

A New Institutional Sustainability Index Regarding Local Governments: The Case of Istanbul*

Yeni Bir Kurumsal Sürdürülebilirlik Endeksi: İstanbul Örneği

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Abstract

The literature on institutional sustainability has largely focused on global-based analysis, and it has generally ignored to examine local-based analyses. The main purpose of this study was to measure the institutional sustainability of local governments. In this research, the intention was to develop an institutional sustainability index based on the district municipalities in the province of Istanbul, which is one of the most significant metropolises in the world. A total of 48 variables were used in the calculation of the General Institutional Sustainability Index (social dimension with 26 variables, economic dimension with 15 variables, and environmental dimension with 7 variables). The index consists of 3 sub-indexes comprising the general institutional sustainability index. The social dimension was examined in 6 sub-dimensions, the economic dimension in 5 sub-dimensions, and the environmental dimension in 4 sub-dimensions. The results indicate that Istanbul municipalities achieved low economic and environmental sustainability index scores. Decision-makers will be able to assess the general institutional sustainability index results for their own municipalities and to observe strong and weak aspects with the sub-indexes. In the process of developing the index, missing value analysis, cluster analysis, principal component analysis, and the composite index calculation methods were applied to data from 39 district municipalities in the province of Istanbul.

Keywords

Indicators, Multivariate Analysis, Institutional Sustainability, Sustainable Development and Municipality Sustainability

Öz

Kurumsal sürdürülebilirlik literatürü büyük ölçüde küresel temelli analizlere odaklanmış ve genellikle yerel temelli analizleri incelemeyi göz ardı etmiştir. Bu çalışmanın temel amacı, yerel yönetimlerin kurumsal sürdürülebilirliğini ölçmektir. Bu araştırmada, dünyanın en önemli metropollerinden biri olan İstanbul ilindeki ilçe belediyelerine dayalı bir kurumsal sürdürülebilirlik endeksi geliştirilmesi amaçlanmıştır. Genel Kurumsal Sürdürülebilirlik Endeksi hesaplamasında toplam 48 değişken kullanılmıştır (sosyal boyut 26 değişken, ekonomik boyut 15 değişken, çevresel boyut 7 değişken). Endeks, genel kurumsal sürdürülebilirlik endeksinin içeren 3 alt endeksten (sosyal, ekonomik ve çevresel) oluşmaktadır. Sosyal boyut 6 alt başlıkta, ekonomik boyut 5 alt başlıkta ve çevresel boyut 4 alt başlıkta incelenmiştir. Sonuçlar, İstanbul belediyelerinin düşük ekonomik ve çevresel sürdürülebilirlik endeksi skoru elde ettiğini göstermektedir. Karar vericiler, kendi belediyeleri için genel kurumsal sürdürülebilirlik endeksi sonuçlarını değerlendirebilecek ve alt endeksler ile güçlü ve zayıf yönleri gözlemleyebileceklerdir. Endeksin geliştirilme sürecinde, İstanbul ilindeki 39 ilçe belediyesinden alınan verilere Eksik Gözlem Analizi, Kümeleme Analizi, Temel Bileşenler Analizi ve Bileşik Endeks Hesaplama yöntemleri uygulanmıştır.

Anahtar Kelimeler

Göstergeler, Çok Değişkenli Analiz, Kurumsal Sürdürülebilirlik, Sürdürülebilir Kalkınma ve Belediye Sürdürülebilirliği

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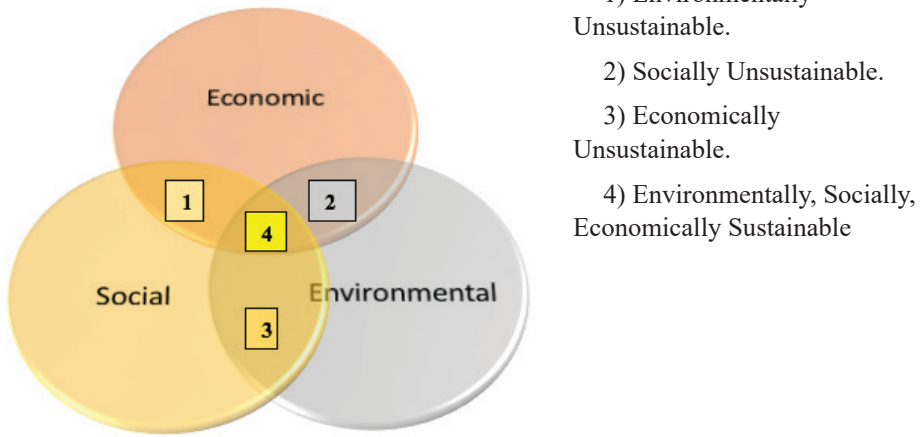
Introduction

The word sustainability comes from the Latin word “*sustinere*”. It is found extensively in sources with the meaning of maintaining, being continuous, ensuring, supporting, existing, continuing, and lasting (Onion, 1964). In the Cambridge Dictionary of the Environment, sustainability was defined as “the quality of causing little or no damage to the environment and therefore able to continue for a long time; the idea that goods and services should be produced in ways that do not use resources that cannot be replaced and that do not damage the environment”.

The purpose of the concept of sustainability is basically to embody ethical concerns regarding the need to sustain a suitable ecological infrastructure for future generations. Despite the concept being formulated as a universal principle, in practice, it should be distinctive and flexible regarding the local, social, cultural, political, and ecological conditions (Wiersum, 1995). Due to these reasons, many international conferences have been organized, and action plans and reports were prepared for sustainability to gain a global meaning, and become a global criterion. Sustainable development has three main dimensions, with these being social, economic, and environmental. For the actualization of sustainability, all these three dimensions need to occur simultaneously (Dillard et al., 2008).

The UN Conference on Environment and Development (Rio Conference) organized in Rio de Janeiro on June 3-14, 1992 was a significant step in terms of the acceptance of a series of principles regarding the adoption of environmentally-friendly regimes by nations. At the Rio Conference, also as known as Agenda 21, that shed light on this study, a different perspective regarding sustainability was proposed because decisions made or opinions regarding sustainability had a global dimension in previous periods. Along with this conference, local administrations, NGOs, other actors, and central administrations were qualified as partners in the international community. In other words, while a macro perspective was dominant regarding sustainability before Agenda 21, a micro perspective was adopted with Agenda 21. In light of this, it is considered that one of the partners in the international community with a significant role for the local dimension of sustainability is the local administrations. In the following years, some practices about the sustainability of local administrations, and especially with respect to the sustainability of municipalities were implemented. All these implementations conducted in Europe and Asia are based on the idea of Agenda 21.

Remmen (2007) suggested some concepts regarding sustainability in their study. First, economic and social sustainability is required for the occurrence of environmental sustainability, and environmental and social sustainability is required for the occurrence of economic sustainability, and environmental and economic sustainability is required for the occurrence of social sustainability (Figure 1).



- 1) Environmentally Unsustainable.
- 2) Socially Unsustainable.
- 3) Economically Unsustainable.
- 4) Environmentally, Socially, Economically Sustainable

Figure 1. The three dimension of sustainability

Levett (1998) emphasized that the actualization of economic activities or social activities will not be possible without the main environmental life support systems of our planet (Figure 2).

