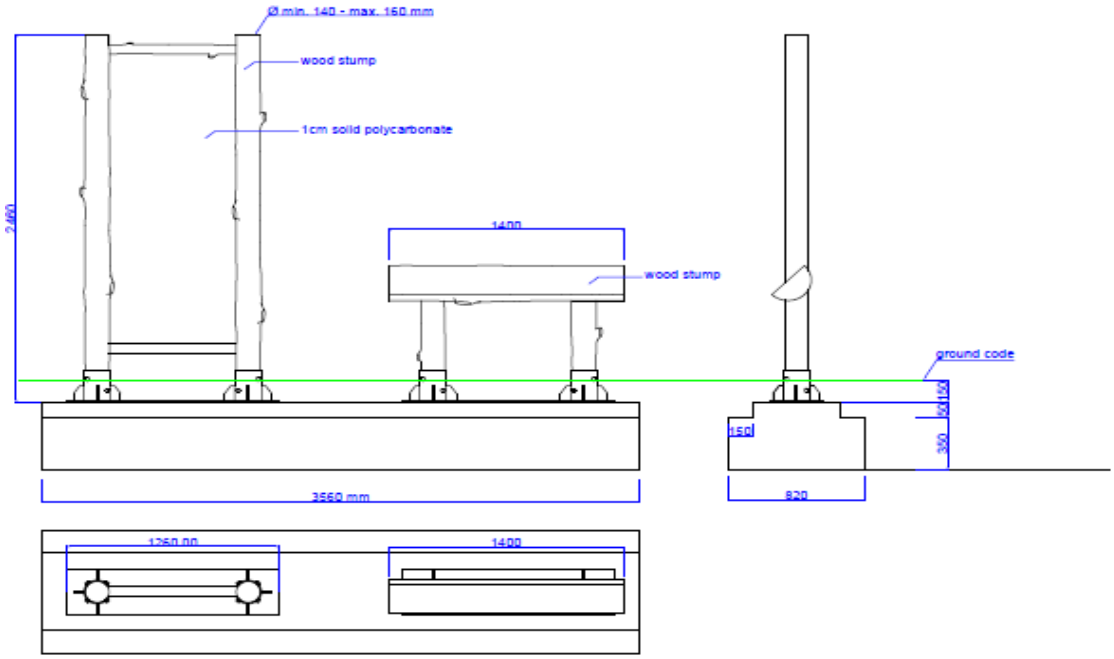


Figure 4-21: Technical details of info board and resting unit

Figure 4-22: An illustrative image of info board and green resting unit

4.8.4 Operational and Maintenance Considerations

The implementation of the route will be prepared compatible with the criteria defined by European Industrial Heritage Route (ERIH). In the post-implementation process this route will be ready for application. In the later stages 'Salt City' in Çamaltı Saltworks will be considered as 'anchor point' and heritage building in the Salt City will be renovated and used as Salt Museum (as a part of experimental building describing the whole production process in a perfect harmony with nature).

Industrial heritage route as a part of existing cycling route will be operated and maintained by IMM. In the later stages, regarding to Salt City and Salt Museum is depend on consensus

between parties - land owner (belongs to government due to salt production was a royal monopoly till 1980s) and its leaseholder (the Saltworks currently operated by a private company in a long-term agreement). If the application process to be successful to ERIH 500 EUR fee paid annually.

4.8.5 Economic Specifications

Cost of Industrial Heritage Route along İzmir Urban Green: 63.000 €

Due to legislative restrictions in Turkey it is not possible to share the detailed cost analysis of the interventions before the tender process is completed. Detailed cost analysis of construction, materials, equipment etc. will be shared with following deliverables after tender processes of interventions are completed.

