Fiscaoeconomia

E-ISSN: 2564-7504

2023, Volume 7, Issue 1, 406-443

https://dergipark.org.tr/tr/pub/fsecon

Submitted/Geliş: 10.08.2022

Accepted/Kabul: 16.11.2022

Doi: 10.25295/fsecon.1160081

Research Article/Araştırma Makalesi

Environmental Performance: Evidence from Level-2 Regions[1]

Çevresel Performans: Düzey-2 Bölgelerinden Kanıtlar

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Abstract

The study's objectives are to assess the environmental performance of the NUTS-2 Region from 2009 to 2020 and to provide policy suggestions based on the results. Multi-Criteria Decision Making (MCDM) techniques were used in the assessment of environmental performance. The environmental performance criteria used in the assessment are the total electricity consumption per capita, agriculture, forestry, and fisheries, the number of water supply enterprises, the urban population, and the amount of wastewater treated by the municipalities. First of all, the weights of the indicators to be used in the evaluation of environmental performance were calculated with the Entropy method, which is one of the MCDM methods. Then, with the help of the ARAS method, the environmental performance ranking of the NUTS-2 Region was obtained. Within the scope of the findings, the environmental performance criterion with the highest weight by the Entropy method is electricity consumption per capita; the lowest is the amount of wastewater treated by the municipalities. With the ARAS method, it was observed that the region with the highest environmental performance was TR10 (Istanbul), while the lowest was TR63 (Hatay, Kahramanmaraş, Osmaniye).

Jel Codes: *C1, Q56, R11*

Keywords: *ARAS Method, Entropy Method, Environmental Performance Index, Level-2 Region, Multi-Criteria Decision Making Method*

Öz

Çalışmanın amacı, 2009-2020 dönemi için Düzey-2 Bölgesi'nde çevresel performansı ölçmek ve elde edilen bulgular doğrultusunda politika önerileri sunmaktır. Çevresel performansın değerlendirilmesinde, Çok Kriterli Karar Verme yöntemleri (ÇKKV) uygulanmıştır. Değerlendirmede kullanılan çevresel performans kriterleri ise kişi başına toplam elektrik tüketimi, tarım, ormancılık ve balıkçılık, su temini girişim sayıları, kentsel nüfus ve belediyeler tarafından arıtılan atıksu miktarı olmaktadır. Öncelikle ÇKKV yöntemlerinden olan Entropi yöntemi ile çevresel performansın değerlendirilmesinde kullanılacak göstergelerin ağırlıkları hesaplanmıştır. Ardından ARAS yöntemi yardımıyla da Düzey-2 Bölgesi'nin çevresel performans sıralaması elde edilmiştir. Bulgular kapsamında, Entropi yöntemiyle ağırlığı en yüksek çıkan çevresel performans kriteri, kişi başına elektrik tüketimi; en düşük ise belediyeler tarafından arıtılan atıksu miktarı olmaktadır. ARAS yöntemi ile de çevresel performansı en yüksek çıkan bölge TR10 (İstanbul) iken en düşük TR63 (Hatay, Kahramanmaraş, Osmaniye) olduğu gözlenmiştir.

Jel Kodları: *C1, Q56, R11*

Anahtar Kelimeler: *ARAS Yöntemi, Düzey-2 Bölgesi, Entropi Yöntemi, Çevresel Performans Endeksi, ÇKKV*

[1] This study has been derived from the work presented as an abstract in Aksaray University International Cappadocia Social Sciences Students Congress.

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Citation/Atıf: Örtlek, Z., Demirtaş, C. & Ilıkkan Özgür, M. (2023). Environmental Performance: Evidence from Level-2 Regions. *Fiscaoeconomia, 7*(1), 406-443. Doi: 10.25295/fsecon.1160081

1. Introduction

Even though an ecological change in the world is believed to have emerged approximately 4 billion years ago, it is thought that the start of human beings to increase their activities and have a non-negligible impact on the ecological order dates back to 4 million years. By the 20th century, this effect has started to threaten the environment (McNeill, 2005: 17). For instance, the global CO_2 emissions have risen from 29.2 million kilotons in 2009 to 34.1 million kilotons in 2019. Similar to this trend, Turkey has experienced an increase of the aforementioned factor from 287.9 to 396.9 thousand kilotons between the years spanned (www.climatewatchdata.org). As a result, certain issues such as rising air pollution, water pollution and climate change whose adverse effects have exponentially intensified have appeared.

The global community has started to call attention to international environmental regulations and agreements which encapsulate numerous topics such as air climate change, air pollution and the protection of ozone layer and oceans, that address these aforementioned problems (Sonnenfeld & Mol, 2002: 1323). It can be stated that a major root cause to this is the reduction of healthy and habitable environments stemming from a significant depletion and downgrading of soil, water and air especially in areas with high population density (Ulucak & Erdem, 2012).

This exponential surge in environmental troubles that threaten the livelihoods of humans and other living beings have led to the construction and development of potential respective solutions. Within this context, international organizations are undertaking numerous activities for the widespread awareness regarding global and local environmental sustainability (Kaypak, 2011: 26; Küçük & Güneş, 2013: 298). Formal reports devised by these academic platforms and global organizations are reckoned by countries on a growing speed, proving efficient and effective in setting down country-wide agendas aimed at mitigating or eliminating environmental problems (Bek, 2019:37). Therefore, it can be posited that assessment of policy responses vis-a-vis environmental pressures and monitoring of ecological conditions can ensure the effectiveness of environment management. Being aware of this need and the lack of sufficient quantitative evaluations of environmental performance, an Environmental Performance Index was developed by Yale University and Columbia University, in cooperation with the World Economic Forum (Hsu & Zomer, 2014: 1). This Index has been published since 2006, and is constructed with 24 topics and 10 categories, namely air pollution, energy, climate, sanitation and drinking water, forests, air quality, heavy metals, fisheries, agriculture, biodiversity and water resources (EPI, 2018). It can be stated that the development of this index has also acted as a pioneer for similar work in the area.

Founding upon the aforementioned mechanism, Tyteca (1996) has formulated an Environmental Performance Index by simultaneously taking into account resources utilized, beneficial and unfavorable outputs and used Data Envelopment Analysis (DEA) to assess performance. Al-Tuwaijri et al. (2004) provide an integrated analysis of the relationship between the three corporate functions: environmental disclosure, environmental performance and economic performance, concluding a significant connection between high environmental performance and high economic performance. In another evaluation, Diaz-

Balteiro & Romero (2004) apply the MCDM methods to formulate the environmental performance index and propose a technique based on goal programming to identify the sustainability for each forestry system studied. Öztel et al. (2018) analyze Akenerji, an energy firm operating in Turkey, to assess the corporate sustainability performance, through the Entropy-based TOPSIS method. As a result, it is deduced that during periods with peak economic performance, social and environmental success is low. Akçakaya & Urmak Akçakaya (2019) use the environmental performance indicators in 23 metropolitan municipalities by first calculating the relative weights of the criteria via the Entropy method, and then obtaining the performance rankings through ARAS and COPRAS techniques. Bek (2019) compares the environmental performance of Turkey and Switzerland by using qualitative research methods, concludes the former to be lagging behind in numerous criteria constituting the environmental indices and identifies the potential root causes. Karaaslan & Aydın (2020), through Analytical Hierarchy Process (AHP), weigh five alternative energy resources in order to determine the most optimal option for Turkey. By ranking renewable energy sources through COPRAS and MULTIMOORA techniques, the authors decide that hydroelectric, solar, wind, geothermal and biomass energy to be the most optimal sources for Turkey, respectively.

Upon review, it is seen that the existing literature mostly focuses on countries, corporates and municipalities, whereas assessments with a regional scope remain limited. It is only the countries and regions that can tackle these rising environmental problems can increase their global competitiveness, and to develop necessary solutions, the assessment of regional performance proves to be as significant as the evaluation of country-based capabilities. Therefore it is believed that the calculation of environmental performance of Turkey's Level-2 Regions is of crucial importance. Within this framework, the objective of this study is to determine the degrees of significance of environmental performance indicators and assess the environmental performances of Level-2 regions between the years 2009 and 2020. In light of this information, it is believed that this study is a first in assessing environmental performance in Level-2 regions in Turkey, in addition to enabling the comparison of 26 districts within the region mentioned. It is expected that this evaluation will contribute to the existing work by assessing the environmental performance of Turkey's Level-2 regions.