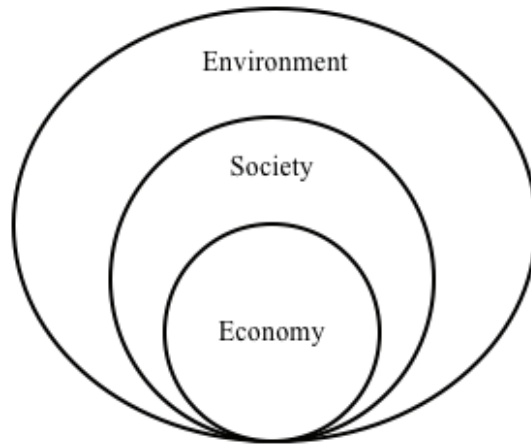


Figure 2. Russian dolls model of sustainability

The importance of this study for municipalities, one of the most significant actors in local administrations, is to ensure they can assess decisions in terms of sustainability, by developing a sustainability index that will enable them to make better decisions in the domain of sustainability. By measuring institutional sustainability, municipalities will observe the consequences of decisions they make and/or will make in terms of sustainability. In addition, municipalities will be able to compare their actions with other municipalities while assessing themselves in terms of sustainability.

The purpose of the study is to develop a new institutional sustainability index that allows for the comparison of institutional sustainability performances in local and global senses. In this regard, the study was based on the 39 district municipalities of the city of

Istanbul, which is one of the most significant metropolises in the world. It is the most crowded city in Europe, with a population of 15,519,267 according to 2019 Turkish Statistical Institute (TURKSTAT) data. The municipalities are generally involved in social, economic, environmental and administration activities. In Istanbul, the municipal services are provided by 39 district municipalities, affiliated to the Istanbul Metropolitan Municipality, with 25 located on the European side, and 14 located on the Asian side. The data for the research was obtained from activity reports recently published (2019) by the municipalities; in other words, secondary data was used. In these activity reports, the municipalities provide information regarding municipal work performed in the previous year. In addition to the activity reports published by the municipalities, the budget reports of the municipalities were examined for some information. This information was accessed for the 39 municipalities in Istanbul through the official internet pages of the municipalities. Moreover, information was requested from some public institutions (İGDAŞ, İSKİ, CK Boğaziçi Electricity Administration, Istanbul Provincial Health Directorate, and Istanbul Provincial Directorate of Security) by official letters. As the Istanbul Provincial Health Directorate and the Istanbul Provincial Directorate of Security responded negatively to our data requests, calculations were made for only 2 variables in the social dimension, and variables relevant to crime could not be accessed.

For some questions in the social dimension, data from the Turkish Statistical Institute (TURKSTAT) were used with respect to the districts. Moreover, regarding the environmental dimension, the data collected by the Istanbul Metropolitan Municipality was used. But air quality could not be measured individually for the 39 municipalities because there are 11 centers in total where urban air quality is measured in Istanbul. The values measured at these centers were used only for the districts where they are located, and the value of the closest district with measurement performed was used for the other 28 districts.

Istanbul is the province in Turkey that receives the highest migration, and is the most crowded in terms of population. It is one of the prominent cities from the economic, historical, and socio-cultural aspects. The city ranks 34th in the world in terms of economic size. In the list of cities per their population, it ranks first in Europe, and sixth in the world, according to ranking considering the municipal borders. In Istanbul, the municipal services are provided by 39 district municipalities, affiliated to the Istanbul Metropolitan Municipality, with 25 located on the European side, and 14 located on the Asian side of Istanbul (TURKSTAT, 2020). For these reasons, the study was based on 39 district municipalities in Istanbul.

In this study, the duties, authorities and responsibilities of municipalities determined by laws were examined, and a variable collection form consisting of 70 questions was prepared after receiving the opinions of experts. However, 48 variables in total were used for the calculation of the General Institutional Sustainability Index (social dimension with 26 variables, economic dimension with 15 variables, and environmental dimension with 7 variables). Moreover, during the preparation of this form, studies conducted in the international domain regarding the sustainability of municipalities were also considered. This variable collection form, not only examined the social, economic and environmental dimensions of sustainability, but the sub-dimensions constituting these dimensions were

also included in the scope of the investigation. In the study, the social dimension was examined with 6 sub-dimensions, the economic dimension with 5 sub-dimensions, and the environmental dimension with 4 sub-dimensions.

Literature Review

Sustainability

While transferring the concept of sustainability to the institutional level, institutional sustainability is defined as the protection of the ability of performing business while meeting the current requirements of an enterprise's stakeholders (shareholders, employees, customers), and meeting the same requirements in the future (Dyllick and Hockerts, 2002). According to the report by the Commission of the European Communities (2001), sustainability is a concept enabling companies to combine their social and environmental concerns with their commercial activities, and enabling their stakeholders to be volunteers. Unlike the previous definitions of sustainability, this definition emphasizes the voluntariness of the stakeholders.

Economic Sustainability

In economic sustainability, sustainability is addressed as an extensively defined approach based on growth that preserves and combines dynamic efficiency, which is measured as the difference between income and expenses, now and in the future (Stavins, Wagner and Wagner, 2003). At the level of corporations, financial sustainability is related to the viability, stability, or security of an enterprise. In their study, Myskova and Hajek (2017) defined economic and financial sustainability as the ability of a company to gain profit, to increase the value of invested capital, and to simultaneously reimburse its short-and long-term liabilities. Financial security is related to the long-term financial balance of a company which reflects its resistance to the negative effects of internal and external threats (Delas, Nosova, and Yafinovich, 2015). Gryglewicz (2011) advocated that the financial sustainability of a company is related to high liquidity, payment power, capital structure, and indebtedness. Dyllick, Thomas and Kai Hockerts (2002) specified that economically sustainable companies are ones that always guarantee sufficient cash flow to ensure liquidity while generating a permanent return above the average for their shareholders. Institutions with a sustainable economic policy increase their competitiveness in the market by responding to the expectations of today's investors and customers.

When examined historically, sustainability indexes are based on the distant past. The first sustainability index applied in companies was the Domini 400 Social Index and Domini Equity Mutual Fund. In the study, potential performance (monthly average variable and raw returns, Jensen's alpha and Sharpe's performance) indexes were examined arising from subjecting the investment decisions to social responsibility screening. Two unlimited comparison portfolios (S&P 500, and CRSP: Value Weighted Index) were used with the Domini 400 Social Index and Domini Equity Mutual Fund, and the results were compared. Consequently, it was decided to use CRSP (Value Weighted Index), because the desire was to minimize the effect size of low potential companies (Sauer, 1997). Compared to the previous research, the performance of the socially responsible portfolio

reviewed in the abovementioned research is not subject to the confounding effects of transaction costs, management fees, or differences in investment policy associated with actively managed mutual funds. Furthermore, this research clearly demonstrates that investors can choose socially responsible investments that are consistent with their value systems and beliefs without being forced to compromise on performance.

Social Sustainability

Friedman (2007) interpreted social sustainability as “enterprises having a single responsibility; it is to remain in the state of making profit in the long term by playing the game per its rules without involving deceit, by participating in free competition, and by using the resources of the enterprise.” McKenzie (2004) stated in their report that social sustainability was the formation of equal access to significant services such as health, education, transportation and shelter, of equality among generations, of the cultural relationship system, and ensuring extensive political participation especially at the local level, and the formation of mechanisms where the requirements are defined.

Eighteen common social indicators were defined in 2000 for the elimination of poverty by the European Union, and approved in December 2001 by the Social Protection Committee of the European Union. These 18 indicators encompass the four significant dimensions of social sustainability: poverty (financial), health, employment, and education. In June 2006, the Social Protection Committee added two more dimensions, i.e., the protection of social life and social sustainability, involving 14 additional indicators. These indicators were recently adopted inclusive goals consisting of 14 indicators, which intend to reflect “social adaptation” and the “growth of the Lisbon Strategy and its interaction with business goals”. Social sustainability gained a structure consisting of three parts: social inclusion, pensions, and health and long-term care (Adelle and Pallemmaerts, 2009). In 2019, new goals were defined for 2020, and the structure was explained more clearly (European Commission- Social Protection Committee, 2019). However, the unforeseen COVID-19 pandemic has led to failures in the realization of these goals, as was reported in the 2021 annual report (European Commission- Social Protection Committee, 2021). The committee now needs to address the longer-term socio-economic impacts of the pandemic and take into consideration future global crises.

