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ISTANBUL'S MEGA PROJECTS UNDER ECOLOGICAL SCRUTINY: A CRITICAL ASSESSMENT

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ABSTRACT

The increasing interdependence between cities and economies has led to a rise in mega projects, which are large-scale investment projects aimed at meeting economic and political demands. While they are planned for economic development, they have significant negative impacts on nature, cities, and people. İstanbul is one of the largest metropolitan areas in the world and has become a popular location for planning mega projects. The 3rd bridge, 3rd airport, and Canal İstanbul are three mega projects developed by the government for urban development and social welfare. The purpose of the article is to reveal the ecological and spatial effects of mega projects in İstanbul. In order to achieve this aim, an analytical assessment method is applied using positive, neutral, and negative correlations for the selected mega projects in İstanbul. The inputs required for the analytical assessment method have identified in accordance with the fundamental principles of the eco-smart planning approach, which is established on the basis of ecological planning and smart city index. The outputs of the study suggest that ecological, social, and spatial impacts must be taken into account in the planning and implementation of mega projects. The study highlights that projects driven solely by economic priorities tend to result in negative urban, environmental, and social consequences in İstanbul.

Keywords: Mega Project, The Impacts of Mega Project, Ecological Planning Approach, Eco-smart Planning Approach, İstanbul

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INTRODUCTION

Presently, the world is experiencing chaos, changes, disturbances, and vulnerabilities driven by global and local forces. These forces lead to socio-spatial-environmental transformations at different scales, such as social segregation, environmental degradation, economic disruption, and spatial fragmentation, which increase and intensify the vulnerabilities of urban and regional systems (Taşan Kök, 2007: 78; Wu et al., 2018: 3). The accumulation of these vulnerabilities results in further shocks and disturbances, especially on social and ecological systems. These transformations are the outcome of the inefficiency of current policies and planning paradigms in addressing them. Mega projects can be one of the disturbances affecting the social, spatial, environmental, and economic aspects of the world. They transform landscapes rapidly, deliberately, and thoroughly in visible ways that require coordinated applications of capital and state power (Gellert & Lynch, 2003: 20; Dalibi et al., 2020).

Borja and Castells (1997) state that mega projects are organized in a strategic planning context that aims to generate short-term profits for the private sector. They are typically located in urban periphery areas or in areas that are impacted by the city. Mega projects create spatial, social, and economic attraction by accelerating transformation. However, the most crucial point in creating mega projects is managing their envisioned environmental impacts, as the balance between production and consumption in the context of sustainability is directly related to environmental issues. Therefore, several conditions are obligatory for mega projects, including designing them according to social-economic and environmental issues in the city, adapting them to other projects in the city and local dimensions, and using them as stepping stones for future projects (Evans & Farrell, 2021: 656).

This study reviews the literature on mega projects in the context of ecological planning and smart city dynamics. It undertakes a combination of scientific literature review, grey literature review, and case study analysis to better understand the impacts of urban mega projects on the environment. Criticisms of mega projects are crucial, as they can override local issues, create environmental and physical disconnections in urban forms, and disregard public interest (Hawken et al., 2019). The main aim of this article is to uncover the ecological and spatial consequences of mega projects in İstanbul. In order to achieve this objective, the author utilized an analytical assessment method that involved a three-way correlation model (positive, neutral, and negative) for selected mega projects in İstanbul. This analytical method is developed based on the fundamental principles of eco-smart planning, which integrates ecological planning with the smart city index (represented in Figure 1) to identify the inputs required for the analysis.

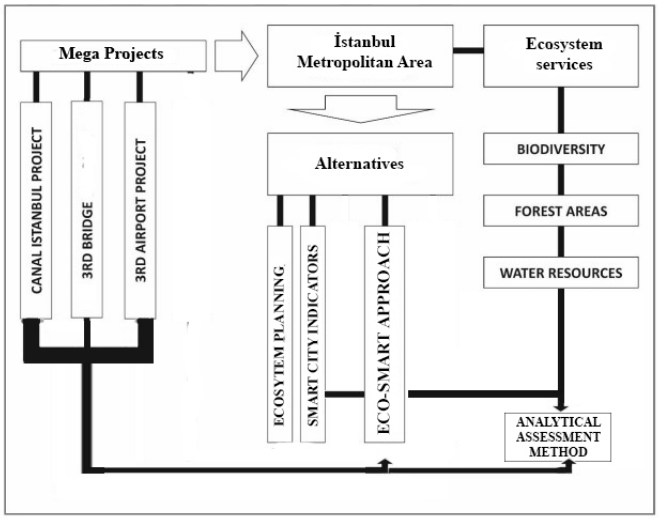

Figure 1. Logical framework of the study

STATE OF ART- MEGA PROJECTS AND ECOLOGICAL PLANNING

Mega Projects

In recent decades, the literature has been debating the impact of mega projects on urban ecology and landscape. A literature review is conducted using the SCOPUS database, with specific keyword searches yielding a total of 34 documents related to "mega projects" and "landscape", with studies dating back to 2002. The economic and social dimensions of mega projects have discussed, with a focus on the impact of the Olympic games on the landscape. A search for "mega projects" and "İstanbul" yielded ten documents that discussed urban growth, macroform changes, and urban transformation areas in İstanbul. The initial articles are related to what are the dimensions of İstanbul's urban growth and macroform changes. Then, the articles evolved as urban transformation areas in İstanbul due to the pressure of urbanization in 2008. After 2016, the impacts of mega projects on İstanbul have been discussed by different fields like planners, engineers, business managers and landscape architectures. Moreover, the last documents have mainly argued especially Canal İstanbul and 3rd airport projects. There were fifteen documents related to "mega projects" and "ecology", which mainly focused on water control and safety regulation, as well as tourism development. Additionally, a search for "mega project impacts" yielded four documents, with discussions on the Nile River and King Shaka Airport in South Africa since 2015. Overall, the topic of mega projects and their impact on the environment is of interest to various fields such as social sciences, environmental sciences, and business management.