This study comprises five sections. In the following part, the literature reviewed is summarized. The method utilized and the findings are presented in the third and fourth sections respectively, and last, the study is concluded.

2. Literature Review

The acceleration of industrialization from the 18th century onwards has led to an escalation of environmental pollution, increasing greenhouse gas emissions, ecological deterioration and the fast depletion of natural resources. By the 21st century, rising environmental issues have become one of the most vital outcomes of globalization. Within this context, the assessment of environmental performance proves significant in the pursuit of a cleaner and more sustainable future.

The literature has examined environmental performance from various perspectives. Accordingly, in theoretical studies, Tyteca (1996) created an Environmental Performance

Index by simultaneously taking into account the resources used, good outputs produced and undesirable outputs, and used Data Envelopment Analysis (DEA) to evaluate environmental performance. Using DEA techniques, it measures the degree to which a firm or country manages to produce good outputs while also taking into account reductions in bad outputs. Diaz-Balteiro & Romero (2004) applied MCDM methods by normalizing the different levels of indicators available for the forestry system to create the environmental performance index. As a result, it proposes a method based on goal programming to determine the overall sustainability associated with each forestry system. Al-Tuwaijri et al. (2004) provides an integrated analysis of how management's overall strategy jointly influences environmental disclosure, environmental and economic performance. After internalizing organizational functions in their simultaneous equation models, they found that "good" environmental performance was significantly correlated with "good" economic performance. In studies where environmental performance is examined on a company basis; Campos et al. (2015) describe the results of a survey that identifies a set of environmental performance indicators to improve the environmental and performance management of ISO 14001 certified companies in the Southern region of Brazil. Environmental performance management of the industrial pulp, paper/furniture/wood and textile sectors was monitored using environmental performance indicators of several companies. They concluded that there is a great concern for companies to meet legal requirements as well as protect their environmental resources. Balezentis et al. (2016) aimed to analyze the Environmental Performance Index of sectors in Lithuania and the main trend in greenhouse gas emissions using DEA method. In the study, it was determined that the paper, pulp and agriculture sectors were the sectors with the best performance. Oztel et al. (2018), Akenerji company, which operates in the energy sector in Turkey, was chosen as the application data in order to evaluate its corporate sustainability performance. Entropy-based TOPSIS method was used for analysis. The corporate sustainability performance of the examined company; Compared with their environmental, social and economic dimensions over the years. As a result of the analysis, it was concluded that in the years when the economic success was high, the social and environmental success was low.

In studies where environmental performance is examined on a provincial or regional basis; Akçakaya & Urmak Akçakaya (2019) used environmental performance indicators in 23 metropolitan municipalities. While making the evaluation, first of all, the weights of the criteria were calculated with the Entropy method. Then, environmental performance rankings were obtained by applying ARAS and COPRAS methods.

In studies where environmental performance is examined in the context of a single country; Savaş (2012), the environmental performance index, the aims of the index, the structural policy and categories, indicators and scores, as well as the relationship between consumer society and the environment were examined. After analyzing Turkey's environmental performance, the comparative situation of Turkey with the countries that are divided into five categories according to the 2012 performance evaluation and placed at the beginning of each category is explained. Finally, some evaluations were made within the framework of consumer society, environment, environmental performance index and Turkey. Hsu et al. (2013) measure the quantitative indicators and index of environmental performance. The latest performance trends from the 2012 Environmental Performance Index (EPI) and Trend EPI are used. 2012 EPI and Trend EPI index indicators are energy, water, forestry, fisheries, biodiversity, habitat and climate change. They concluded that the progress in environmental targets is not evenly distributed by country, region and subject. Karaaslan & Aydın (2020) weighed 5 alternative energy sources with the AHP method to determine the most suitable renewable energy source option for Turkey. Renewable energy alternatives are listed with COPRAS and MULTIMOORA methods. In both methods used, it was concluded that hydroelectric, solar, wind, geothermal and biomass are the most suitable renewable energy sources, respectively.

Finally, environmental performance in studies involving more than one country; Çobanoğlu et al. (2012) examined the eco-efficiency and environmental performance development of 30 countries, including Switzerland, Turkey and Norway, along with 27 member states of the European Union. In the study, the Environmental Performance Index was measured using the Malmquist index method and the equivocal weight gain approach. Compared to other EU countries, it has been determined that in some developing countries such as Turkey, Poland, Bulgaria and Romania, the environmental waste released into the atmosphere is relatively higher. Sözen et al. (2016) analyzed Turkey's environmental impact performance comparatively with BRICS and OECD countries. For this purpose, Malmquist index and DEA methods were used between 2009 and 2013. According to the results of the analysis, the most efficient country is Luxembourg, and the total factor productivity developments of 27 countries, including Turkey, were limited. Topal & Hayaloğlu (2017) investigated the effect of institutional quality on environmental performance by considering the economic development levels of countries. In the study, the relationship between environmental performance and institutional quality indicators of 124 countries in the period of 2000-2014 was examined by panel data analysis methods. Environmental indicators were compared within the scope of policies regarding environmental health (the effects of air, environmental health and water pollution on human health) and the continuity of the ecosystem (water resources, agriculture, forest, fisheries, air pollution, biodiversity and habitat, energy and climate change). As a result of the findings, democracy within the institutional indicators in developing economies; In developed economies, on the other hand, political risk plays a more active role on environmental performance. Akandere & Hakses (2018), In the context of the relationship between economic and logistics performance and environmental performance, the effect and relationship between the countries ranked in the twenty-eighth in the Logistics Performance Index (LPI) in 2016 and the Turkey Logistics Performance Index (LPI) and Environmental Performance Index (EPI) scores are quantitative. methods were analyzed. The indicators used in the Environmental Performance Index are biodiversity and habitat, agriculture, forests, fisheries, health effects, air quality, water and sanitation, water resources, climate and energy. It has been emphasized that the negative effects that may harm the environment and society such as industrial pollution and emissions caused by high technology that emerged with the economic, logistics and commercial activities of the countries can be prevented with the concept of green logistics. As a result, the model used has shown that it has significant variability according to countries and time. Karaman (2018) aims to reveal the environmental performance level of Turkey by making a comparison with the EU. In this context, Environmental Performance Index, which is one of the most inclusive variables related to the environment, was used. As of 2016, Turkey's Environmental Performance Index is 67.68 points and is ranked 99th worldwide (out of 180 countries). Ayçin & Çakın (2019) evaluated the environmental performance of countries by using Entropy, Multi-Objective Optimization Based on Proportional Analysis (MOORA) and Gray Relational Analysis (GRA) methods, which are among the multi-criteria decision making (MCDM) methods. According to the results of the analysis, the best performing countries were Austria, Denmark and France, while the most important criteria were forest, agriculture and water resources. Bek (2019) made a comparison of the two countries by examining the environmental performance of Turkey and Switzerland. Qualitative research methods were used in the study. It was ranked 108th with 52.96 points in the Environmental Performance Index of Turkey. As a result, it has been observed that Turkey lags behind developed countries in many criteria that make up its environmental indicators, and the deficiencies that cause it to be in the lower ranks in terms of environment have been tried to be determined. Yiğit (2020) examined the role of globalization in the impact of countries on their environmental performance. It has benefited from the Environmental Performance Index in order to measure the environmental performance of countries in a multi-dimensional way. While the effect of economic globalization on environmental performance is not significant; It is concluded that the political and social indicators of globalization have a positive effect on environmental performance. Using the Environmental Performance Index, Uca & Yüncü (2020) tested the competitiveness of the Mediterranean countries in terms of sustainability and ecological performance with a multidimensional scaling analysis. In this context, it has been determined that Turkey's environmental competitiveness remains weak compared to the Mediterranean Bowl Countries, ranking 99th among 180 countries in the 2020 Environmental Performance Index. Altıntaş (2021) measures the environmental performance of G7 countries for 2018 with TOPSIS and CODAS MCDM. It is concluded that there is a positive, significant and very high correlation between the Environmental Performance Index values of the countries and the values measured by TOPSIS and CODAS methods. Akandere (2021) measured the Environmental Performance Index (EPI) and Logistics Performance Index (LPI) of countries with seaway connections. In terms of EPI, Performance ratings were made on the sub-criteria of climate, energy, agriculture, water and sanitation, forests, fisheries, air quality, biodiversity and habitat, and water resources. With the entropy method, he concluded that the highest scoring criteria are air quality, water and sanitation, and water resources. However, countries; They have increased their environmental performance by reducing their negative environmental impacts with their investments in wastewater treatment plant infrastructures, sustainability initiatives and measures they have taken to reduce carbon emission formations. Adapting the fertilization activities used by the countries in their agricultural activities to the nitrogen needs also contributes to the development of their environmental performance. Akandere & Zerenler (2022) examined the relationship between environmental performance and economic performance using multi-criteria decision making (MCDM) techniques. They concluded that the environmental performances of the countries affect their economic performances significantly and positively. For performance measurement, ecosystem vitality, environmental health, climate change, water resources, agriculture, acid rain, fisheries, ecosystem services, bio and habitat, waste management, heavy metals, sanitation and drinking water resources, air quality, climate change mitigation, property and Environmental and economic criteria such as service exports, agriculture, forestry and fisheries, manufacturing, gross capital formation, GDP growth were used. Within the scope of the findings, the lowest value criterion determining the environmental performance according to the countries; agriculture first, fisheries second, waste management third and air quality fourth; It has been determined that the most important component is water resources. Alkaya (2022) measures the relative efficiency of OECD countries according to their environmental performance with the DEA method. According to the findings, Luxembourg, Lithuania, Latvia, Colombia, Denmark, Iceland, Sweden and Finland are active countries; other OECD countries were determined as inactive countries. Korea and Turkey were the two countries with the lowest efficiency in terms of environmental performance.