(Indicative Exchange Rates Announced at 15:30 on 08/08/2018 by the Central Bank of Turkey, Euro: 6.1362 TL)

5 Non-technical Interventions

5.1 Educational Path/Bio-boulevard

As a part of Sub Demo B and part of Izmir's new urban green corridor, Bio-Boulevard is an educational path to exemplify less reliance on conventional grey infrastructure systems, thereby reducing cumulative urban heat island effects, and increasing bio diversity and filtration of ground/air pollutants.

Bio-Boulevard helps to learn about urban bio-diversity, climate change effects and storm water management. It will include grassed swales, storm water retention ponds, and pollinator modules to attract public's attention to biodiversity issues. Bio-Boulevard is also holding significant educative value with carefully selected species and markings. The increased participative nature of these activities via multiple bio-blitz events, regular visits by elementary schools and institutions will allow for an urban-nature relationship to be enhanced.

Bio-boulevard is located at the climate-smart urban farming area, a special precinct within Sasalı Natural Life Park. This Park area is situated in the southeastern part of Gediz Delta and surrounded by coastal wetlands, agricultural areas and lightly settled rural and suburban landscapes. Therefore, it represents an interface among different types of nature-culture areas, a perfect setting for educative purposes.

Bio-boulevard will be a real showcase for the most of Izmir's NBSs with regard to URBAN GreenUP Project. Therefore, urban residents will learn how nature-base solutions affect the cities and their significance to corresponding urban environments.

Bio-boulevard, as an integral part of climate-smart urban farming precinct, will help to increase awareness amongst the wider urban community about the value of green infrastructure in urban areas. Therefore, it helps to promote the understanding of İzmir's local green infrastructure strategy that was officially held in March 2018. GI in urban areas through active engagement with schools/community groups. A seminar room in the precinct will also be used for education activities of Bio-Boulevard including site visits, exhibitions, consultation and talks/seminars.

Promotional material like leaflets and brochures will be prepared and distributed in the entrance of Sasalı Natural Life Park to increase the awareness of the new precinct. Therefore, GI catalog and other promotional material provided by URBAN GreenUP Project and İzmir Green Infrastructure strategy will be distributed to the community of interests. Together with supporting activities for the food-smart future of Izmir (see 5.2) Bio-boulevard will promote ecological concepts and implementations among urban residents. The location of Bio-boulevard and its surroundings given in Figure 3-10: Location and selected area of Bio-boulevard.

Related KPIs: a) Green intelligence awareness, b) Perceptions of citizens on urban nature

Expected Impacts: a) Increase in impacted citizens, b) Increase in awareness impact rising, c) Increased number of pollinator species, d) Increased run-off detention and infiltration, e) Habitat for biodiversity, f) Green intelligence awareness

5.2 Supporting Activities for the Food-smart Future of Izmir

Local socio-economic development has gained utmost importance in Turkish metropolitan municipalities within the frame of recent legal changes extending boundaries towards their peripheral areas. With this regard, Izmir Metropolitan Municipality (IMM) have completed series of local development strategies aiming the sustainable development of the city's rural hinterland. For three fertile basins of Izmir, namely as Peninsula, Gediz-Bakırçay and Küçük Menderes, local development strategies were prepared consecutively. In the framework of local development strategies; agriculture, tourism, settlement pattern and culture, local innovation and entrepreneurship, and environmental issues and water resources were examined as strategic themes[13]. Among them, agriculture has gained prevalence, with successful implementations (i.e. support purchase from agricultural cooperatives including products like milk and flowers), İzmir's agriculture industry has grown two and half times higher than Turkey's average.

In those local strategies, covering parts of the URBAN GreenUP demo sites, extension of farmer's activity throughout the city has been encouraged. To this end, İzmir Metropolitan Municipality prepared market stalls along specific thematic routes and theme parks includes sales units for the products by local agricultural cooperatives to meet easily and directly by urban residents. The Municipality has also given practitioner trainings on many agricultural topics including soilless agriculture.

With this regard, URBAN GreenUP Project will provide opportunity to meet urban residents and farmers meeting directly. The project also supports urban residents' learning of urban farming via educative activities (i.e. vertical farming) and municipality-enabled and community-supported agriculture practices within climate-smart farming precinct.