Environmental Sustainability

In ecological terms, sustainable companies are ones that consume natural resources only below the renewal rate of the resource, or at the rate of development of their substitute. They don't cause emissions beyond the capacity of the natural system for absorbing or suppressing these emissions. They are not involved in activities which will decrease the activity of the ecosystem (Dyllick and Hockerts, 2002). If industrial structures consume more energy and material than can be renewed, or if they cause emissions at an amount higher than the volume that can be absorbed by nature, the industrial system becomes ecologically unsustainable (Ayres and Simonis, 1994). In the second part of the Brundtland report, sustainable environment was examined under six dimensions as population and human capital, food security, ecosystems and types, energy, industry, and urban struggle (Imperatives, 1987).

In general, indicators relevant to air pollution, climate change, biological diversity, consumption of natural resources, urban problems, waste generation, water pollution, population, health, and diseases, among environmental indicators, are most frequently used (OECD, 1991). The assessment of environmental tendencies at the level of the European Union and its member states is based on the assessment of indicators. Thirty indicators were used to measure the 27 environmental tendencies defined by the European Union in 2008 for Environmental Resource Planning (ERP). The indicators cover the key environment issues: climate change, energy, nature, biological diversity, health, natural resources, wastes, economy, and practices. These indicators were also divided into groups as circumstances, pressure, responsibility, effect, and driving force indicators (Biesbroek et al., 2010).

Institutional Sustainability in Local Governments

Institutional sustainability indicators can help individuals, communities, organizations, businesses, local and national government to better understand the implications of sustainability actions and encourage them to act in a more sustainable way. Studies on the sustainability of local governments differ in the number of dimensions covered. The dimensions considered in these studies range from one to four, with most of them involving three dimensions. Also, as in the current study, most of the studies on the sustainability of local governments are based on Local Agenda 21.

The most relevant research among those investigating sustainability as one or two dimensions was conducted in the Reggio Emilia area of Italy (North Italy) and the city of Coventry in England. Sustainability was examined as one dimension (i.e., environmental) in Reggio Emilia, while it was examined as two dimensions (i.e., environmental and social & economic) in Coventry. The environmental status of 45 municipalities located in Reggio Emilia was examined using 25 indicators and the municipalities were ranked using Multi-Criteria Analysis (Ferrarini, Bodini and Becchi, 2001). For the city of Coventry, on the other hand, sustainability was examined as two dimensions, the environmental dimension (involving eight indicators) and the social & economic dimension (involving 12 indicators). Researchers developed an environmental indicator system, which covered the generated and recycled domestic wastes, habitats for wildlife, domestic water consumption, electricity consumption, water quality, and air quality (Coventry Agenda 21, 2008). These two studies mainly focused on the environmental dimension of sustainability.

Several other studies examined sustainability as a three-dimensional construct. For example, studies conducted in Algarve (Portugal), Galicia (Spain), and Shanghai (China) municipalities assessed sustainability using three dimensions: social, economic, and environmental. In the Algarve study, data was collected from all the municipalities in the region through a questionnaire, and a profile of the region was created. As a result, a sustainable development index consisting of 20 common indicators for municipal sustainability was developed (Mascarenhas et al., 2010). In Galicia, sustainability was assessed using 38 indicators relating to the three dimensions of sustainability and the data was analyzed using the *Analytical Hierarchy Process* (Gonzalez et al., 2019). The common feature of the Algarve and Galicia studies is that they both are regional-scale studies.

The Shanghai study also measured sustainability as composed of social, economic, and environmental dimensions and measured sustainability using 86 indicators (Yuan et al., 2003). Lastly, a six-year-long project (1995-2001) that offered policy recommendations to improve quality of life and sustainable development conducted by the local government of Bristol assessed sustainability under three dimensions but with a nuance. The study operationalized sustainability as a construct consisting of environmental, ecological, and social dimensions (McMahon, 2002).

Finally, some studies examined sustainability under four dimensions. In the study conducted in the municipality of Padua (Italy), local sustainability was assessed by 61 indicators grouped under four dimensions: protecting the environment, developing the economy, ensuring social solidarity, and health/justice. The study conducted in the Milanowek (Poland) municipality, on the other hand, operationalized sustainability as consisting of environmental, social, economic, and institutional dimensions with six strategic purposes and 21 indicators (Gutowska, Śleszyński, and Grodzinska, 2012). In sum, most studies involve the three widely accepted dimensions of sustainability (i.e., social, economic, and environmental). Therefore, we employed these three dimensions to operationalize sustainability in the current study.

Methodology

Variable Collection Form

The variables for the research were selected based on international studies on the sustainability of municipalities related to Agenda 21. They comprise variables regarding the issues under the duty, authority, and responsibility of municipalities where the implementation was performed; in other words, regarding issues covered by the municipal law. In the determination of variables based on municipal law, the opinions of specialists (academics, engineers, and members of NGOs) who previously worked and conducted studies on this issue were sought. In the study, which intended to research the institutional sustainability of municipalities with 70 variables in total, index calculations were made with 48 variables due to the lack of recorded data, inability to access enough data, and variables being eliminated as a result of principal component analysis.

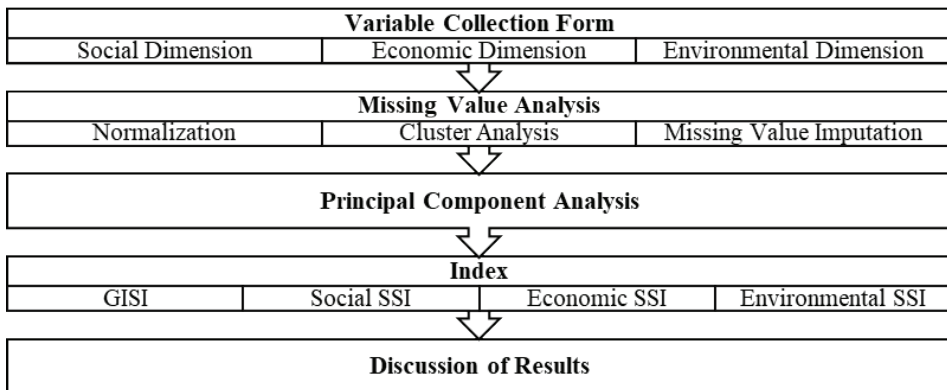


Figure 3. Research design.

Missing Value Analysis

Before starting the cluster analysis, the variables in the data set were normalized, and converted to the range of 0-1. The reason for the use of the following normalization method is to eliminate outliers among the unit values of the variables.

$$\text{Normalization} = \frac{x_i - \min(x_i)}{\max(x_i) - \min(x_i)} \quad (1)$$

Afterwards, cluster analysis was applied to assign missing values. Primarily, the districts were clustered per their sustainability indicators. The central tendency measure (arithmetic mean for quantitative variables, and mode for qualitative variables) of the cluster, where the relevant district was present, was assigned to the missing values.