Upon a general evaluation of the literature reviewed, for studies tackling environmental performance from a country-based or a regional perspective, Al-Tuwajiri (2004) uses a theoretical; Diaz-Balteiro & Romero (2004), Öztel et al. (2018), Ayçin & Çakın (2019), Akçakaya & Urmak Akçakaya (2019), Karaaslan & Aydın (2020), Akandere (2021), Altıntaş (2021) and Akandere & Zerenler (2022) use MDCM; Savaş (2012), Hsu et al. (2013), Karaman (2018), Bek (2019), Yiğit (2020), Al-Tuwaijri et al. (2004) and Uca & Yüncü (2020) compare Environmental Performance Index values; Tyteca (1996), Çobanoğlu et al. (2012), Balezentis et al. (2016), Sözen et al. (2016) and Alkaya (2022) use DEA whereas Akandere & Hakses (2018) quantitative method; Campos et al. (2015) survey; Topal & Hayaloğlu (2017) utilize panel data analysis techniques. Generally, the findings of those listed stress the need for a heightened emphasis to be given to the Environmental Performance Index upon the development of national and global policies. Moreover, it is also identified that assessments focusing on the environmental performances of regions, within Turkey, are limited. Therefore, it is believed that this evaluation, by concentrating on Level-2 regions in Turkey, will contribute to the existing literature.

3. Data and Method

3.1. Data

It is observed that energy efficiency, greenhouse gas emissions, particulate matter, recycling, biodiversity, renewable energy, amount of waste disposal, amount of hazardous waste, electricity consumption, agriculture, forestry and fishery, water supply and the number of initiatives in mining and quarrying are the most frequently used variables in the literature, for the measurement of environmental performance. However, due to limited or no access to these data on a regional basis, only electricity consumption, agriculture, forestry and fisheries, the number of water supply enterprises, the urban population and the amount of wastewater treated by municipalities were used to measure environmental performance. The effects of these indicators on environmental performance in the literature; negative of the urban population with total electricity consumption per capita; It is expected that the number of enterprises in agriculture, forestry and fisheries, water supply, sewerage, waste management and remediation activities and the amount of wastewater treated by municipalities will have a positive impact. Entropy-ARAS methods, one of the MCDM methods, were used to measure the effects of the above-mentioned indicators on environmental performance. There are many MCDM methods in the literature. These methods include methods based on qualitative measurements (Fuzzy set theory methods, AHP), methods based on quantitative measurements (COPRAS, COPRAS-G, ARAS, TOPSIS, LINMAP, SAW), linguistic decision-making methods involving high uncertainty and using qualitative information. methods (such as linear programming) and preference methods based on pairwise comparison of alternatives (ORESTE, TACTIC, AKUTA, PROMETHEE, ELEKTRE, MUSA, UTA) (Zavadskas et al., 2010). The entropy method allows experts to calculate the importance weights of the criteria without resorting to their personal opinions and judgments. For this reason, it is accepted as one of the multi-criteria decision-making methods that act with reliable and objective judgments. The ARAS method, on the other hand, tries to determine the ideal performance among the alternatives and clarifies the proportional similarity of each alternative to the ideal alternative (Dadelo et al. 2012; Ecer 2016). Therefore, we can say that the ARAS method is the most suitable method for the proportional rating target compared to other MCDM methods. These methods have been preferred in order to measure the environmental performances of 26 regions within the NUTS-2 Regions due to their superior characteristics compared to their alternatives.

In the study, following the literature, in the TUIK's Regional Statistics database, in the form of main and subheadings; total electricity consumption per capita (kwh/year), agriculture, forestry and fisheries (number of enterprises/annual), water supply (number of enterprises/yearly), urban population (population of province and district centers) and amount of wastewater treated by municipalities (1000 cubic meters /year) five environmental performance criteria were used.

Table 1: Environmental Performance Criteria

Measurement	Criteria	Aspects	Source
Environmental Performance	Total electricity consumption per capita (kwh/ annual)	Negative	TUIK
Environmental Performance	Agriculture, forestry and fishery (number of initiatives/ annual)	Positive	TUIK
Environmental Performance	Water supply; sewage, waste management and remediation activities (number of initiatives/ annual)	Positive	TUIK
Environmental Performance	Urban Population: Population of provincial and district centers according to Address Based Population Registration System	Negative	TUIK
Environmental Performance	Amount of wastewater treated by municipalities (1000 cubic meters/year)	Positive	TUIK

Environmental performance criteria pertaining to the data mentioned are presented in Table 1. Variables listed are then analyzed via Entropy-based ARAS method, a MCDM technique, by using the environmental performance indicators of Level-2 Regions.

3.2. Method

3.2.1.Entropy Method

Entropy, a weight identification method, is one of the techniques developed with the pursuit of monitoring more realistic weights by jointly taking into account objective data and subjective information (Zhang et al., 2011; Çınar, 2004). This method allows one to explain the uncertainty in information via the probability theory and eliminates the measurement complications pertaining to other weight-deduction techniques (Zhang et al., 2011).

The following process is undertaken for the calculation of weights via the Entropy method (Hwang & Yoon, 1981; Çınar, 2004; Shemshadi vd., 2011, Savaş & Baykal, 2011):

Step 1: Construction of the Decision Matrix

In the first stage, a normalized matrix in which the rows and columns represent decision options and the number of evaluation criteria respectively is obtained. Decision matrix, symbolized by X is presented in Equation (1).

$$X=(x_{ij})\mathrm{m}*\mathrm{n}\begin{bmatrix} x11 & \dots & \dots & x1n \\ x21 & \dots & \dots & x2n \\ . & . & . & . \\ . & . & . & . \\ xm1 & \dots & \dots & xmn \end{bmatrix} \quad (1)$$

In this study, rows show the aforementioned environmental performance indicators and the columns depict the cities, the latter of which contains 26 districts. These districts are listed in Table 2[5].

Step 2: Obtaining the Normalized Matrix

In the normalized matrix, the pij values are j. according to the evaluation criteria i. shows the normalized value of the alternative.

$$p_{ij} \quad {x_{ij}}/{\sum_{j=1}^{m} xij} \; \forall \, i,j \quad (2)$$

Step 3: Entropy Values of Criteria

In the next stage, entropy values of criteria are calculated via the following formula:

$$ej = -k \sum_{j=1}^{m} r_{ij} * ln\,(r_{ij}) \quad (3)$$

i= 1, 2, 3, …,m

j= 1, 2, 3, …,n

k is a fixed coefficient and is equal to 1/ln (m). In this case, the number of decision alternatives is 26.

[5] Table 2 is shown in Appendix 1.