Mega projects have been seen as a main part of economic growth due to globalization. In other words, they have already been brought to the agenda in relation to international connection with national economic policies (Eren, 2019: 682). Therefore, every country tries to put large-scale urban projects into practice mainly expecting to gain profit (Xiaolong et al., 2021: 3). The popularity of global neoliberal economic policies has led to mega projects development, which is the reason why mega projects are so attractive in the world (Jessop, 2002: 111; Ponzini, 2011: 254; Rizzo, 2013: 538). According to government economic based priority, mega projects are developed basically to increase National Gross Domestic Product and decrease unemployment rates (i.e. İstanbul 3rd bridge, 3rd airport). Whereas the purpose of economic development is thought to be vital for mega projects, some scholars criticize the importance of economic development instead of social and environmental impacts in mega projects (Allmendinger & Haughton, 2009: 620). In other words, they should not have only economic gains but also have some social and environmental impacts on cities (Kamat, 2015: 74; Wilson & Swyngedouw, 2015: 4; Söderlund et al., 2017: 9).

Apart from the cost, there are seven features in order to define a project as mega, which are duration, risks, reach, uncertainties, different actors, controversy and natural areas and legal issues (Pitsis et al., 2018: 23). Hence, mega projects are presently characterized by their multi-dimensional nature, encompassing social, environmental, and economic dimensions, which adds complexity to the design and implementation of such projects. Consequently, numerous scholarly inquiries have been conducted to comprehend and interpret the intricate systems of mega projects (Giezen, 2012: 784; Brady & Davies, 2014: 24). For instance, Miller et al. (2017) explain the mega projects as a technological based game and they try to define the rules of the game. Besides, mega projects can be defined as capital projects with a total installed cost greater than $1 billion with any of the following complexity criteria (Caldas & Gupta, 2017):

- Significant number of stakeholders;
- Large number of interfaces;
- Challenging project location;
- Inadequate supply of resources;
- Unfamiliar technology;

- Difficult regulatory constraints;
- Extensive infrastructure requirements;
- Geographically dispersed teams;
- Significant political, economic, environmental, or social influence.

Similarly, Flyvberj (2017) explains four drivers of mega projects as technological, economic, aesthetic, and economic dynamics. Moreover, the management of mega projects should be multidisciplinary that consists of planners, policymakers, citizens and NGOs within the related topic. Clegg and Kreiner (2013) evaluate mega project as processes of organizing, as action localities and as emerging organizational entities. Besides, the success of mega projects can be understood by participating variable stakeholders, especially political and environmental related (Söderlund et al., 2017: 9), which creates conflicting agenda due to the duality of environmental and economic purposes (Ansar et al., 2017: 30) (Figure 2).

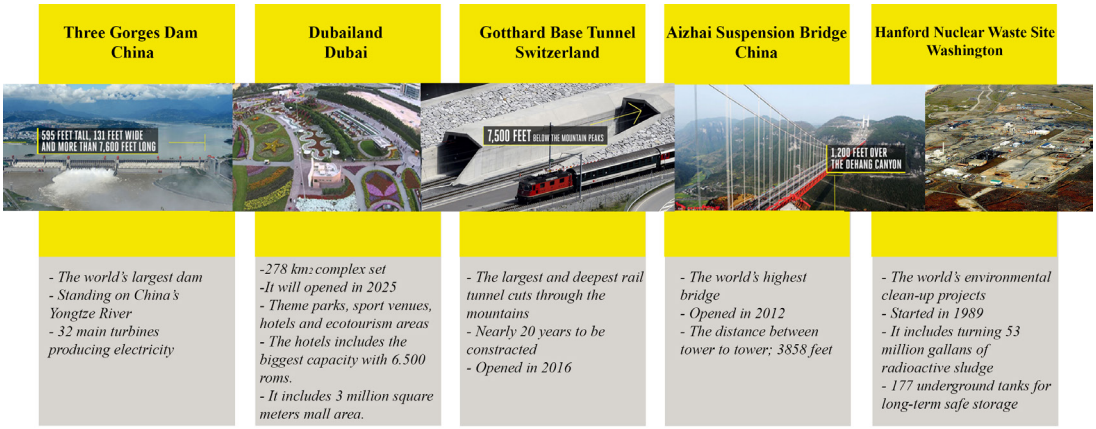

Figure 2. Different mega projects examples

Figure 2 demonstrates that different types of projects can be evaluated as mega. Dams, cleaner areas, train nodes, convention centers, bridges and huge sports venues etc. are examples of mega projects in terms of the types of material, size, cost, and capacity. The main purpose of organizing mega projects is the transformation of urban spaces (Sklair, 2005: 487; Di Maddaloni & Davis, 2017: 1539). They need mega budget for showing power and wealth both on international and national levels (Bourdieu, 1986: 246; Xiaolong et al., 2021: 6). However, environmental and social dynamics of mega projects are not generally considered in the world. Environmental characteristics can be defined as ecosystem services, biodiversity, sensitive areas and protection areas. Furthermore, within mega project areas, social attributes including user profiles such as homeowners and employees can be delineated. However, it is important to acknowledge that in the broader urban context, two main dynamics, namely economic gains and social considerations, play integral roles, with the former often being prioritized, particularly in developing countries such as Türkiye (Eren, 2019: 671). This tendency is reflected in the development of mega projects, where discussions on physical conditions and aesthetic appeal that contribute to attraction often overshadow considerations of environmental and social dynamics (Dalibi et al., 2020; Wu et al., 2018: 6).

To sum up, especially environmental dynamics can be determined as fundamentals of mega projects. Firstly, due to hazard risk coming from nature/environment, mega projects system can collapse. Secondly, after finishing mega projects construction, it can affect nature shrewishly. Thus, environmental based problems can occur, which is the impact of mega projects on the environment.