The strong producer presence will be around the climate-smart urban farming precinct through community facilities, producers' sail unit (including 10 İzmir-based women cooperatives with a total member of 530) that greatly increase and enhance the interfaces urbanites have with the natural world and urban farming practice. The impacted citizens will mostly be the visitors of the Sasalı Natural Life Park bringing that area's total to over 1.500.000 citizens annually.

[13] Velibeyoglu, K., Yazdani, H. & Baba, A. (2018). Groundwater in local development strategies: case of Izmir, Water Science and Technology: Water Supply, 18(4):1339-1349. DOI: 10.2166/ws.2017.199.

5.3 Education for the Food-smart Future of Izmir

This special educative and communication programs will simulate the future climate condition of the Izmir city and will be demonstrated some of precautions against changing condition. The effects of climate change on green texture, fresh water and soils will be explained both the rural and urban populations for create awareness. Targeted population will be farmer, citizens and particularly elementary school students. Effects of increased temperatures, decreased and rainfall irregularity and changes of soil chemistry will be demonstrated in the open-air "laboratory of the future" and climate smart greenhouse.

According to the drought scenarios for the future periods, the decrease in rainfall in İzmir province is predicted against the increase of temperature and evaporation. Increasing awareness of climate change, emphasizing the importance of reducing the greenhouse effect, and improving social sensitivity in this regard, a section will be created to simulate the changes that will be seen in the future in the living environment we are in.

The strong producer presence will be around the climate-smart urban farming precinct through community facilities, producers' stalls, women cooperatives and local government enabled urban farming activities that greatly increase and enhance the interfaces urbanites have with the natural world and urban farming practice. This KPI will carry out with the Izmir Metropolitan Municipality.

Especially farmers living in the urban and peri-urban will be informed about climate change and its increasing affects, periodically. First of all, leading farmers living in the urban periphery (Çiğli and Menemen districts), agricultural cooperatives and students will be determined and training seminars will be organized. Secondly, the visitors of the Natural Life Park where the demo side area is also located will also benefit from these seminars. Secondly, visitors to the natural life park (around 1.500.000) area will be able to visit climate sensitive greenhouse and its garden. All visitors will be counted for measuring.

One part of the green house will be used for demonstrating future stress conditions due to climate changes and soil degradation including dried plants, dried soil with cracks and salt crust on the surface etc. Aims of this part of the greenhouse will be used for educative purposes trough students and citizens. A seminar room will be established beside this part.

5.4 Engagement Portal

Engagement Portal for citizens will be prepared integral to İzmir Green Infrastructure Strategy Website: http://izmirdoga.izmir.bel.tr (delivered in Turkish only) (see Figure below). This portal will also directly be linked to real-time information like İZUM Dashboard illustrating the real time urban transportation data of Izmir (see Figure below). If city budget allows this website and other associated links could easily be converted to a 'İzmir's Green Dashboard' that allows basic infographics (i.e. carbon emissions), real time environmental data (i.e. air quality), list of NBSs and some other interactive features. Therefore, after the URBAN GreenUP project completed, this website and green dashboard will alive engaging the community with online.

By development of a user-friendly interface, engagement portal will inform people of Izmir about existing and new GI interventions by illustrating the impacts on the urban environment. This portal will also allow monitoring results of complete and ongoing implementations. This will be also promoted through social media to residents and related project partners. It is expected that these special thematic accounts will reach around 5000 recipients.