Step 4: Degree of Difference

The degree of difference for each criteria is calculated in the fourth step via the following equation:

$$d_j = 1 - e_j \tag{4}$$

Then, the degree of deviation of the endogenous average information each factor contains, "dj", is calculated. This value explains the difference between the values all other alternatives take vis-a-vis a benchmark, therefore, the more performance values are within proximity, the benchmark is considered insignificant and of a lesser-weight, pro tanto.

Step 5: Importance Weights

Last, the importance weights of criteria are established by the following formula:

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \tag{5}$$

3.2.2. ARAS Method

One of the MCDM methods used to determine the best performance among the alternatives is the ARAS method. The ARAS method was first shaped and implemented by Zavadskas & Turskis in 2010 (Zavadskas & Turskis, 2010; Zavadskas et al., 2010). Therefore, we can say that the ARAS method is the most suitable method for the proportional rating target compared to other MCDM methods. The steps to be followed in this method are (Dadelo et al., 2012):

Step 1: Formulation of the decision matrix

First a decision matrix consisting of m rows (alternatives) and n columns (criteria) is constructed.

$$X=\begin{bmatrix} x_{01} & x_{02} & \dots & x_{0n} \\ x_{11} & x_{12} & \dots & x_{1n} \\ . & . & . & . \\ . & . & . & . \\ xm1 & x_{m2} & \dots & xmn \end{bmatrix} \tag{1}$$

Step 2: Normalization

In this stage, the goal is to standardize criteria, which can be in various dimensions and scales, by applying normalization, in which all criteria range between 0 and 1.

For the environmental performance criteria aimed to be maximized, Equation (2) is applied for normalization.

$$\bar{X}_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \tag{2}$$

For the environmental performance criteria aimed to be minimized, Equation (3) is applied for normalization.

$$\bar{X}_{ij} = \frac{1/x_{ij}}{\sum_{i=0}^{m} 1/x_{ij}} \tag{3}$$

Step 3: Weighted normalized decision matrix

Then, the weighted normalized decision matrix is formulated in which the weights range between 0 and 1 ($0 < w_j < 1$) and their overall value amounts to 1. Normalized weights are established in Equation (4), where $\underline{X}_{ij}$ represents the normalized version of the j criteria and w_j depicts the level of importance (weight) of the said criteria.

$X_{ij}=\bar{X}_{ij}*w_{ij}$; i=0,1,…, m (4)

Step 4: Optimality function

$S_{iJ}=\sum_{j=1}^{n} X_{ij}$ (5)

In Equation (5), the optimality function of the i alternative, S_i is obtained. Alternative with a higher value of S_i can be thought of as the most effective option.

Step 5: Calculation of the degree of utility and ranking

The degree of utility is acquired via the comparison of the optimality function value of an alternative with the best alternative. S_0 depicts the best optimality function and is calculated through Equation (6).

$K_i=\frac{S_i}{S_0}$; i=0,1,…,m (6)

4. Findings

The value of the criteria obtained after the application of Entropy and ARAS methods to the weights and ranks of environmental performance are presented in the following tables. The respective values (electricity consumption per capita, agriculture, forestry and, fishery, water supply, the amount of wastewater treated by the urban population and municipalities) pertaining to the 26 districts in the Level-2 Region presented in Table 3[6], are gathered from the official website of Turkish Statistical Institute (www.tuik.gov.tr) and an X matrix is formulated via the normalization of the decision matrix constructed in line with these values.

In Table 4, the Entropy value "ej" is calculated, following the computation of the fixed "k" value. Because the assessment of environmental performance of Level-2 region is undertaken for 26 districts, the value of k is found to be 0,306927676, in line with the equation 1/LN (26 cities). The entropy values computed via the calculated k value are listed in Table 4.

[6] Table 3. Normalized matrix is presented in Appendix 2.

Tablo 4: Entropy Values of Criteria (e_j)

Years	Total electricity consumption per person (KWh)	Agriculture, forestry and fishing (number of ventures/year)	Water supply (number of ventures/year)	Urban Population	Amount of wastewater treated by municipalities (1000 cubic meters/year)
2009	2,431	2,194	1,933	2,356	1,254
2010	2,485	2,160	1,852	2,352	1,290
2011	2,498	2,123	1,875	2,353	1,253
2012	2,524	2,090	1,817	2,349	1,218
2013	2,423	2,063	1,796	2,249	1,241
2014	2,432	1,974	1,840	2,253	1,260
2015	2,436	2,183	1,874	2,258	1,340
2016	2,468	2,206	1,918	2,260	1,405
2017	2,481	2,157	1,950	2,254	1,385
2018	2,523	2,201	1,954	2,252	1,362
2019	2,551	2,221	1,982	2,252	1,409
2020	2,570	2,222	1,974	2,248	1,451

The degrees of difference, “dj” between the years 2009 and 2020 for Level-2 Region is presented in Table 5, in which the environmental performance value that has the closest proximity is exhibited to be urban population and total electricity consumption per capita.

Table 5: Degrees of Difference (d_j)

Years	Total electricity consumption per person (KWh)	Agriculture, forestry and fishing (number of ventures/year)	Water supply (number of ventures/year)	Urban Population	Amount of wastewater treated by municipalities (1000 cubic meters/year)
2009	-1,431	-1,194	-0,933	-1,356	-0,254
2010	-1,485	-1,160	-0,852	-1,352	-0,290
2011	-1,498	-1,123	-0,875	-1,353	-0,253
2012	-1,524	-1,090	-0,817	-1,349	-0,218
2013	-1,423	-1,063	-0,796	-1,249	-0,241
2014	-1,432	-0,974	-0,840	-1,253	-0,260
2015	-1,436	-1,183	-0,874	-1,258	-0,340
2016	-1,468	-1,206	-0,918	-1,260	-0,405
2017	-1,481	-1,157	-0,950	-1,254	-0,385
2018	-1,523	-1,201	-0,954	-1,252	-0,362
2019	-1,551	-1,221	-0,982	-1,252	-0,409
2020	-1,570	-1,222	-0,974	-1,248	-0,451

The relative weights of the environmental performance values computed by the Entropy method are given in Table 6. The high changes in the criteria values were realized in 2012 in electricity consumption per capita, agriculture forestry and fisheries in 2015, water supply in 2017, urban population in 2012 and the amount of wastewater treated by municipalities in 2020. The environmental indicator with the highest weight in the table is agriculture, forestry and fisheries and water supply after electricity consumption per capita.

Table 6: Degrees of Significance (w_j)

Years	Total electricity consumption per person (KWh)	Agriculture, forestry and fishing (number of ventures/year)	Water supply (number of ventures/year)	Urban Population	Amount of wastewater treated by municipalities (1000 cubic meters/year)
2009	0,276	0,230	0,180	0,262	0,049
2010	0,288	0,225	0,165	0,263	0,056
2011	0,293	0,220	0,171	0,265	0,049
2012	0,304	0,218	0,163	0,269	0,043
2013	0,298	0,222	0,166	0,261	0,050
2014	0,300	0,204	0,176	0,263	0,054
2015	0,281	0,232	0,171	0,247	0,066
2016	0,279	0,229	0,174	0,239	0,077
2017	0,283	0,221	0,181	0,239	0,073
2018	0,287	0,226	0,180	0,236	0,068
2019	0,286	0,225	0,181	0,231	0,075
2020	0,287	0,223	0,178	0,228	0,082

Table 7[7] shows the normalized values of the environmental performance values via the ARAS method, for the Level-2 Region between 2009 and 2020.

The environmental performance rankings acquired via the ARAS method for the Level-2 districts are presented in Table 8. First of all, it is seen that the TR10 Region ranks first in environmental performance rankings in all years. Afterwards, it is seen that TRA2 (Ağrı, Kars, Iğdır and Ardahan) Region (except 2020) ranked second in environmental performance ranking between 2009-2020. TR63 (Hatay, Kahramanmaraş, Osmaniye) Region, on the other hand, ranks 26th (except for 2009) and has the lowest environmental performance ranking.