Ecological Planning Approach

Sustainable development can be characterized as a form of development or growth that fulfills the requirements of the present generation while safeguarding the capacity of future generations to fulfill their own needs (Brundtland, 1987). There are many contributions to this definition since its release in 1987 of Brundlant Report (Hassan & Lee, 2015: 1274). Sustainability is defined as "the conception and realization of ecologically, economically and ethically sensitive and responsible expression as a part of the evolving matrix of nature" (McDonough, 1992). In addition, according to Berke and Manta (1999), sustainable development can be described as a dynamic process that connects local and global concerns, as well as considering ecological, social and economic issues. In light of these definitions, ecology is one of the crucial dimensions of sustainable development. Therefore, ecological planning approach can directly contribute to protecting natural resources and it can balance built up environment and natural environment in the city.

Ecological planning is planning guided by ecological principles and includes spatial planning and nature related spatial characteristics into decision-making. It should provide a "bridge" to link natural dynamics and spatial planning for promoting coordination between economic growth and ecological sustainability (Wang et al., 1998: 210). Furthermore, ecological planning can be the environmental policy instrument to organize land-use activities. It aims to protect the environment, promoting the conservation and sustainable use of natural resources. Moreover, it is considered to harmonize human activities and environmental changes poisedly (Metternicht, 2017; Dalibi et al., 2020). In brief, ecological planning has both sustainability of nature's resources/benefits/products and processes through balanced and rational use/conservation and mitigation of the risks originating from nature. There are three objectives that may be defined under both ecological planning and smart city approaches (Tezer et al., 2018: 8; Metternicht, 2017).

- Reducing ecological footprint
- Sustaining ecosystem's integrity and ecosystem services
- Improving resilience against chaos and uncertainties.

Eco-Smart Planning Approach

Currently, the future of ecological strategies is outlined as efficient use of resources in a technological way. It was originally released with smart city approach in the late 1990s. While smart city approach emphasizes energy and resource efficiency to boost economic growth, the concept of eco-smart is guiding a more inclusive and holistic approach to make sustainable design in cities. In other words, eco-smart approach can concurrently serve the economy and the community as well as the environment (Visser, 2019: 208; Kazancı, 2022: 280). Although it has a significant meaning, eco-smart approach is not yet a popular universal term like sustainability. When searched as "eco-smart" in SCOPUS, there are only fifteen documents. The studies about eco-smart have been continuing since 2011, and the content/scale of eco-smart approach is generally variable such as eco-smart city and eco-smart initiatives. Eco-smart approach is defined in the context of city according to Cheng and Xie (2011). They emphasized that an eco-smart city should consist of a healthy living environment. Therefore, it should avoid the fragmentation pattern, especially organic urban area because it is the basis of urban life diversity and work efficiency. Moreover, eco-smart city can be the periphery of the city which includes both natural and artificial environment. Similarly, it can have different types of networks such as ecological networks, transportation networks and information networks. Therefore, eco-smart city may be compact and well-controllable.

The eco-smart approach can be understood within the context of eco-smart corporate communities, as discussed by Dean et al. (2014). This study introduces an enhanced business operation model that encompasses elements such

as environmental considerations, synergistic facility management, and the cultivation of green imagery. These components serve as indicators for the establishment and development of eco-smart communities. Facilities and staffs as transforming resources and materials, technology and customers as transformed resources can be defined as input resources in the context of eco-smart communities. The aim of these communities is that environmental benefits increases when green image is created (Dean et al., 2014: 140). In addition to given eco-smart definitions, ecosystem services are another key tool to regulate eco-smart planning approach. They can be defined as the benefits, products and processes provided by ecosystems for human well-being. Ecosystem services includes supplementary tools. In other words, beneficial areas like agricultural land, forests in the city are defined as ecosystem services and they should be protected. According to Burkhard and his colleagues (2012), ecosystem services can be defined as regulatory, provisionary and cultural ecosystem services. If land-use decisions taken by governments or local municipalities promote sustainable development in terms of ecosystem services, nature can provide a better life for the current and future generations (Hassan &Lee, 2015). In this aspect, mega projects in İstanbul whose details are given above are evaluated in terms of ecological planning perspective. In addition, mega projects of İstanbul are evaluated in terms of smart city perspectives. This paper criticizes whether the mega projects are smart in terms of ecological perspective. Therefore, ecological planning indicators and smart city indicators are harmonized as eco-smart approach according to the environmental impacts of mega projects. By embracing an ecological planning approach within urban areas, the city becomes more intelligent and efficient, as energy, environmental sustainability, waste management, building infrastructure, and transportation are identified as primary catalysts for a smart city (Kazancı, 2019: 158). Moreover, these aspects also serve as fundamental components of the ecological planning approach (Wehrmann, 2012). Therefore, it can be called eco-smart planning approach. Furthermore, different types of ecosystem services such as regulatory, cultural and provisioning shows are component of eco-smart planning approach in terms of sustaining benefits and mitigating the risk, which are directly related to ecological planning approach.

METHODOLOGY

The study utilized an analytical assessment method to evaluate the spatial and ecological impacts of mega projects in İstanbul. This method has applicability in various fields, including social sciences, cultural research, and place-based studies. The chosen assessment methodology drew upon the research conducted by Burkhard et al. (2012) titled "Mapping Ecosystem Service Supply, Demand, and Budgets". This study effectively investigates the impacts of land-use infrastructure on the provisioning, demand, and overall budgeting of ecosystem services. The study determines the positive and negative ecological impacts of different land-cover classes by assessing their capacities, which are then numbered on a scale of 0-5 under the categories of ecological integrity, provisioning services, regulating services, and cultural services. Canal İstanbul, the 3rd airport, and the 3rd bridge mega projects have been evaluated using Burkhard's ecosystem services numbering system to highlight their ecological impacts in İstanbul in this study. Unlike Burkhard's approach, the analytical evaluation inputs in this study are limited to the components of the eco-smart planning approach (Figure 3) to demonstrate the ecological impacts of mega projects in İstanbul.