Principal Component Analysis

Principal component analysis was separately applied to social, economic, and environmental variables that constitute the general institutional sustainability. The variables, whose component load was 0.55 and more, were included in the calculations of the index. The weights of sub-indexes (social, economic, environmental) of the general institutional sustainability index were also determined per the results of principal component analysis. For instance, principal component analysis was applied to 7 environmental variables with a component load greater than 0.55. In this case, for the calculation of general institutional sustainability index, the weight of the environmental sub-index (W_{ENV}) was 7/48 (here, 48 is the total variable number included in the index calculations). When performing index calculations, as high values of some variables would be disadvantageous, these variables were subtracted from 1 before being used in the index calculation (Expense: E6, E7, E8, E9, E10, E11, Loan: E18, E19, Use of Natural Resources: ENV4 Waste Management: ENV9).

Index

The general institutional sustainability index (GISI) consists of 3 sub-indexes of social, economic, and environmental. The general institutional sustainability composite index is calculated with the following formula:

$$\text{GISI} = [W_S I_S + W_E I_E + W_{ENV} I_{ENV}] \quad (2)$$

Here, the weights were defined as follows:

$$W_S = \frac{\text{Number of Social indicators included in the calculation of index}}{\text{Total number of variables in all dimensions}} \quad (3)$$

$$W_E = \frac{\text{Number of Economic indicators included in the calculation of index}}{\text{Total number of variables in all dimensions}} \quad (4)$$

$$W_{Env} = \frac{\text{Number of Environmental indicators included in the calculation of index}}{\text{Total number of variables in all dimensions}} \quad (5)$$

The calculations for Istanbul's general institutional sustainability index, and its sub-indexes are as follows:

$$I_S = \frac{\sum_{i=1}^{n_s} x_i}{n_s}, \quad I_E = \frac{\sum_{j=1}^{n_e} x_j}{n_e}, \quad I_{ENV} = \frac{\sum_{k=1}^{n_{env}} x_k}{n_{env}} \quad (6)$$

I_S	: Social sub – index
I_E	: Economic sub – index
I_{ENV}	: Environmental sub – index
x_i	: i^{th} value of social variable
x_j	: j^{th} value of economic variable
x_k	: k^{th} value of environmental variable
n_s	: Number of Social indicators included in the calculation of index (26)
n_e	: Number of Economic indicators included in the calculation of index (15)
n_{env}	: Number of Environmental indicators included in the calculation of index (7)

Results

Missing Value Analysis

Cluster analysis was applied to the data set without missing values, which consisted of 35 variables. Similar clusters were formed for sustainability, and central tendency measures (arithmetic mean for quantitative variables, and mode for qualitative variables) of districts were assigned to missing values. Before performing cluster analysis, normalization (min. value 0, max. value 1) was applied to compare and interpret the observed values.

Taking into consideration integration coefficients of algorithms for hierarchical cluster analysis used for clustering, Ward’s minimum variance method was selected (Table 1).

Table 1
Integration coefficients of Hierarchical Clustering Analysis

Average	Single	Complete	Ward
0.90562	0.79558	0.95251	0.96951

To decide the number of clusters, the elbow and silhouette methods were used. According to methods, 4 clusters emerged as seen in Figure 4.

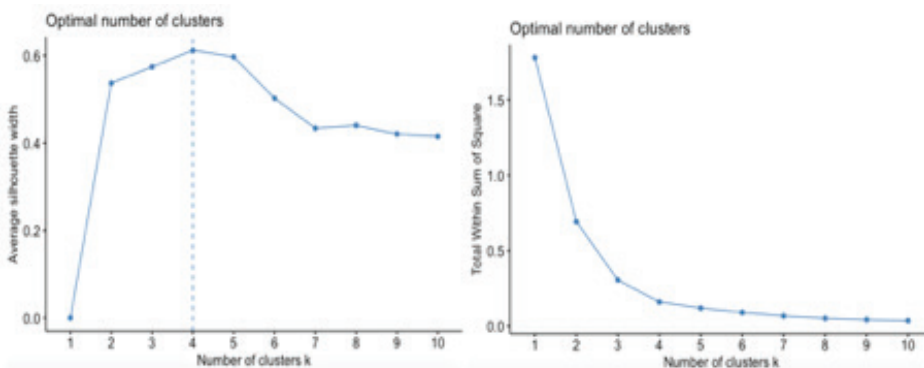


Figure 4. Results of Elbow and Silhouette methods

When the number of clusters was selected as 4 in non-hierarchical (K-means) cluster method, the districts, which were present in clusters obtained with hierarchical cluster

analysis, were the same (Figure 5). As specified previously, the central tendency measures for the relevant cluster were assigned to districts with missing values.

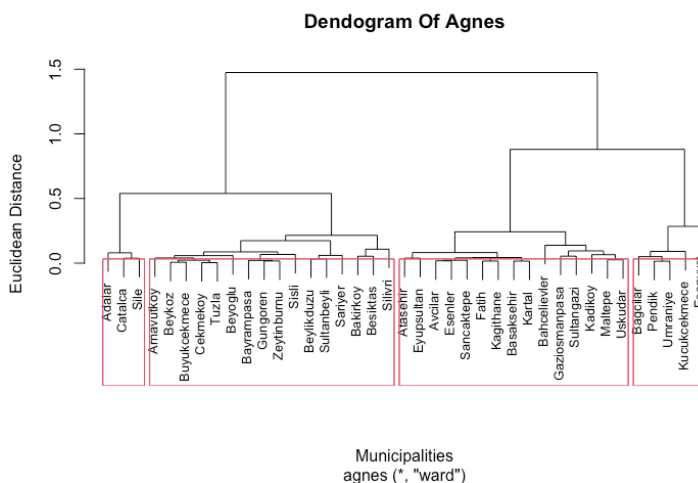


Figure 5. Result of hierarchical cluster analysis.

Principal Component Analysis

After the assignment of missing values, principal component analysis was applied for each dimension (social, economic, and environmental) of institutional sustainability. For the principal components, the variables with a component load greater than 0.55 were used for the calculation of the index. In addition, the result of the Quartimax method, an orthogonal rotation method, indicated that there are more meaningful and interpretable relationships than varimax. For these reasons, the Quartimax method was used in the principal component analysis for social, economic and environmental dimensions.

Results of Principal Component Analysis for Variables in the Social Dimension (Table 2).

Table 2
The List of Variables Forming the Social Dimension

Code of Variable	Sub-Dimension	Description of Variable
S1	Population	Measures the population of the district. ¹
S2		Measures the ratio of population of women living in the district to the population of the district. ²
S4		Measures the number of individuals per m ² in the district. ¹
S5		Measures the ratio of individuals of age 16 and younger living in the district to the population of district. ¹
S6		Measures the ratio of individuals of age 65 and older living in the district to the population of district. ¹
S7		Measures the population increase at the district in the last 5 years. ¹
S8		Employment

S14	Governance	Measures the total number of council members at the municipality. ³
S15		Measures the ratio of number of female council members at the municipality to the number of total council members. ³
S16		Measures the rate of valid votes at the recent municipal elections. ¹
S17_1	Education	Measures the ratio of illiterate individuals at the district to the population of the district. ²
S17_2		Measures the ratio of the number of individuals at the district with elementary school and less educational level to the population of district. ²
S17_3		Measures the ratio of the number of individuals at the district with secondary school educational level to the population of district. ²
S17_4		Measures the ratio of the number of individuals at the district with high school educational level to the population of district. ²
S17_5		Measures the ratio of the number of individuals at the district with undergraduate educational level to the population of district. ²
S17_6		Measures the ratio of the number of individuals at the district with postgraduate educational level to the population of district. ²
S22	Health	Measures the distance between the municipality, and the closest hospital/clinic. ¹
S23		Measures the number of health institution operated or owned by the municipality. ³
S29		Measures the number of damaged buildings at the district. ³
S31_1	Cultural Events	Measures the total number of museums at the district. ²
S31_2		Measures the total number of libraries at the district. ²
S31_3		Measures the total number of locations at the district that operate as art gallery. ²
S31_4		Measures the total number of locations at the district where theatres are being performed. ²
S31_5		Measures the total number of locations at the district where movies are being shown. ²
S31_6		Measures the total number of locations at the district where sports activities are being performed. ²
S32		Measures whether the district has guest house, or not. ³
<p>¹ González-García, S., Rama, M., Cortés, A., García-Guaita, F., Núñez, A., Louro, L. G., ... & Feijoo, G. (2019). Embedding environmental, economic and social indicators in the evaluation of the sustainability of the municipalities of Galicia (northwest of Spain). <i>Journal of Cleaner Production</i>, 234, 27-42. https://doi.org/10.1016/j.jclepro.2019.06.158</p> <p>² Mascarenhas, A., Coelho, P., Subtil, E., & Ramos, T. B. (2010). The role of common local indicators in regional sustainability assessment. <i>Ecological indicators</i>, 10(3), 646-656.</p> <p>³Turkey Municipality Law (Law No:5393)</p>		

According to the KMO index value (0.505) and Bartlett’s Test of Sphericity (0.000), it is understood that principal component analysis can be applied to the variables forming the social dimension.