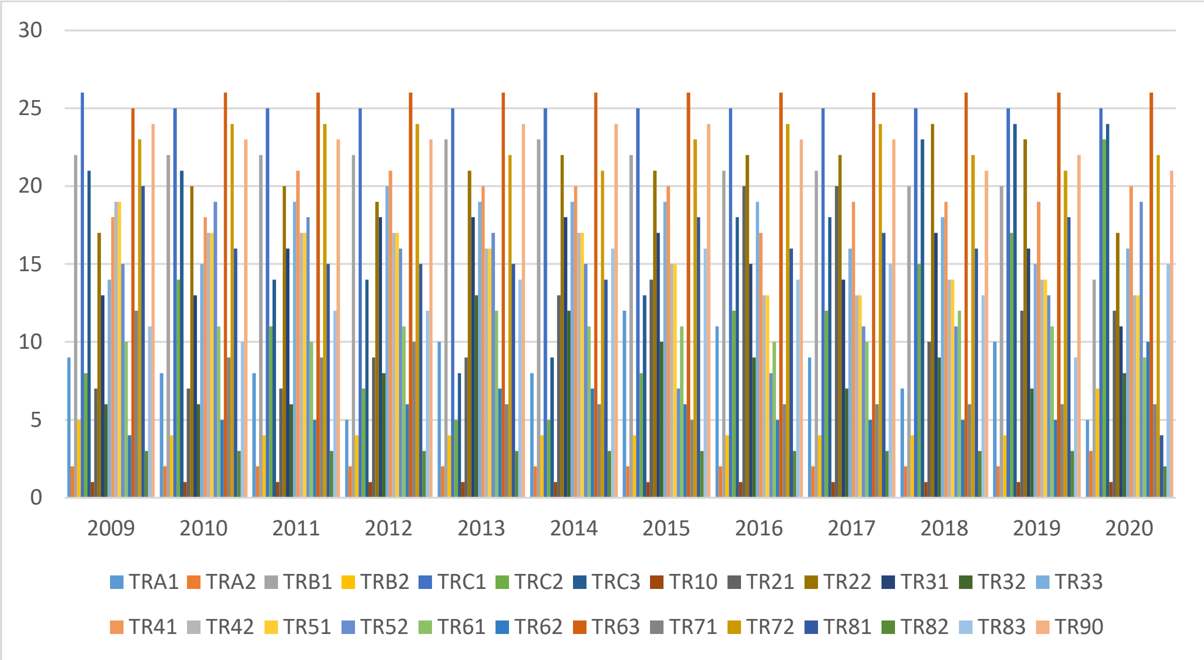
[7] Table 7. Normalized Matrix is presented in Appendix 3.

Table 8: Environmental Performance Ranking

Regions	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
TRA1	9	8	8	5	10	8	12	11	9	7	10	5
TRA2	2	2	2	2	2	2	2	2	2	2	2	3
TRB1	22	22	22	22	23	23	22	21	21	20	20	14
TRB2	5	4	4	4	4	4	4	4	4	4	4	7
TRC1	26	25	25	25	25	25	25	25	25	25	25	25
TRC2	8	14	11	7	5	5	8	12	12	15	17	23
TRC3	21	21	14	14	8	9	13	18	18	23	24	24
TR10	1	1	1	1	1	1	1	1	1	1	1	1
TR21	7	7	7	9	9	13	14	20	20	10	12	12
TR22	17	20	20	19	21	22	21	22	22	24	23	17
TR31	13	13	16	18	18	18	17	15	14	17	16	11
TR32	6	6	6	8	13	12	10	9	7	9	7	8
TR33	14	15	19	20	19	19	19	19	16	18	15	16
TR41	18	18	21	21	20	20	20	17	19	19	19	20
TR42	19	17	17	17	16	17	15	13	13	14	14	13
TR51	16	12	13	13	11	10	9	7	8	8	8	18
TR52	15	19	18	16	17	15	7	8	11	11	13	19
TR61	10	11	10	11	12	11	11	10	10	12	11	9
TR62	4	5	5	6	7	7	6	5	5	5	5	10
TR63	25	26	26	26	26	26	26	26	26	26	26	26
TR71	12	9	9	10	6	6	5	6	6	6	6	6
TR72	23	24	24	24	22	21	23	24	24	22	21	22
TR81	20	16	15	15	15	14	18	16	17	16	18	4
TR82	3	3	3	3	3	3	3	3	3	3	3	2
TR83	11	10	12	12	14	16	16	14	15	13	9	15
TR90	24	23	23	23	24	24	24	23	23	21	22	21

The variation of environmental performance ranking through years is presented in Graph 1.

Graph 1: Environmental Performance Indicators



As depicted in Graph 1, while TR10 ranks best among the Level-2 Region, TR63 is placed last. The reasons for the high environmental performance of the TR10 Region are policies such as prevention of noise pollution, improvement of waste management and water services, protection and improvement of air quality, protection of water resources and basins are among the main priorities of the region. In addition, the practices and regulations required by various international conventions and agreements on the environment provide an opportunity to improve the environmental situation in the region. Eastern Mediterranean Development Agency's TR63 Regional Plan (2015) and Eastern Mediterranean Development Agency's TR63 Region Current Situation Analysis report explains the reasons why the TR63 Region's environmental performance is in the last place as follows; In a study conducted by the World Resources Institute (WRI) on the inadequacy of water resources in Turkey, it was stated that the districts of Reyhanlı, Altınözü, Kırıkhan, Hassa, Kumlu, and central districts of Hatay and Osmaniye, located in the TR63 Region, are in the high risk group in terms of water scarcity. The districts of Dörtyol, İskenderun, Erzin, which are located on the coastline of Hatay province; Göksun, Afşin, Elbistan districts of Kahramanmaraş province; On the other hand, all districts of Osmaniye are in the middle risk group in terms of water scarcity. Another reason is that Elbistan Thermal Power Plant, located in Kahramanmaraş province, is among the serious polluting sources of the region. Wastewater from the facility is used for irrigation of agricultural lands around the power plant without being treated appropriately. In addition, the use of animal wastes from animal breeding as natural fertilizers and the mixing of these wastes into rivers are also a factor that threatens the environment. Domestic heating, traffic, industry, meteorological and topographic factors of this region affect the formation of air pollution. Urban infrastructure, which is generally handled with the approach of drinking and utility water, sewage, solid waste management and transportation, is also one of the priority intervention areas in the TR63 Region. However, per capita industrial electricity consumption is increasing in all provinces in the TR63 Region, and the reason for the high increases in total electricity consumption in Osmaniye is due to the growth in the industrial sector. In terms of urban population, all three provinces of the TR63 Region are below the average of Turkey. These negative factors stated in the TR63 Regional Plan (2015) of the Eastern Mediterranean Development Agency and the Current Situation Analysis of the Eastern Mediterranean Development Agency in the TR63 Region support this study as they reveal the reasons why the environmental performance is the lowest in the TR63 Region. As a result, all of these listed factors lead to an increase in CO2 emissions, negatively affecting environmental performance.

When an overall analysis is undertaken for the findings, policies that focus on the promotion of renewable energy and green areas, enhancement of forest lands, establishment of drinking water purification facilities in all regions, but especially the ones with relatively lower environmental performance can be put forward as important steps for environmental sustainability in the Level-2 Regions of Turkey.

5. Conclusion

Countries and regions that succeed in turning increasing environmental problems into opportunities can take a step forward on a global scale. It is important to measure environmental performance for a sustainable country and region, together with the solutions developed by countries and regions against increasing environmental problems. Performance evaluation plays an active role in overcoming environmental problems, and the Environmental Performance Index provides a global view on the environmental performance of countries and regions. In this context, it is important to evaluate the environmental performances of Turkey and its regions in terms of minimizing environmental problems. In this context, the current study evaluates the environmental performance indicators of 26 regions in the NUTS-2 Region. In our study, 5 criteria were used to measure environmental performance. First of all, the weights of environmental variables were determined with the Entropy method, and then the environmental performance ranking of the regions was obtained with the ARAS method. According to the entropy method, the environmental performance criterion with the highest weight is electricity consumption per capita, and the lowest is the amount of wastewater used by municipalities. According to the ARAS method, the region with the highest environmental performance value of the NUTS-2 Region is TR10; The lowest yielding region is TR63. Regions with higher environmental performance after the TR10 Region become TRA2 (except 2020) and TR82 (except 2020) between 2009-2020. The second indicator with the highest weight is the urban population, followed by agriculture, forestry and fisheries. The seas add value to cities and cover many social, economic and ecological functions. Due to the fact that a significant proportion of the pollution in the seas is carried out by humans, marine pollution is an important indicator of environmental quality, especially in large cities that have a coast to the sea. It has an important role in increasing the quality of the environment because the seas produce a significant amount of oxygen with the biodiversity they contain and are natural receiving environments that can renew themselves. Therefore, in order to protect and increase the quality of the sea and coastal areas, which are of great importance for the TR10 Region, pollution prevention activities should be accelerated and individuals should be made aware of this issue. In addition, it should be ensured that the planning studies are carried out in a way that protects the sea and coastal areas (İstanbul Kalkınma Ajansı, 2014: 441-442).