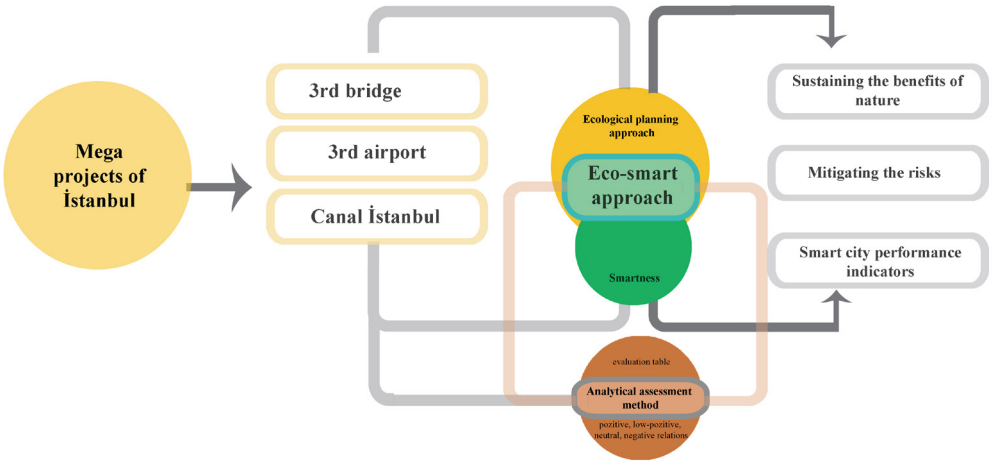

Figure 3. The framework of the study

Figure 3 shows that selected mega projects are evaluated in terms of both ecological planning approach and smartness, which can be called "eco-smart approach". Sustaining the benefits and mitigating the risk coming from ecological planning perspective and smart city indicators are key tools for criticizing mega projects in İstanbul in terms of eco-smart approach. Therefore, an assessment table has been created by using eco-smart approach that consists of both ecological perspectives and smartness, which comes from literature review about mega projects and ecological planning perspective/smartness. This study involves analytical assessment across three mega projects that usually shares a common focus or goal. To be able to do this well, the specific features of each mega projects have been described.

CASE STUDY: MEGA PROJECTS IN İSTANBUL

Mega projects, referred to as large-scale urban projects, are considered highly significant in Türkiye, particularly in İstanbul, in accordance with Türkiye's "Vision 2023" objectives. These objectives have been established to attain additional economic growth, urban development, and global development by the end of the Turkish Republic's century (World Profile Group, 2013). They have been designed to align with the 2023 goals, such as constructing the third bridge across the Bosporus, constructing a new waterway known as Canal İstanbul that links the Black Sea and the Sea of Marmara, and developing the third airport, which is the largest in Europe, all located in İstanbul (Figure 4).

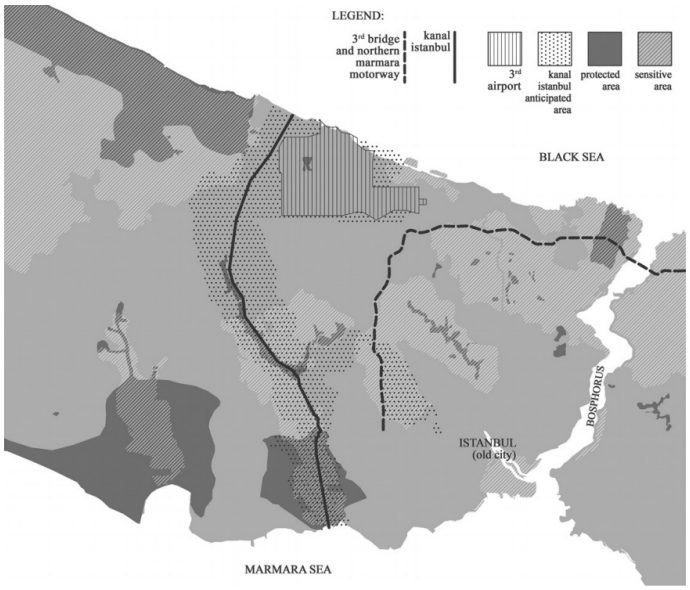

Figure 4. Mega projects in İstanbul

Figure 4 shows that mega projects are located in the northern part of İstanbul. Before the details of these mega projects, the historical background of İstanbul will be examined. After that, the characteristic of İstanbul in terms of ecological values will be discussed.

Historical Background of İstanbul's Spatial Development

Interventions that cause significant changes in the morphology of İstanbul constitute the breaking points in the city in 5 different periods (Türkeş, 2014; Çalışkan et al., 2014; Tekeli, 2010: 34; Kubat, 2018: 19) (Figure 5). The first period is 1920 and before. In 1872, the first Sirkeci-Hadımköy tramway line was built. Since the Anatolia Haydarpaşa-İzmit tramway line was built, a new settlement was begun to locate around this line in 1874. In this way, new settlements were seen mostly in the historical peninsula and its surroundings. In other words, they were not moved away from the city center. The second period is between 1920 and 1950. Henry Prost made one of the first plans of İstanbul to ensure the modern development of the city after the declaration of the Republic of Türkiye in 1930. After that, in 1939, İstanbul was beginning to change as all European cities with World War II. According to Marshall Plan between 1948 and 1952, the city continued spatial variables. The main reason for this was mechanization in agriculture. Because the individuals living in rural areas were becoming unemployed, they started to immigrate in İstanbul hoping to find new financial opportunities and jobs.