In the data set forming the social dimension, the number of principal components were determined based on the Eigenvalue criterion. There were 7 principal components with

an eigenvalue greater than 1. All 7 principal components define 77.015% of the total variance.

The common variance (communalities) of all the variables forming the social dimension is greater than 0.5.

In the component matrix, variables with a loading value greater than 0.55 were used for the calculation of this sub-dimension of the institutional sustainability index. According to this, the 1st principal component represents education (S17_1, S17_2, S17_3, S17_4, S17_5, S17_6) and population (S2, S5, and S6) variables. The 2nd principal component contains variables with a load of 0.55 and more (S31_2, S31_4, S31_5, S31_6, S1, S14) which mainly measure cultural activities. The 3rd principal component includes variables with a load of 0.55 and more (S7, S22) that specify population and health. The 4th principal component contains variables with a load of 0.55 and more representing population (S4) and governance (S14, S16). The 5th principal component represents cultural activities with the variables S31_3. The 6th principal component, mainly examines cultural activities (S32). The 7th principal component is expressed by the variables that mainly (variables with a load of 0.55 and more) examine employment (S8), and measure health (S23).

Results of Principal Components Analysis Applied to Variables in the Economic Dimension (Table 3).

Table 3
The List of Variables Forming the Economic Dimension

Code of Variable	Sub-Dimension	Description of Variable
E1	Income	Measures the rate per person of the revenue obtained by the municipality. ³
E2		Measures the average income of the households at the district. ³
E4		Measures the rate per person of the expense by the municipality. ³
E6	Expense	Measures the rate per person of total expenditure made by the municipality for socio-cultural, art, science, and sports events. ³
E7		Measures the rate per person of municipality's expenses for ceremonies, hosting and presentation. ³
E8		Measures the rate per person of municipality's total lawsuit pursuit and execution expenses. ³
E9		Measures the rate per person of the total amount of services and aids provided for low-income, poor, needy and orphan individuals. ³
E10		Measures the rate per person of total expenses made for procurement, construction, maintenance and repair of municipal buildings, facilities, and vehicles and materials.
E11		Measures the rate per person of all kinds of infrastructure, construction, repair and maintenance expenses of the municipality. ³
E12	Income or Expense	Measures the rate per person of the municipality's total budget. ³
E13		Measures the rate per person of municipality's total budget deficit or surplus. ³
E15	Invest	Measures the rate per person of the municipality's total investments. ³
E16		Measures the rate per person of total number of beds at the hotels located within the borders of the municipality. ³

E18	Debt	Measures the rate per person of total liabilities of the municipality in the recent 1 year. ³
E19		Measures the rate per person of municipality's total interest and borrowing costs. ³

According to the KMO index value (0.55) and Bartlett's Test of Sphericity (0.000), it is clear that principal components analysis can be applied to the variables forming the economic dimension.

In the data set forming the economic dimension, the number of principal components was determined based on the Eigenvalue criterion. There were 6 components with an Eigenvalue greater than 1. All 6 principal components define 83.11% of the total variance, and the communality value of all the variables included in the analysis is greater than 0.5.

The 1st principal component represents the variables about income (E1, E2), income/expense (E12, E13), and loan (E18, E19) (variables with a load of 0.55 and more). The 2nd principal component was observed to include variables (E8, E18) with a load of 0.55 and more measuring expense and loan. The 3rd principal component contains variables with a load of 0.55 and more specifying expense and investment (E11, E15). The 4th principal component has variables with a load of 0.55 and more representing expense (E7, E10). The 5th principal component was represented by variables examining cultural activities (E6, E9) (variables with a load of 0.55 and more). The 6th principal component included the variable E16, with a load greater than 0.55, representing investments.

Results of Principal Components Analysis Applied to Variables in the Environmental Dimension (Table 4).

Table 4
The List of Variables Forming the Environmental Dimension

Code of Variable	Sub-Dimension	Description of Variable
ENV1	Air Quality	Measures the average O ₃ concentration (Mg/m ³) in air within the borders of the district. ¹
ENV2		Measures the average NO ₂ concentration (Mg/m ³) in air within the borders of the district. ¹
ENV3		Measures the average PM10 amount (Mg/m ³) in air within the borders of the district. ¹
ENV5	Use of Natural Sources	Measures the ratio of average electricity amount (mwh) consumed at lodgings within the borders of the district to the population. ¹
ENV9	Waste Management	Measures the ratio of total solid waste amount collected within the borders of the district to population. ¹
ENV12	Eco School	Measures the total number of schools located within the borders of the district. ²
ENV13		Measures the total number of eco-schools (having green flag) located within the borders of the district. ²

According to the KMO index value (0.563) and Bartlett's Test of Sphericity (0.000), principal components analysis can be applied to variables forming the environmental dimension.

In the data set forming the environmental dimension, the number of principal components was determined based on the Eigenvalue criterion. There were 3 components with an Eigenvalue greater than 1. All 3 principal components define 78.06% of the total

variance, and the communality value of all the variables included in the analysis was greater than 0.5.

The 1st principal component included variables with a load greater than 0.55 (ENV1, ENV2, and ENV3) measuring air quality. The 2nd principal component contained variables with a load greater than 0.55 (ENV12, and ENV13) representing ecological education. The 3rd principal component represents the use of natural resources (ENV5) and amount of waste (ENV9). Here, the loads for variables ENV5 and ENV9 are again greater than 0.55.

Index

Principal component analysis was applied individually for each sub-dimension, and the variables with a component load greater than 0.55 were included in the calculation of the index. A total of 48 variables were used in the calculation of general institutional sustainability index (social dimension 26 variables, economic dimension 15 variables, environmental dimension 7 variables). The purpose of the study was to calculate the social, economic, and environmental sub-indexes of general institutional sustainability for 39 districts in Istanbul. First, Istanbul’s institutional sustainability indexes were calculated based on the averages of 39 districts. Thus, this would enable the assessment of whether the index values obtained for the 39 districts were above or below the average for Istanbul.