In the light of these findings, some recommendations can be made to researchers and policy makers. In the context of suggestions to researchers, the effect of environmental performance indicators obtained according to NUTS-2 Regions on various socio-economic factors can be examined. In the context of advice to policy makers, regions with low environmental performance should quickly replace their dirty and old technologies with green technologies. At the same time, it should get rid of dependency by turning to environmentally friendly energy sources with high energy efficiency instead of fossil fuels. For high energy efficient and environmentally friendly technologies, both the state and the private sector should make their R&D activities operative. In addition, steps should be taken to make adequate arrangements in priority areas and to implement them quickly in order to increase environmental awareness and performance in NUTS-2 Regions.

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Ethics Statement: The authors declare that ethical rules are followed in all preparation processes of this study. In case of detection of a contrary situation, Fiscaoeconomia has no responsibility and all responsibility belongs to the authors of the study.

Attachments

Appendix 1

Table 2: Level-2 Regions

Level-2 Code	Provinces Covered by Level-2 Regions
TRA1	Erzurum, Erzincan, Bayburt
TRA2	Ağrı, Kars, Iğdır, Ardahan
TRB1	Malatya, Elazığ, Bingöl, Tunceli
TRB2	Van, Muş, Bitlis, Hakkari
TRC1	Gaziantep, Adıyaman, Kilis
TRC2	Şanlıurfa, Diyarbakır
TRC3	Mardin, Batman, Şırnak, Siirt
TR10	İstanbul
TR21	Tekirdağ, Edirne, Kırklareli
TR22	Balıkesir, Çanakkale
TR31	İzmir
TR32	Aydın, Denizli, Muğla
TR33	Manisa, Afyon, Kütahya, Uşak
TR41	Bursa, Eskişehir, Bilecik
TR42	Kocaeli, Sakarya, Düzce, Bolu, Yalova
TR51	Ankara
TR52	Konya, Karaman
TR61	Antalya, Isparta, Burdur
TR62	Adana, Mersin
TR63	Hatay, Kahramanmaraş, Osmaniye
TR71	Kırıkkale, Aksaray, Niğde, Nevşehir Kırşehir
TR72	Kayseri, Sivas, Yozgat
TR81	Zonguldak, Karabük, Bartın
TR82	Kastamonu, Çankırı, Sinop
TR83	Samsun, Tokat, Çorum, Amasya
TR90	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane

Appendix 2

Table 3: Normalized Matrix

2009	Total electricity consumption per person (KWh)	Agriculture, forestry and fishing (number of ventures/year)	Water supply (number of ventures/year)	Urban Population	Amount of wastewater treated by municipalities (1000 cubic meters/year)
TRA1	0,598	0,086	0,052	0,625	0,007
TRA2	1	0,039	0,025	0,771	0,001
TRB1	0,506	0,101	0,086	0,384	0,0581
TRB2	0,983	0,072	0,052	0,413	0,039
TRC1	0,315	0,137	0,119	0,215	0,103
TRC2	0,845	0,305	0,142	0,204	0,049
TRC3	0,695	0,089	0,030	0,326	0,006
TR10	0,284	0,616	1	0,031	1
TR21	0,135	1	0,147	0,399	0,001
TR22	0,201	0,475	0,136	0,4332	0,043
TR31	0,185	0,456	0,448	0,114	0,292
TR32	0,312	0,620	0,373	0,261	0,117
TR33	0,357	0,572	0,194	0,223	0,062
TR41	0,217	0,577	0,306	0,131	0,166
TR42	0,148	0,748	0,214	0,158	0,179
TR51	0,346	0,444	0,309	0,089	0,237
TR52	0,325	0,545	0,186	0,251	0,035
TR61	0,2521	0,697	0,261	0,229	0,157
TR62	0,354	0,877	0,295	0,131	0,160
TR63	0,219	0,269	0,125	0,243	0,042
TR71	0,383	0,443	0,105	0,439	0,047
TR72	0,388	0,368	0,128	0,235	0,082
TR81	0,187	0,112	0,022	0,791	0,023
TR82	0,446	0,180	0,027	1	0,000
TR83	0,485	0,565	0,153	0,236	0,027
TR90	0,500	0,301	0,041	0,290	0,016
2011	Total electricity consumption per person (KWh)	Agriculture, forestry and fishing (number of ventures/year)	Water supply (number of ventures/year)	Urban Population	Amount of wastewater treated by municipalities (1000 cubic meters/year)
TRA1	0,571	0,084	0,036	0,624	0,007
TRA2	0,998	0,051	0,027	0,780	0,000
TRB1	0,477	0,138	0,070	0,386	0,062
TRB2	1	0,087	0,045	0,417	0,026
TRC1	0,3109	0,168	0,113	0,213	0,106
TRC2	0,582	0,366	0,126	0,204	0,050
TRC3	0,649	0,105	0,027	0,329	0,006
TR10	0,293	0,658	1	0,031	1
TR21	0,130	1	0,128	0,401	0,002
TR22	0,189	0,502	0,128	0,427	0,041
TR31	0,179	0,484	0,425	0,114	0,296
TR32	0,300	0,663	0,330	0,261	0,120
TR33	0,333	0,609	0,165	0,217	0,061
TR41	0,207	0,619	0,291	0,130	0,187
TR42	0,145	0,783	0,221	0,158	0,205
TR51	0,337	0,478	0,330	0,088	0,253
TR52	0,288	0,631	0,138	0,250	0,048
TR61	0,264	0,743	0,226	0,221	0,166

TR62	0,356	0,897	0,266	0,132	0,165
TR63	0,219	0,284	0,106	0,238	0,043
TR71	0,367	0,521	0,101	0,441	0,050
TR72	0,356	0,411	0,115	0,233	0,092
TR81	0,194	0,114	0,029	0,780	0,025
TR82	0,434	0,199	0,024	1	0,000
TR83	0,503	0,618	0,131	0,235	0,034
TR90	0,501	0,314	0,038	0,291	0,025
2011	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,555	0,087	0,036	0,627	0,005
TRA2	1	0,048	0,026	0,755	0,000
TRB1	0,463	0,154	0,065	0,378	0,052
TRB2	0,859	0,072	0,051	0,415	0,024
TRC1	0,320	0,191	0,143	0,210	0,098
TRC2	0,691	0,388	0,118	0,201	0,040
TRC3	0,736	0,127	0,030	0,319	0,013
TR10	0,300	0,689	1	0,031	1
TR21	0,135	1	0,164	0,391	0,002
TR22	0,190	0,508	0,131	0,434	0,037
TR31	0,173	0,488	0,426	0,116	0,267
TR32	0,298	0,687	0,315	0,260	0,119
TR33	0,318	0,618	0,160	0,227	0,059
TR41	0,210	0,618	0,281	0,130	0,166
TR42	0,147	0,824	0,240	0,156	0,195
TR51	0,343	0,494	0,357	0,088	0,280
TR52	0,299	0,672	0,141	0,248	0,055
TR61	0,251	0,778	0,248	0,223	0,158
TR62	0,335	0,932	0,252	0,132	0,165
TR63	0,203	0,313	0,103	0,241	0,037
TR71	0,375	0,531	0,097	0,442	0,037
TR72	0,365	0,416	0,103	0,235	0,084
TR81	0,190	0,113	0,030	0,806	0,026
TR82	0,423	0,231	0,026	1	0,000
TR83	0,452	0,644	0,143	0,239	0,031
TR90	0,474	0,311	0,038	0,292	0,024
2012	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,532	0,088	0,034	0,628	0,004
TRA2	1	0,043	0,020	0,759	0,000
TRB1	0,429	0,172	0,051	0,377	0,044
TRB2	0,787	0,071	0,042	0,409	0,022
TRC1	0,286	0,196	0,166	0,207	0,092
TRC2	0,607	0,491	0,142	0,200	0,032
TRC3	0,645	0,134	0,028	0,316	0,018
TR10	0,291	0,668	1	0,031	1
TR21	0,125	1	0,152	0,389	0,002
TR22	0,166	0,533	0,123	0,431	0,034
TR31	0,163	0,490	0,412	0,116	0,244
TR32	0,266	0,702	0,286	0,257	0,117