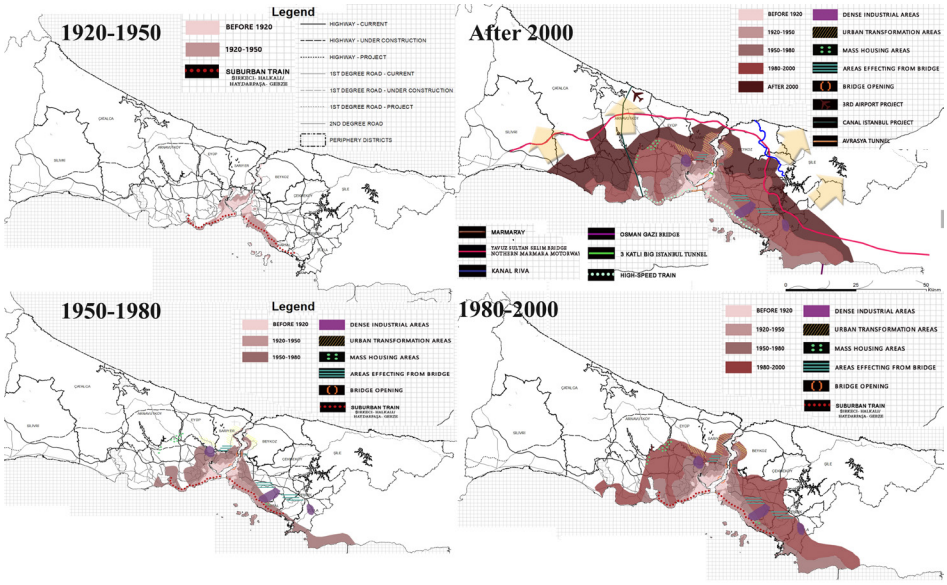

Figure 5. Spatial development of İstanbul

The third period of İstanbul is between 1950 and 1980. Due to rapid urbanization, illegal construction began in İstanbul. The most important factor that triggered the spatial development of İstanbul in this period can be defined as industrial fields. Industry began to develop along the main transport axes, which has significantly changed the macroform of the city in terms of boundaries. For example, residential areas developed along the periphery of İstanbul. Moreover, industry developed throughout E5 and continued until Gebze on the Asian side of İstanbul. Similarly, it developed on the European side between Zeytinburnu and Atatürk Airport. On the other hand, CBD (Central Business District) area has extended through Eminönü and Şişli regions towards the TEM and progressed towards Maslak district. Parallel to the development of industrial areas, illegal settlements have also been seen, and they have a significant impact on the unhealthy development of the city's macroform. With the 1970s, İstanbul faced with major problems in terms of infrastructure requirements such as housing and transportation due to rapid urbanization. However, this was associated with connection problem. Therefore,

Bosphorus Bridge was constructed in 1973, which can be defined as a spine that strengthens the main transportation system of İstanbul.

The fourth period of İstanbul is between 1980 and 2000. The spatial development of İstanbul over the period from 1980 to 1990 was based on new economic and political decisions because of both current illegal settlements and developing settlements (Erbas, 2013: 71). In the 1990s, especially the concept of globalization effect is remarkable. The attractiveness of international capital approach which can be called "global city" includes expectations that will affect the future of identity (Erbas, 2013: 74). Therefore, after the 1990s, İstanbul's macroform has developed along the east and west corridors especially in peripheries like Şile, Silivri, Tuzla, Pendik, Büyükçekmece. As a result, İstanbul entered into a process of decentralization of the industry. In other words, the location of industrial areas began to change. On the other hand, according to Bosphorus Law and Dalan Zoning Law, many natural areas were transformed into residential areas. In addition to these, the FSM Bridge which is the second bridge of İstanbul was opened in 1988. After opening this bridge, Sarıyer, Pendik, Beykoz and Kartal began to develop.

The last period is after the 2000s. Regulatory arrangement for the built environment gained importance in this period. Private Province Administration (5302), Restriction and Restructuring of Historical and Cultural Immovable Assets (5366) are the laws which control the settlements. However, these laws led to a loss of sense of locality (Özakbaş, 2015: 430). On the other hand, this period has become prominent with mega projects. The third airport project was announced in 2010. The area of the airport is seen as a forest and watershed in environmental master plan. However, 80% of the project area (7650 hectares) is located in the forest area. That is why, this mega project entails significant environmental risks. Regrettably, despite the forests' crucial role in climate change mitigation, the government perceives this region as suitable for construction purposes. Similarly, the Canal İstanbul project was introduced in 2011, encompassing a 38,500-hectare, which includes densely populated facilities and residential zones in close proximity to the project site. Due to the Canal İstanbul project, Küçükçekmece and Büyükçekmece lakes also encounter impending threats. The upcoming news about the Project's destiny is in the hand of the authorities and the discussions on the topic are still in the upcoming agenda. The last mentioned in this paper is the 3rd bridge. It was projected in the North of İstanbul with the Northern Marmara Highway Project. The effects on the natural environment could be observed during the construction, but the effects on the city's sprawl will be clearly visible in the future.

The Latest Mega Projects in İstanbul: Canal İstanbul, 3rd Airport & 3rd Bridge

İstanbul has significant ecological values in terms of water basins, forests, natural parks and dunes that are located between settlement areas and the Black Sea coast. Also, there is a lot of endemic species, both plants and animals (Çalışkan, 2014). In other words, this area is the main part of the ecological continuum of İstanbul. In 1999, this region was designated by the WWF as part of Europe's most significant and critically preserved forests in terms of biodiversity. These are defined as "Hot Spots of European Forests". Indeed, 47.7 percent of İstanbul's surface area is composed of forest areas and 58.4 percent of the forest land is located on the European side and 41.6 percent is on the Anatolian side (İMP, 2006). They are significant in terms of bird migration concentration areas and they enable hundreds of water birds, birds of prey and songbirds during the migration period. Important bird areas can be defined in İstanbul like Büyükçekmece Lake Basin, Küçükçekmece Basin, Boğaziçi and Terkos Basin on the European Side; on the Anatolian side is the coast of Şile. The forests in the north of İstanbul also include Istıranca, Terkos, Büyükçekmece, Alibeyköy and Sazlıdere basins on the European side and Ömerli, Elmalı and Darlık basins on the European side, which cover the drinking and potable water needs of the city, and cover 46% of İstanbul's total area. Therefore, it is assumed that forests with water basins are the main components of ecological belts and corridors that are indispensable for the sustainable development of İstanbul (İMM, 2011).