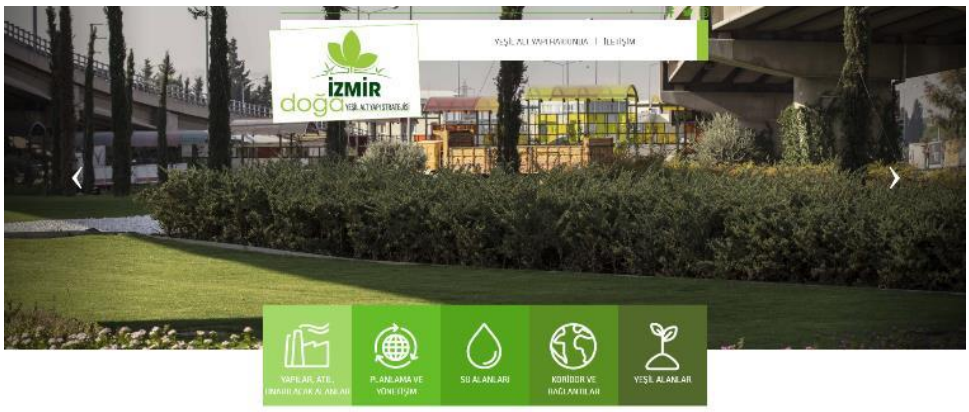


Figure 5-1: Existing website of Izmir Green Infrastructure Strategy as the basis for Engagement Portal

Figure 5-2: IZUM Dashboard illustrating the real time urban transportation data of Izmir

Supporting activities for the food-smart future of Izmir (5.2), educational path Bio-Boulevard (5.1), Engagement Portal (5.4) and its associated supporting ICT platforms will all help to promote ecological reasoning and awareness about nature-based solutions throughout the city.

5.5 Bio-blitz Event

A bioblitz is an event that focuses on finding and identifying as many species as possible in a specific area over a short period of time. A bioblitz may involve scientists, families, students, teachers, and other community members work together to get an overall count of the plants, animals, fungi, and other organisms that live in a place. This event will be a part of 'citizen science'.

Participative nature of bio-blitz event will be used to enhance ecological reasoning and awareness. The event will be delivered in Sasalı Region through a series of incentives including lectures and site surveys. The typical steps for these activities are shown below:

- Taking education about looking at nature and recording techniques (i.e. photography)
- Exploring Nature with an expert guide (a visit to learn about using techniques)
- Creating a Species Inventory (in our case it will be done only with vegetation) with a team
- Sharing photos with scientists/experts

Figure 5-3: Views from a bioblitz event

A Bioblitz event will last 24 hours, it will be run once in a project time. It will be held in spring or autumn where the biodiversity is high. School children are especially aimed to be involved in the Bioblitz event in Sasalı (approx. 100 people). Each team is made of 5-10 participants and supervised by a biodiversity expert.

A small experimental step was taken to discover cultural asset with a site survey in Urla District of İzmir in August 2018. At this event a mobile application called 'Rescaper' are used to record cultural heritage in a given part historical route. Citizen of 30 people with mountain climbing background were selected and they record their findings via this app. Before the site survey those volunteers learn how to look at the site and using the app for recording purposes (see Figure 5.4). The same procedure will be used for bio-blitz event which details given above.