TR33	0,288	0,635	0,137	0,225	0,058
TR41	0,202	0,638	0,263	0,130	0,149
TR42	0,139	0,847	0,227	0,155	0,188
TR51	0,324	0,486	0,336	0,088	0,301
TR52	0,270	0,760	0,114	0,247	0,060
TR61	0,240	0,781	0,246	0,220	0,151
TR62	0,303	0,948	0,253	0,132	0,165
TR63	0,184	0,314	0,105	0,239	0,033
TR71	0,337	0,550	0,098	0,441	0,027
TR72	0,350	0,406	0,095	0,235	0,078
TR81	0,177	0,120	0,018	0,808	0,027
TR82	0,378	0,252	0,023	1	0,000
TR83	0,413	0,637	0,133	0,240	0,029
TR90	0,447	0,319	0,032	0,291	0,024
2013	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,552	0,081	0,024	0,467	0,004
TRA2	1	0,046	0,018	0,775	0,000
TRB1	0,363	0,177	0,050	0,317	0,047
TRB2	0,956	0,073	0,035	0,279	0,028
TRC1	0,272	0,209	0,166	0,188	0,099
TRC2	0,646	0,508	0,167	0,127	0,035
TRC3	0,764	0,127	0,039	0,258	0,018
TR10	0,276	0,674	1	0,030	1
TR21	0,123	1	0,147	0,314	0,005
TR22	0,164	0,536	0,110	0,300	0,039
TR31	0,159	0,495	0,378	0,107	0,248
TR32	0,250	0,695	0,273	0,153	0,131
TR33	0,264	0,668	0,14	0,183	0,058
TR41	0,187	0,615	0,267	0,117	0,141
TR42	0,128	0,851	0,231	0,138	0,189
TR51	0,313	0,508	0,335	0,086	0,285
TR52	0,250	0,818	0,104	0,194	0,062
TR61	0,237	0,809	0,210	0,166	0,148
TR62	0,291	0,946	0,234	0,113	0,161
TR63	0,170	0,313	0,112	0,147	0,032
TR71	0,317	0,552	0,102	0,441	0,023
TR72	0,325	0,399	0,094	0,218	0,080
TR81	0,162	0,120	0,012	0,725	0,026
TR82	0,368	0,240	0,015	1	0,000
TR83	0,391	0,637	0,126	0,197	0,035
TR90	0,415	0,308	0,039	0,206	0,025
2014	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,573	0,086	0,026	0,482	0,004
TRA2	1	0,050	0,019	0,790	0,000
TRB1	0,407	0,208	0,054	0,321	0,049

TRB2	0,990	0,073	0,036	0,285	0,033
TRC1	0,281	0,222	0,174	0,191	0,105
TRC2	0,730	0,506	0,171	0,130	0,039
TRC3	0,790	0,134	0,040	0,262	0,018
TR10	0,310	0,676	1	0,031	1
TR21	0,131	0,997	0,146	0,317	0,008
TR22	0,194	0,564	0,118	0,304	0,043
TR31	0,173	0,518	0,367	0,110	0,252
TR32	0,280	0,712	0,272	0,155	0,145
TR33	0,286	0,725	0,145	0,188	0,058
TR41	0,208	0,626	0,297	0,120	0,133
TR42	0,148	0,868	0,261	0,140	0,190
TR51	0,354	0,548	0,321	0,087	0,270
TR52	0,277	0,982	0,115	0,198	0,064
TR61	0,257	0,840	0,222	0,168	0,145
TR62	0,303	1	0,240	0,116	0,158
TR63	0,186	0,341	0,127	0,151	0,032
TR71	0,333	0,601	0,099	0,450	0,020
TR72	0,360	0,425	0,106	0,222	0,082
TR81	0,184	0,130	0,012	0,740	0,025
TR82	0,402	0,244	0,018	1	0,001
TR83	0,427	0,649	0,127	0,202	0,040
TR90	0,448	0,323	0,048	0,209	0,025
2015	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,585	0,069	0,026	0,500	0,013
TRA2	1	0,043	0,018	0,802	0,000
TRB1	0,426	0,210	0,056	0,327	0,055
TRB2	0,987	0,069	0,038	0,291	0,030
TRC1	0,270	0,186	0,207	0,193	0,105
TRC2	0,655	0,392	0,174	0,131	0,043
TRC3	0,784	0,109	0,038	0,267	0,018
TR10	0,314	0,566	1	0,031	1
TR21	0,121	0,825	0,154	0,318	0,017
TR22	0,193	0,502	0,119	0,314	0,047
TR31	0,1790	0,460	0,401	0,112	0,250
TR32	0,272	0,636	0,291	0,158	0,148
TR33	0,285	0,628	0,161	0,192	0,061
TR41	0,198	0,531	0,306	0,121	0,144
TR42	0,144	0,715	0,287	0,140	0,185

TR51	0,353	0,488	0,324	0,088	0,260
TR52	0,269	1	0,114	0,202	0,068
TR61	0,252	0,722	0,221	0,169	0,160
TR62	0,292	0,867	0,248	0,119	0,164
TR63	0,178	0,302	0,128	0,155	0,039
TR71	0,321	0,564	0,117	0,457	0,025
TR72	0,367	0,354	0,112	0,227	0,081
TR81	0,187	0,110	0,014	0,749	0,025
TR82	0,438	0,221	0,017	1	0,001
TR83	0,409	0,557	0,134	0,206	0,058
TR90	0,451	0,268	0,050	0,213	0,057
2016	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,583	0,080	0,028	0,511	0,023
TRA2	1	0,048	0,014	0,829	0,000
TRB1	0,431	0,264	0,054	0,334	0,060
TRB2	0,977	0,081	0,041	0,301	0,027
TRC1	0,252	0,216	0,219	0,195	0,105
TRC2	0,612	0,431	0,168	0,134	0,047
TRC3	0,673	0,111	0,055	0,276	0,018
TR10	0,332	0,584	1	0,032	1
TR21	0,116	0,688	0,161	0,321	0,024
TR22	0,201	0,527	0,111	0,322	0,050
TR31	0,178	0,493	0,402	0,114	0,249
TR32	0,268	0,653	0,315	0,161	0,152
TR33	0,268	0,653	0,165	0,196	0,063
TR41	0,207	0,555	0,325	0,123	0,154
TR42	0,149	0,706	0,319	0,141	0,181
TR51	0,372	0,562	0,328	0,090	0,251
TR52	0,246	1	0,132	0,207	0,071
TR61	0,264	0,736	0,238	0,172	0,175
TR62	0,303	0,895	0,239	0,122	0,171
TR63	0,183	0,320	0,127	0,158	0,046
TR71	0,326	0,588	0,135	0,458	0,029
TR72	0,335	0,339	0,121	0,232	0,080
TR81	0,182	0,114	0,016	0,767	0,025
TR82	0,387	0,225	0,023	1	0,002
TR83	0,422	0,553	0,142	0,210	0,076
TR90	0,481	0,274	0,059	0,214	0,087