In light of the intricate and diverse progression of constructed environments and envisioned mega projects, the mere preservation of natural elements such as water basins and forests proves to be inadequate. This situation necessitates a holistic and comprehensive reengagement of both fundamental and contextual aspects of landscape and planning disciplines, as they contend with the intricate interplay and mounting pressures exerted on the natural environment. According to İstanbul's Environmental Master Plan, mega projects are located in the northern part of İstanbul. The essential ecosystem services like food and fresh water for human well-being are under pressure due to the mega projects of İstanbul (Figure 6).

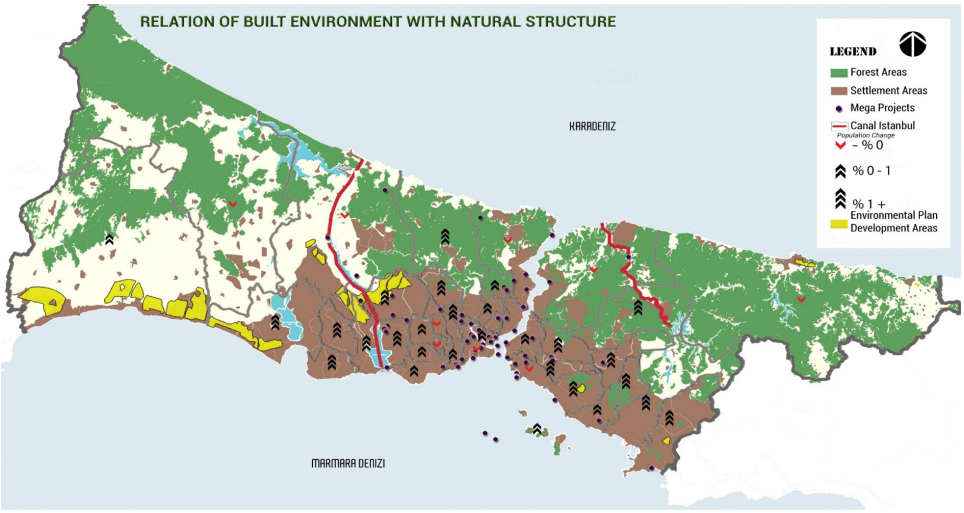

Figure 6. The correlation between the built-environment, mega projects and natural areas

Canal İstanbul mega project

Canal İstanbul, which was announced in 2011, was designed as not only transportation and infrastructure projects but also commercial and residential facilities by the Administration of Housing (TOKİ), Emlak Konut Company and Greater İstanbul Municipality. The area has a 50 km long, 150 m wide and 25 m deep waterway, and it is located along 45 km, which could allow the passage of vessels up to 300.000 dwt (Kundak & Baypınar, 2011: 56). Therefore, it creates a gateway connecting Asia and Europe. Similarly, it aimed at mitigating the risks of accidents in the Bosphorus by redirecting ships whilst charging a higher fee (Benmayor, 2013). Yet, according to Montreux Convention which is signed by Türkiye in 1936, commercial ships can pass through the Bosphorus without paying any fee (ORSAM, 2013), which can create a problem between Türkiye and other countries.

Nevertheless, there are two reasons why Canal İstanbul is necessary. The first reason is to compete with other countries in terms of economic and political agenda. By increasing international exports and imports, integrating into the European Union, rising influence on the Black Sea Region, The Balkans, and Northern Africa and the Middle East, Türkiye is seen as a significant actor in the global arena as an emerging market economy. Therefore, as a result of the need for logistics, transportation facilities, business districts, international tourism areas and residential complexes, supplementary investments should be organized in the Canal İstanbul project. The secondary rationale involves the mitigation of hazards posed to populations and cultural and natural heritages as a consequence of potential maritime accidents occurring in the Bosporus (Kundak & Baypınar, 2011: 59).

Although İstanbul's water comes from the European side (around 40 percent) like Sazlıdere Dam, Sazlıdere Dam will be entirely uprooted, and smaller streams and underground water that feed at least three other lakes in the area could end up being disrupted. Moreover, by mixing the Black Sea and Bosphorus

water dynamics, the change in the salinity could also spark an anoxic state in the waters, one that would end up leaving the city smelling of hydrogen sulfide (Saydam, 2015: 48). Similarly, the biodiversity located in the northern part of İstanbul is destroyed by the project and it is threatened by extinction. As a result, Canal İstanbul mega project has a serious negative impact on the environment like the 3rd airport mega project.

İstanbul 3rd Airport mega project

İstanbul 3rd airport mega project was officially announced in 2012 due to the insufficient capacity of existing airports (Doğan & Stupar, 2017: 284). Actually, the report which was entitled "Transport Infrastructure Needs Assessment for Türkiye" in 2007 includes the necessity for a large international airport (Mueller, 2007). Moreover, this report predicted that İstanbul's current airports could reach their maximum capacity so they could be inefficient to meet prospective airway passenger and load demand in ten years (Eren, 2019: 680). That is why, it is planned to be the biggest airport in the world as it covers 76.500.000 m2 (CAPA, 2016). This project can respond to the growing needs of the city with an annual passenger capacity of 150 million (DHMI, 2013). It means that the project does not only have airport related facilities but also hotels, commercial offices, logistic centers and public spaces (CAPA, 2016).

Like Canal İstanbul mega project, İstanbul's 3rd airport created a confrontational socio-political environment. Due to the harmful environmental impacts of the 3rd Airport mega project, İstanbul and its surroundings can lose its forests, clean air and water. According to the Chamber of Environmental Engineers, a total of around 2.5 million trees in the project area will be destroyed. Although the project area is defined as land without qualification, it is an area where natural habitat develops fast with birds and insects. Moreover, this area consists of 81% forests and 8.6% lakes and ponds (Northern Forest Defence, 2015). On the other hand, according to İstanbul Environmental Plan, İstanbul can carry a maximum of 16 million people whereas İstanbul will hold over 20 million people with the 3rd airport mega project. This means that healthy and sustainable living conditions will not be provided in İstanbul (Figure 7).