The calculation of Istanbul’s general institutional sustainability index and its sub-indexes is as follows:

$$W_S = \frac{26}{48} = 0.54166, \quad W_E = \frac{15}{48} = 0.31250, \quad W_S = \frac{7}{48} = 0.14583 \quad (1)$$

The calculation of sub-indexes;

$$I_{S(ISTANBUL)} = \frac{\sum_{i=1}^{n_s} x_i}{n_s} = \frac{8.5}{26} = 0.32690 \quad (2)$$

$$I_{E(ISTANBUL)} = \frac{\sum_{j=1}^{n_e} x_j}{n_e} = \frac{8.4}{15} = 0.55979 \quad (3)$$

$$I_{ENV(ISTANBUL)} = \frac{\sum_{k=1}^{n_{env}} x_k}{n_{env}} = \frac{2.52}{7} = 0.36007 \quad (4)$$

Then, the GISI will be as follows;

$$GISI = [0.54166 * (0.32690) + 0.31250 * (0.55979) + 0.14583 * (0.36007)] = 0.4045 \quad (5)$$

When these index scores are multiplied by 100, they can be interpreted as 32.69%, 55.979%, 36%, and 40.45%, respectively.

When the general institutional sustainability index scores are examined, the district of Kadıköy is the most successful municipality for general institutional sustainability. Along with Kadıköy, the districts of Beşiktaş, Küçükçekmece, Bakırköy, Maltepe, Kağıthane, Başakşehir, Şişli, Pendik, Ümraniye, Beylikdüzü, Esenyurt, Fatih, Üsküdar, Bahçelievler, Eyüpsultan, Kartal, Ataşehir, Bağcılar, and Beyoğlu are above the average for Istanbul (40.45%) in terms of general institutional sustainability (Table 5, Figure 6).

Table 5
 General Institutional Sustainability Index Scores of 39 Municipalities of Istanbul

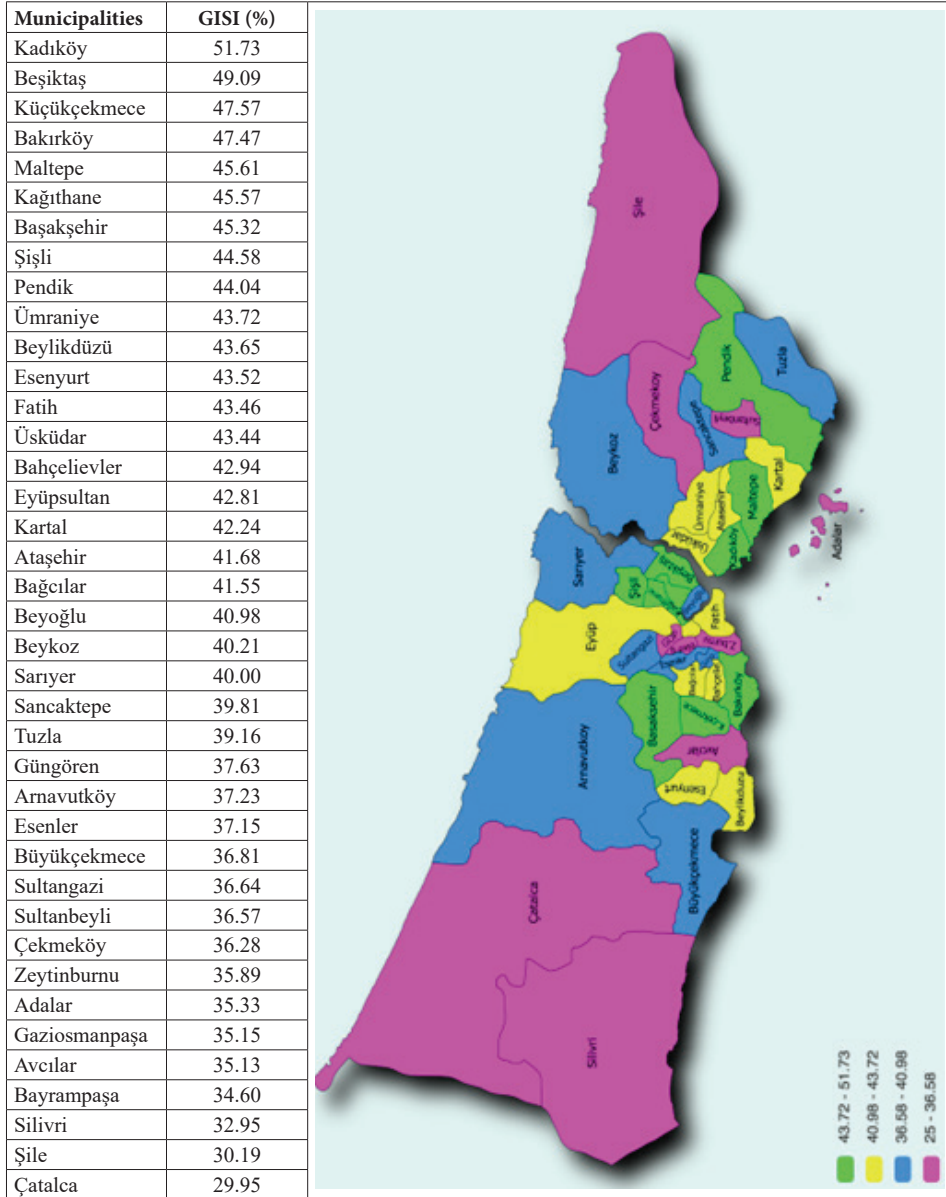


Figure 6. Map of general institutional sustainability index scores of 39 municipalities of Istanbul based on quartile range

When the social sustainability sub-index scores are examined, the district of Küçükçekmece is the most successful municipality for social institutional sustainability. Along with Küçükçekmece, the districts of Kadıköy, Kağıthane, Eyüpsultan, Başakşehir, Bakırköy, Ataşehir, Beylikdüzü, Beşiktaş, Bahçelievler, Maltepe, Esenyurt, and Ümraniye

are above the average for Istanbul (32.69%) in terms of social institutional sustainability (Table 6, Figure 7).

Table 6
Social Sub-Index Scores of 39 Municipalities of Istanbul

Municipalities	SSI (%)
Küçükçekmece	48.74
Kadıköy	48.48
Kâğıthane	45.52
Eyüpsultan	42.32
Başakşehir	41.39
Bakırköy	39.06
Ataşehir	37.14
Beylikdüzü	36.62
Beşiktaş	36.26
Bahçelievler	35.59
Maltepe	33.66
Esenyurt	33.52
Ümraniye	32.85
Pendik	32.22
Üsküdar	30.69
Sancaktepe	30.15
Kartal	30.12
Fatih	29.52
Tuzla	28.76
Bağcılar	28.58
Esenler	28.15
Sarıyer	27.47
Şişli	27.41
Zeytinburnu	27.07
Büyükçekmece	26.65
Bayrampaşa	26.52
Arnavutköy	25.74
Sultanbeyli	25.48
Sultangazi	25.19
Beykoz	24.39
Avcılar	23.86
Güngören	23.83
Gaziosmanpaşa	23.62
Çatalca	22.96
Beyoğlu	22.57
Çekmeköy	21.65
Silivri	19.44
Şile	17.25
Adalar	15.88