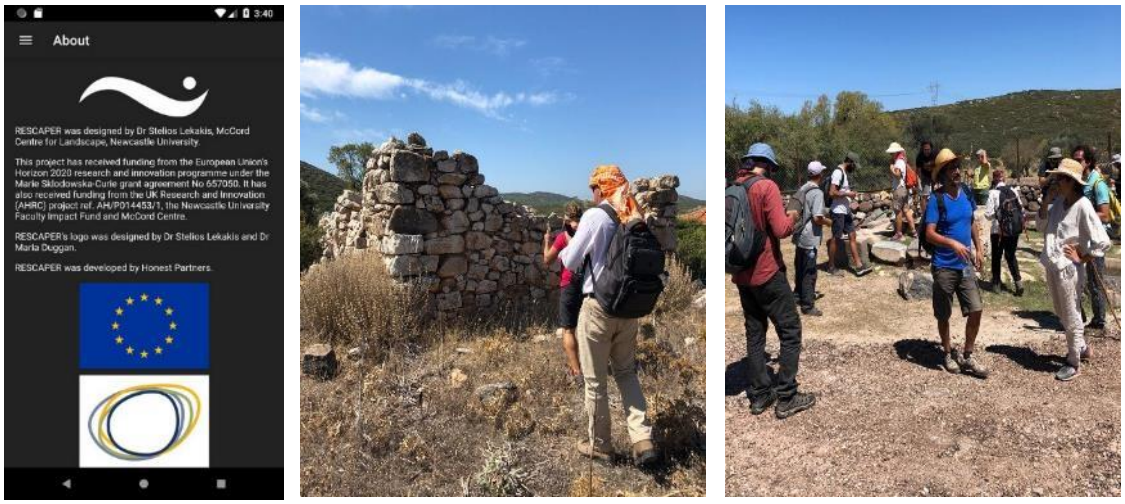


Figure 5-4: Views from cultural heritage site survey by using mobile app Rescaper

İzmir Bio-atlas project will be a web portal like French online platform of Tela Botanica. Additionally, like Rescaper in cultural heritage mapping, it can be supported by mobile app too. In this category iNaturalist, a joint initiative by the California Academy of Sciences and the National Geographic Society, is one of the best-known mobile application with a community of over 400,000 scientists and naturalists. With this regard, it is aimed to reach 5.000 Izmir residents with a means of mobile app in later stages. As a part of citizen science tool, taking photos of the plants, you see and loading them into mobile app will provide recording observations and get help with species identification from scientists.

At the end of the event, Bioblitz guidelines will be prepared and shared with the public. New bioblitz event will be planned to focus on new areas where loss of biodiversity is extremely high or in danger. In further steps İzmir Bio-Atlas project will be launched basically depends on bio-blitz events and other crowd-sourced data collection techniques (i.e. mobile app) based on citizen reporting. Bio-Atlas Project can easily be linked with other ICT platforms like the Engagement Portal for Citizens (5.4) and İzmir Green Dashboard.

5.6 Support to citizen project of NBS

This action will support green job creation which is open to third party developers and citizens as makers. The widespread use of the rapidly raising Maker Movement and the increased use of 3D printers has opened a door for everyone to do home production. Now it is easy for people to create their own workshops and turn their own precision designs into products. The objective here is that İzmir Metropolitan Municipality-led support to citizen project of NBS to facilitate the development of novel nature-based solutions and possibly the increase in nature-based entrepreneurship.

To increase number of project suggestions from local communities İzmir Metropolitan Municipality will held regular green-collared job training programs under the 'Department of Meslek Fabrikası'. This renovated building includes training rooms, ateliers and municipality-operated FabLab that was launched with a grant program of Izmir Development Agency earlier this year (2018).

As a concrete example to citizen project of NBS, prototypes of green resting units and associated information bulletins in Industrial Heritage Route (see 4.8) will be designed within the content of Urban Green Infrastructure Design Atelier in 'FabrikaLab İzmir'. The co-creation and co-production maker activities at the end of this design atelier will be the basis of implementation and related creative works.

This non-technical intervention will promote the use of maker space operated by İzmir Metropolitan Municipality as a special program within the frame of URBAN GreenUP Project. This FabLab called as 'FabrikaLab İzmir', as novel and innovative infrastructure, allow citizens to make specific products or design where they may wish to see some new green infrastructure developed to meet a specific local need.

Figure 5-5: Views from FabrikaLAB İzmir

5.7 City Mentoring Strategy

Izmir is the frontier Turkish city declaring Local Green Infrastructure Strategy. In Turkey, Izmir's leading efforts in terms of EU Covenant of Mayors (CoM) membership (4 of Turkey's 10 members are in the Izmir area) represent a global positioning of İzmir in environmental issues. In national context, Izmir Metropolitan Municipality ranks high in terms of environmental investments in Turkey. According to 'Sustainability Research of Turkey's Sustainable Cities' [Türkiye'nin Şehirleri Sürdürülebilirlik Araştırması], İzmir leads a total of 81 cities in terms of environmental quality and natural resources sub-indexes. Objective criteria of sustainability indicators illustrate that the city is in the first rank in terms of environmental performance and quality of life[14].