Before **After**

Figure 7. İstanbul 3rd Airport Area

As a result, İstanbul 3rd airport project has serious environmental impacts such as climate change. There are two aspects of climate change within the impact area of the mega projects including the Canal İstanbul and the 3rd airport. The first one is that global climate change can cause regional climate change in İstanbul. The second one is that new facilities may need more residential, commercial and business districts (Türkeş, 2014). Therefore, natural resources will be consumed more and the impacts of climate change are felt dramatically.

İstanbul 3rd Bridge mega project

İstanbul 3rd bridge mega project, which has 8 motorways and 2 railway lanes, was officially announced to the public in 2010. The first alternative of direction was between two existing bridges that pass over Arnavutköy. However, this direction

was changed to the north end of Bosphorus (Doğan & Stupar, 2017: 285) because it should work with Northern Marmara Motorway. Shortly after, the construction of the 3rd bridge started in 2013. It will be the widest suspension bridge in the world with 59 meters, and it will be the longest bridge (1408 meters). Moreover, the estimated cost of this bridge and the northern Marmara highway was 4.5 billion (ICA, 2013). In addition to the high amount of cost, the impacts of 3rd bridge are discussed severely.

The aim of the 3rd bridge is to ease traffic problems in İstanbul. However, according to "The 3rd Bridge Project Evaluation Report" which was prepared by the Chamber of Urban Planners İstanbul Branch in 2010, the number of motor vehicles and private vehicles is still increasing (UCTEA, 2010). That is, existing bridges are not enough to decrease traffic density in İstanbul. In fact, the 3rd bridge of İstanbul as a mega project caused not only environmental impacts but also social and economic impacts. One of the environmental implications of the project is that Belgrade Conservation Forest and Bosphorus Key Biodiversity Area hung by a thread. Furthermore, it will give way to new areas for unplanned urbanization, which creates social and economic degradation. In other words, ecological areas in the north of the city will deeply be influenced by the urban sprawl and eventually, the city's residential areas will shift to the North Sea shoreline. Thus, the occurrence will impose the following irreversible effects on the natural environment of İstanbul.

CASE STUDY OBSERVATION

The analytical assessment method utilized in the study employs an evaluation table to reveal the current situation in İstanbul. The matrix used by Burkhard and colleagues in their 2012 study explains the effects of land-use facilities on ecosystem services such as biodiversity areas, metabolic efficiency, and freshwater, as depicted in Figure 8. It demonstrates that there are variable columns to support ecological integrity (column on the left side) and to supply ecosystem services (the three columns on the right). The values/colors indicate the following capacities: 0/ rosy = no relevant capacity; 1/grey green = low relevant capacity; 2/light green = relevant capacity; 3/yellow green = medium relevant capacity; 4/blue green = high relevant capacity; and 5/dark green = very high relevant capacity. Although the number of inputs given by CORINE land cover types is more than three, road and rail networks, port areas and airports are selected in the context of the study. Since the types of mega projects in İstanbul are related to selected land cover inputs in the table the evaluation is related to them.

Land cover inputs	Ecological Integrity Σ	Abiotic heterogeneity	Biodiversity	Biotic waterflows	Metabolic efficiency	Exergy Capture (Radiation)	Reduction of Nutrient loss	Storage capacity (SOM)	Provisioning services Σ	Crops	Livestock	Fodder	Capture Fisheries	Acquaculture	Wild Foods	Timber	Wood Fuel	Energy (Biomass)	Biochemicals / Medicine	Freshwater	Regulating services Σ	Local climate regulation	Global climate regulation	Flood protection	Groundwater recharge	Air Quality Regulation	Erosion Regulation	Nutrient regulation	Water purification	Pollination	Cultural services Σ	Recreation& Aesthetic Values	Intrinsic Value of Biodiversity
Road and rail networks	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Port areas	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	1	1	0
Airports	7	1	1	1	1	1	2	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 8. Assessment matrix illustrating the capacities of different land cover classes

The methodology described in this study can be applied to various scenarios, ranging from regional to theme-based scales, as previously demonstrated by Vihervaara et al. (2010). Burkhard et al. (2012) explored the relationship between ecosystem services and land cover and assessed the level of connection between urban land uses and ecosystem services in ecological planning. Figure 8 demonstrates that several land cover types, such as forests, wetlands, water bodies, green urban areas, and some agricultural areas, exhibit significant potential to support ecological integrity. Various types of forest land cover, peatlands, moors, and heathlands demonstrate a high capability in providing

several ecosystem services. Conversely, the human-modified land cover types, such as urban fabric, industrial or commercial areas, mineral extraction, and dump sites, possess minimal or insignificant potential in sustaining ecological integrity or providing regulating and provisioning ecosystem services.

Moreover, this 0-5 scale, being a relative measure, provides an alternative means of assessment compared to monetary accounting or value-transfer techniques. However, it is crucial to conduct thorough scrutiny of the values obtained through this method in future case studies. Additionally, these values should be replaced with quantifiable data from relevant research, monitoring, or statistical sources (Burkhard et al., 2012: 24). According to Burkhard et al. (2012), Canal İstanbul, the 3rd airport, and the 3rd bridge can be assessed as port area, airport, and road, respectively, based on their land-cover inputs. In this study, however, the inputs of the eco-smart planning approach are used, and unlike the other study, the impact type (positive, low-positive, neutral, and negative) is explained (Table 1). In order to ensure the continuity of ecosystem services according to the type of mega project, a score of *2 points=positive* is given for inputs with a certain capacity, *1 point=low-positive* for inputs with low capacity, *0 points=neutral* for inputs that have no positive or negative impact on the subject, and *-1 point=negative* for inputs that may harm ecosystem services by disrupting the current situation. Thus, a new perspective is introduced with the eco-smart approach to provide an interpretation of the effects of mega projects, based on the study conducted by Burkhard and colleagues.