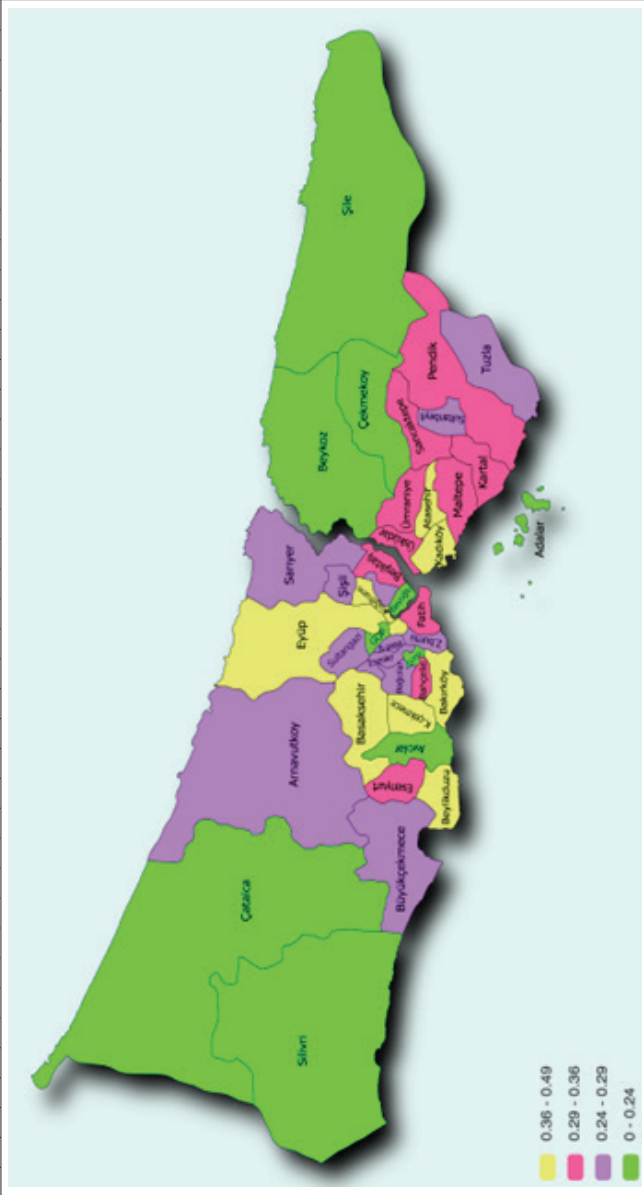


Figure 7. Map of social sub-index scores of 39 municipalities of Istanbul based on quartile ranges

When the economic sustainability sub-index scores are examined, the district of Başakşehir is the most successful municipality for economic institutional sustainability. Along with Başakşehir, the districts of Beşiktaş, Bakırköy, Beyoğlu, Beykoz, Kadıköy,

and Fatih are above the average for Istanbul (55.97%) in terms of economic institutional sustainability (Table 7, Figure 8).

Table 7
Economic Sub-Index Scores of 39 Municipalities of Istanbul

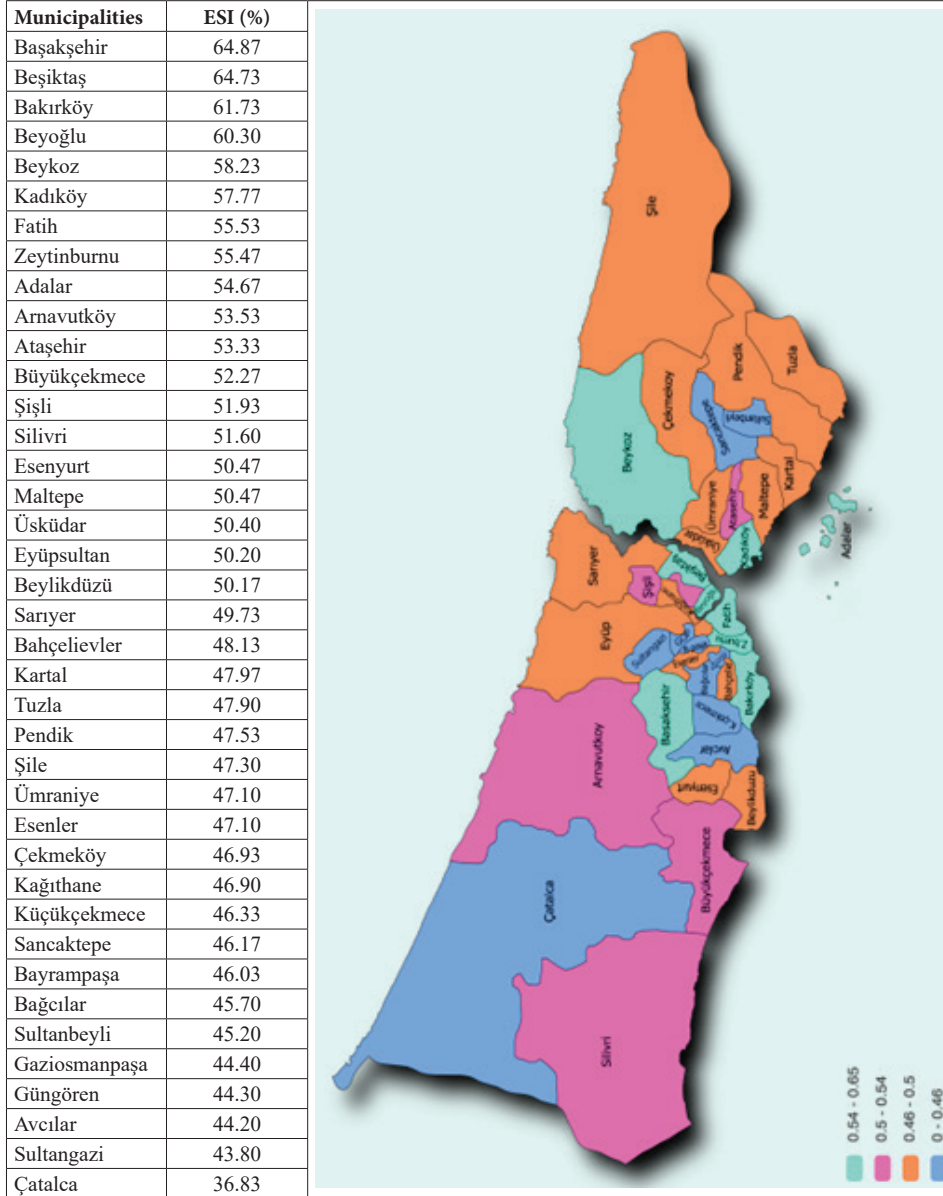


Figure 8. Map of economic sub-index scores of 39 municipalities of Istanbul based on quartile ranges

When the environmental sustainability sub-index scores are examined, the district of Beşiktaş is the most successful municipality for environmental institutional sustainability.

Along with Beşiktaş, the districts of Bakırköy, Şişli, Başakşehir, Adalar, Tuzla, Üsküdar, Sarıyer, Fatih, Beyoğlu, Kadıköy, Çekmeköy, Maltepe Beylikdüzü, Şile, Büyükçekmece, Bağcılar, Pendik, Ümraniye, Beykoz, and Kartal are above the average for Istanbul (33.47%) in terms of environmental institutional sustainability (Table 8, Figure 9).