Therefore, as a frontrunner city, İzmir City partners will provide mentor support for partners within the Urban GreenUP project and in turn will welcome mentoring from colleagues in other organisations in order to exchange and build. In the course of replication activities, staff exchange will be considered and a number of good environmental practices from İzmir will be selected for mentoring purposes.

As in Liverpool case, a mentoring strategy document will be developed by the İzmir Metropolitan Municipality. This document will be produced in conjunction with the other lead cities and the follower cities and delivered to other Turkish cities that wish to progress towards green infrastructure issues and nature-based solutions.

[14] Velibeyoglu, K., Mengi, O. (2018). The multi-level policy learning of environmental policy: insights from Izmir, Turkish Studies, DOI: 10.1080/14683849.2018.1502041, forthcoming.

6 Conclusions

Izmir has three Sub-Demo areas with 19 technical and 10 non-technical interventions. Technical interventions are;

- Sub-Demo A: arboreal areas around car park areas, installation of parklets, smart soil into green shady structures, cool pavements around car parking area, green covering shelter for car parking area and green shady structures for car parking area.
- Sub-Demo B: smart soil production in climate-smart urban farming precinct, natural pollinator's modules, development of smart soils from mud plant to use in urban farming, grassed swales and water retention ponds around bio-boulevard and climate smart greenhouses.
- Sub-Demo C: cycle and pedestrian route in green corridor, planting 4,800 trees, urban carbon sink, culvert works for Peynircioğlu Stream, green pavements for Peynircioğlu Stream, green fences, establishment of fruit walls and industrial heritage route.

This report has presented:

- the general description, location, expected impacts and related KPIs,
- technical specifications,
- operational and maintenance considerations and
- economic specifications of planned NBS interventions at each Sub-Demo Area.

The report will be a base for the tendering process and will be revised if there would be changes during the tendering process.

As mentioned in introduction, it could not be possible to give breakdown of the budget of NBSs under the economic specifications subsections because of two main reasons:

- The design stage of many of the interventions still on going. It is possible to give accurate estimations by the help of unit prices of materials, equipment, plants etc. from market because the determination of dimensions of the interventions almost completely determined for most of the interventions. However, before the preparation of the tender documents giving the estimated values does not make any sense because of rapidly changing market prices.
- The rapidly changing currency rates of Turkish Lira (TL) is one of the main reasons to postpone delivering a detailed budget evaluation prior to the preparation of tender documents. Ratios of TL / $ and TL / € are rapidly changing. 1 € was equal to 5.33 TL in 1st of June, 6.13 during the preparation of economic specifications of this document, it is 7.57 (29th of August) and it is still increasing. Under this condition, it is not possible to prepare accurate breakdowns of budgets of NBSs. During the tender processes of NBSs the currency will be accepted with the value of that day (the day of the publishing the tender documents) and it will be possible to prepare the breakdowns of the budgets of each NBSs.

Non-technical interventions are bio-boulevard, education for the food-smart future of Izmir, urban farming educative/participate activities, learning for producers, support for agricultural

cooperatives and community-supported urban farming practices, engagement portal, bio-blitz event, the development of Izmir's bio-diversity atlas, support to citizen project of NBS and city mentoring strategy. To take attention of the general public into the issue, there are two strategies will be followed in parallel to widen up the effects of URBAN GreenUP Project:

İzmir's local green Infrastructure strategy will also be used to reach wider audience planned within the non-technical interventions.

- Bio-boulevard and food-smart future of Izmir in climate-smart agriculture precinct will be used as living lab, accordingly, FabrikaLab İzmir will hosts maker activities for citizen NBSs. Therefore, a new nature-based innovation will be flourished via the help of non-technical activities of URBAN GreenUP.