Table 1. Evaluation of mega projects in İstanbul in terms of eco-smart planning approach

Inputs	**Mega Projects in İstanbul**					
	Canal İstanbul		**3rd airport**		**3rd bridge**	
	Score	**Impact**	**Score**	**Impact**	**Score**	**Impact**
Abiotic heterogeneity	2	Positive impacts	1	Low-positive impact	1	Low-positive impact
Biodiversity	1	Low-positive impact	1	Low-positive impact	1	Low-positive impact
Mixed forest	-1	Negative impact	-1	Negative impact	-1	Negative impact
Water bodies	-1	Negative impact	0	Neutral	0	Neutral
Biotic water flows	-1	Negative impact	-1	Negative impact	1	Low-positive impact
Reduction of nutrient loss	0	Neutral	-1	Negative impact	-1	Negative impact
Flood protection	1	Low-positive impact	0	Neutral	0	Neutral
Recreation aesthetic values	1	Low-positive impact	1	Low-positive impact	1	Low-positive impact
Local climate regulation	-1	Negative impact	-1	Negative impact	-1	Negative impact
TOTAL	**1**		**-1**		**1**	

Table 1 helps to give a clear view of the assets of nature which may be both tangible and intangible. It is assumed that in the table, bold-green color means positive impacts, light-green color means low-positive impacts, grey color means neutral and red color means negative impacts. When the inputs coming from the eco-smart planning approach are evaluated, it is observed that the 3rd airport area causes the most ecological harm. It is seen that the sustainability of the benefit areas, which form the basis of ecological planning, is ignored due to negative effects on forest and wetland areas. Canal İstanbul and the 3rd bridge have similar impact levels but differ from each other in detail. For instance, while Canal İstanbul has positive impacts on abiotic heterogeneity, the 3rd bridge has less positive effects. It is emphasized that the three mega projects have common negative effects on the local climate and cause a decrease in biodiversity in forests. On the positive side, it can be stated that they provide opportunities for adding new species to the biodiversity pattern in their respective areas and offer new recreational areas to the city.

Eco-smart analytical assessment method is used for determining the environmental impacts of mega projects and it investigates whether the mega

projects are really smart. Additionally, although there can be differences in ecosystem services depending on the context and location, it is accepted in this study that every ecosystem service has equal importance.

CONCLUSION

The primary objective of this article is to elucidate the ecological and spatial impacts and ramifications of mega projects in İstanbul. In general, the lack of studies that measure the social, spatial, ecological, and economic impacts of mega projects mathematically/numerically makes it difficult to determine the precise effects of these projects. However, in this study, the negative effects of mega projects are highlighted numerically using a method similar to the one used by Burkhard et al. (2012). The comprehensive evaluation approach employing a three-dimensional correlation model (characterizing positive, neutral, and negative relationships) has been employed for a selection of significant undertakings in İstanbul.

Following the establishment of clear definitions and delineation of diverse categories and attributes of mega projects, this research directs its attention towards investigating the effects of such ventures. The findings of this study ascertain that prominent mega projects in İstanbul, specifically the 3rd bridge, 3rd airport, and Canal İstanbul, have engendered noteworthy transformations in both the natural (ecological) and built-environment (spatial) milieu. These mega projects, which cause socioeconomic segregation independent of organic urban fabric and encourage unplanned growth around them, can create ecological, spatial, and socio-economic crises by differentiating them from the local organic fabric. Mega projects that threaten sustainability by reducing the benefits derived from nature, particularly from an ecological perspective, also negatively impact the social structure, space, and economy. Currently, they are evaluated as projects that neglect the whole, do not prioritize the relationship between structure-environment-silhouette, and push ecological values into the background. Selected case study areas are located in areas in the north of İstanbul that have rich biodiversity, forest assets, and unique species. This indicates that mega projects are designed to bring economic benefits instead of ecological/environmental priorities. However, using multifaceted approaches and models while planning the location, activity areas, infrastructure status, and users of mega projects by both national and local policymakers can reduce their negative effects. As envisaged in the eco-smart planning approach, natural hazards (such as floods, landslides, extreme weather events), land vulnerabilities (such as slope, erosion, soil movement), and ecosystem services (regulatory, beneficial, and cultural) should be taken into account in all developed and to-be-developed mega projects. Additionally, developing a decision support mechanism through artificial intelligence/technological tools to identify potential risks is important (Figure 9).

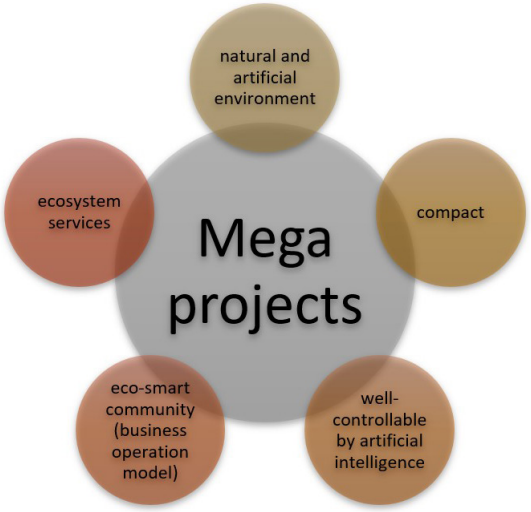

Figure 9. Main qualities of mega projects

Figure 9 displays the fundamental components that the expected future mega projects should possess. The eco-smart planning approach offers a variety of alternatives for mega projects. This approach embraces ecosystem services that aim to reduce risks and sustain benefits derived from nature. It enables a balance between investments by prioritizing resource efficiency at the same time. Therefore, if mega projects are developed in a participatory environment that is sensitive to natural and delicate areas, while considering local values, they have the potential to contribute to the environmental and cultural development of the city. Moreover, it is highly suggested to undertake research focused on determining the guiding principles that mega projects should adhere to, commencing from the stages of site selection and planning, extending through to the construction phase. Additionally, it is essential to identify the key stakeholders who should be engaged and involved throughout these processes.

Araştırmacıların Katkı Oranı Beyanı

Çalışma tek yazarlıdır, yazar %100 oranında katkı sağlamıştır.

Çatışma Beyanı

Çalışmada herhangi bir potansiyel çıkar çatışması bulunmamaktadır.

Etik Kurul Beyanı

Etik kurul onayı gerektiren bir çalışma değildir.

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