Table 8
Environmental Sub-Index Scores of 39 Municipalities of Istanbul

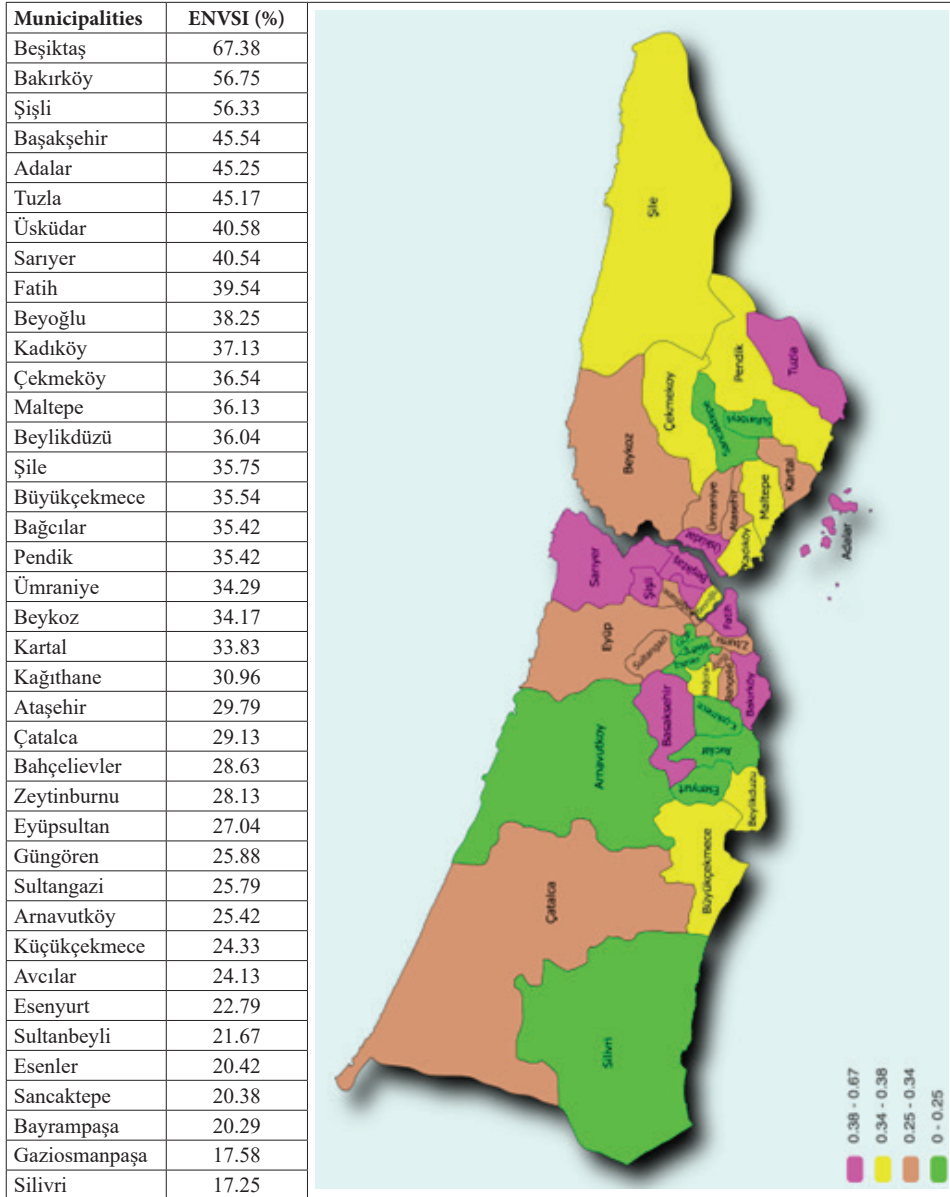


Figure 9. Map of environmental sub-index scores of 39 municipalities of Istanbul based on quartile ranges

Sustainability studies conducted in European municipalities (Bristol, Coventry, Padua, Reggio Emilia, Algarve, Galicia, Milanowek) highlighted the need for improvement in environmental and social issues. In the Shanghai study, however, economic sustainability stands out. In the current study, the average sustainability scores of Istanbul municipalities in the social (30.16%) and environmental (33.47%) dimensions were lower than the average scores in the economic (50.62%) dimension, highlighting the need for improvement in social and environmental issues. In this regard, our results are similar to those of the European municipalities.

Discussion

The results of our study showed that Istanbul municipalities achieved low scores on environmental and social dimensions. The fact that the economic activities of the municipalities are legally limited by the national government may explain the higher score on the economic dimension compared to the social and environmental dimensions. When our results are compared to the results of the sustainability studies conducted in European municipalities, concerns about environmental and social issues come to the forefront more than economic issues. This suggests that Istanbul, as a European municipality, deals with issues similar to other European municipalities.

Some of the known basic problems of Istanbul municipalities have been revealed with this study. The results obtained by the index used in the current study are in line with the actual problems of Istanbul municipalities. For example, our results showed that the weakest aspect of Istanbul municipalities in social dimension was urban transformation. Indeed, it is well acknowledged that there is a serious urban transformation problem in Istanbul (Korkut, 2004). Recently, some incentives and aids have been introduced by the national and local governments to solve the urban transformation problem. The other weakest aspect was the air quality in the environmental dimension. This is also a well-known issue, as Istanbul is the most populated and the most industrialized city in Turkey. The irregular migration and irregular industrial settlement adversely affect the air quality of Istanbul (Doğan, 2013). Similarly, the weakest aspect in the economic dimension was income, which is also not surprising, as municipalities are non-profit institutions in Turkey (Turkey Municipality Law: 5393).

The results are also consistent for the strongest aspects of Istanbul municipalities. In the social dimension is governance, waste management in the environmental dimension, and use of and debt in the economy dimension. Istanbul had a high score on the waste management sub-dimension, which is also evident in real-life applications. For example, Istanbul municipalities introduced an eco-friendly practice to solve the waste management problem by applying Smart Recycling Containers to encourage recycling (Tezel & Yıldız, 2020). The other strongest aspect was the debt in the economic dimension, which is also an expected result, as their debt is limited by the national government of Turkey (Turkey Municipality Law: 5393).

When Istanbul is assessed in terms of districts, the results indicate that municipalities should give more importance to institutional sustainability operations. The sustainability index values for all municipalities in Turkey can be calculated if cooperation and agreements are made with the municipalities. Decision-makers will be able to assess

the general institutional sustainability index result for their own municipalities, and to observe strong and weak aspects by virtue of the sub-indexes.

In this study, an institutional sustainability index of the local governments was calculated for the first time in Turkey. The study is distinctive in this sense. It is considered that periodic calculations of general and sub institutional sustainability indexes developed in this study by the municipalities will increase the reputation of the municipalities, and ensure the municipalities monitor their own development related to social, economic, and environmental issues. Also, municipalities will have the opportunity to compare themselves with their rivals. Thanks to these indexes, decision-makers will be able to assess the general institutional sustainability index for their own municipalities, and to observe strong and weak aspects by virtue of the sub-indexes.

Research Limitations

While creating the Variable Collection Form based on questions in international studies investigating the sustainability of municipalities based on Agenda 21, inquiries were made about the duties, authorities and responsibilities of the municipalities where our study was implemented. The remaining questions were prepared based on municipal law by which the duties, authorities and responsibilities of municipalities are determined. In the preparation of questions based on municipal law, the opinions of specialists (academics, engineers, and members of NGOs), who previously worked and conducted studies on this issue, were obtained. In the study, which intended to research the institutional sustainability of municipalities with 70 questions (variables) in total, data for 48 questions could be used for a variety of reasons (lack of recording of data, lack of accessing sufficient number of data and failure of variables in the analyses). In other words, the sustainability index values for 39 municipalities in Istanbul, used as a case in practice, were calculated depending on 48 variables. Last but not least, some sub-dimensions in our study may not be relevant for every municipality, as the duties of municipalities differ by country. The index might be needed to be revised so as to better encompass the specific issues of other municipalities.

Future Research

This study identified that Istanbul municipalities have weaknesses in the social and environmental dimensions. Future research could focus on social and environmental issues specifically, determine the reasons for the failings in these domains, and offer policy recommendations for amending these problems.

Today, there are widely accepted indexes for measuring the sustainability of countries. However, index studies for municipal sustainability have remained at a regional or local scale. One reason for this is that the duties and authorities of municipalities differ by country, which makes a global index for municipal sustainability difficult. Future research could find ways to tackle these differences and offer a global index that could allow for the comparison of municipalities from all around the world.

If cooperation and agreements are made with municipalities, the sustainability index values for municipalities may be calculated in future projects. The sustainability indexes that we developed may be used for calculating the sustainability indexes of local

administrations, not only in Turkey, but also in different countries. Thus, this study will not just ensure the calculation of local sustainability indexes, but it may also contribute to the calculation of sustainability indexes for municipalities in different countries.

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