2017	Total electricity consumption per person (KWh)	Agriculture, forestry and fishing (number of ventures/year)	Water supply (number of ventures/year)	Urban Population	Amount of wastewater treated by municipalities (1000 cubic meters/year)
TRA1	0,639	0,095	0,027	0,516	0,026
TRA2	0,993	0,050	0,011	0,823	0,000
TRB1	0,438	0,290	0,056	0,330	0,058
TRB2	1	0,087	0,049	0,298	0,026
TRC1	0,270	0,248	0,226	0,192	0,103
TRC2	0,578	0,479	0,184	0,131	0,038
TRC3	0,678	0,125	0,056	0,270	0,026
TR10	0,346	0,632	1	0,032	1
TR21	0,126	0,691	0,170	0,311	0,030
TR22	0,206	0,521	0,123	0,318	0,049
TR31	0,193	0,518	0,427	0,113	0,217
TR32	0,282	0,725	0,353	0,159	0,129
TR33	0,281	0,702	0,194	0,194	0,065
TR41	0,208	0,584	0,320	0,122	0,154
TR42	0,164	0,741	0,330	0,138	0,183
TR51	0,363	0,642	0,347	0,089	0,208
TR52	0,264	0,943	0,131	0,205	0,069
TR61	0,283	0,761	0,229	0,169	0,171
TR62	0,316	1	0,238	0,121	0,158
TR63	0,189	0,355	0,130	0,156	0,052
TR71	0,338	0,630	0,136	0,444	0,030
TR72	0,359	0,358	0,125	0,230	0,073
TR81	0,189	0,130	0,021	0,757	0,025
TR82	0,393	0,277	0,025	1	0,002
TR83	0,43	0,550	0,145	0,208	0,072
TR90	0,488	0,288	0,064	0,213	0,082
2018	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,612	0,090	0,028	0,501	0,029
TRA2	0,940	0,044	0,013	0,835	0,000
TRB1	0,427	0,254	0,058	0,341	0,056
TRB2	1	0,079	0,058	0,294	0,025
TRC1	0,261	0,243	0,233	0,193	0,101
TRC2	0,464	0,501	0,198	0,131	0,031
TRC3	0,554	0,119	0,054	0,266	0,032
TR10	0,331	0,572	1	0,032	1

TR21	0,138	0,865	0,167	0,311	0,035
TR22	0,199	0,494	0,119	0,318	0,048
TR31	0,183	0,470	0,411	0,114	0,190
TR32	0,269	0,609	0,334	0,159	0,109
TR33	0,272	0,639	0,202	0,195	0,067
TR41	0,204	0,522	0,315	0,122	0,154
TR42	0,163	0,639	0,336	0,138	0,184
TR51	0,323	0,590	0,356	0,089	0,172
TR52	0,243	0,914	0,118	0,206	0,067
TR61	0,263	0,691	0,211	0,168	0,167
TR62	0,297	1	0,219	0,122	0,147
TR63	0,194	0,339	0,151	0,156	0,057
TR71	0,327	0,619	0,137	0,443	0,030
TR72	0,372	0,366	0,127	0,232	0,066
TR81	0,186	0,116	0,024	0,775	0,025
TR82	0,388	0,253	0,021	1	0,002
TR83	0,431	0,550	0,130	0,210	0,069
TR90	0,487	0,289	0,064	0,220	0,078
2019	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,577	0,088	0,026	0,511	0,030
TRA2	0,94	0,039	0,018	0,847	0,001
TRB1	0,448	0,233	0,064	0,341	0,057
TRB2	1	0,078	0,054	0,298	0,025
TRC1	0,264	0,235	0,249	0,194	0,104
TRC2	0,461	0,507	0,198	0,132	0,050
TRC3	0,524	0,122	0,054	0,269	0,033
TR10	0,360	0,575	1	0,032	1
TR21	0,151	0,825	0,180	0,312	0,046
TR22	0,219	0,477	0,116	0,325	0,054
TR31	0,198	0,464	0,425	0,116	0,194
TR32	0,291	0,616	0,421	0,162	0,116
TR33	0,286	0,638	0,235	0,197	0,074
TR41	0,215	0,506	0,321	0,123	0,151
TR42	0,171	0,617	0,360	0,138	0,188
TR51	0,348	0,564	0,363	0,089	0,157
TR52	0,266	0,876	0,127	0,209	0,068
TR61	0,279	0,694	0,213	0,167	0,173
TR62	0,306	1	0,221	0,124	0,150
TR63	0,202	0,339	0,160	0,158	0,070

TR71	0,341	0,627	0,138	0,443	0,030
TR72	0,405	0,353	0,132	0,235	0,070
TR81	0,192	0,113	0,032	0,783	0,024
TR82	0,402	0,251	0,018	1	0,002
TR83	0,473	0,539	0,134	0,212	0,077
TR90	0,504	0,288	0,067	0,221	0,081
2020	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,575	0,078	0,026	0,513	0,030
TRA2	0,932	0,035	0,017	0,837	0,001
TRB1	0,454	0,241	0,053	0,338	0,057
TRB2	1	0,082	0,049	0,295	0,026
TRC1	0,268	0,218	0,245	0,191	0,108
TRC2	0,446	0,520	0,177	0,130	0,070
TRC3	0,538	0,118	0,058	0,263	0,034
TR10	0,381	0,601	1	0,032	1
TR21	0,158	0,777	0,189	0,308	0,056
TR22	0,218	0,501	0,121	0,323	0,060
TR31	0,279	0,489	0,398	0,115	0,197
TR32	0,310	0,686	0,422	0,160	0,123
TR33	0,287	0,684	0,252	0,196	0,081
TR41	0,229	0,480	0,330	0,121	0,148
TR42	0,176	0,570	0,358	0,136	0,192
TR51	0,361	0,506	0,391	0,089	0,142
TR52	0,258	0,821	0,145	0,208	0,070
TR61	0,319	0,719	0,204	0,166	0,179
TR62	0,303	1	0,201	0,123	0,153
TR63	0,207	0,312	0,150	0,156	0,083
TR71	0,333	0,574	0,129	0,439	0,029
TR72	0,404	0,332	0,136	0,233	0,075
TR81	0,182	0,101	0,038	0,784	0,023
TR82	0,388	0,230	0,017	1	0,003
TR83	0,471	0,503	0,136	0,212	0,085
TR90	0,522	0,271	0,065	0,221	0,085

Appendix 3

Table 7: Normalized Matrix

2009	Total electricity consumption per person (KWh)	Agriculture, forestry and fishing (number of ventures/year)	Water supply (number of ventures/year)	Urban Population	Amount of wastewater treated by municipalities (1000 cubic meters/year)
TRA1	0,055	0,007	0,008	0,072	0,001
TRA2	0,092	0,003	0,004	0,088	0,000
TRB1	0,046	0,008	0,014	0,044	0,014
TRB2	0,090	0,006	0,008	0,047	0,009
TRC1	0,029	0,011	0,020	0,024	0,026
TRC2	0,078	0,026	0,023	0,023	0,012
TRC3	0,064	0,007	0,005	0,037	0,001
TR10	0,026	0,052	0,166	0,003	0,252
TR21	0,012	0,085	0,024	0,046	0,000
TR22	0,018	0,040	0,022	0,049	0,010
TR31	0,017	0,038	0,074	0,013	0,073
TR32	0,028	0,053	0,062	0,030	0,029
TR33	0,033	0,048	0,032	0,025	0,015
TR41	0,0201	0,049	0,051	0,015	0,041
TR42	0,013	0,063	0,035	0,018	0,045
TR51	0,032	0,037	0,051	0,010	0,060
TR52	0,030	0,046	0,031	0,029	0,009
TR61	0,023	0,059	0,043	0,026	0,039
TR62	0,032	0,074	0,049	0,015	0,040
TR63	0,020	0,023	0,020	0,028	0,010
TR71	0,035	0,037	0,017	0,050	0,011
TR72	0,035	0,031	0,021	0,027	0,020
TR81	0,017	0,009	0,003	0,091	0,006
TR82	0,041	0,015	0,004	0,115	0,000
TR83	0,044	0,048	0,025	0,027	0,007
TR90	0,046	0,025	0,006	0,033	0,004
2010	Total electricity consumption per person (KWh)	Agriculture, forestry and fishing (number of ventures/year)	Water supply (number of ventures/year)	Urban Population	Amount of wastewater treated by municipalities (1000 cubic meters/year)
TRA1	0,055	0,006	0,006	0,072	0,001
TRA2	0,096	0,004	0,004	0,090	0,000
TRB1	0,046	0,011	0,012	0,044	0,015
TRB2	0,096	0,006	0,008	0,048	0,006
TRC1	0,030	0,013	0,020	0,024	0,026

TRC2	0,056	0,029	0,022	0,023	0,012
TRC3	0,062	0,008	0,004	0,038	0,001
TR10	0,028	0,052	0,177	0,003	0,245
TR21	0,012	0,079	0,022	0,046	0,000
TR22	0,018	0,040	0,022	0,049	0,010
TR31	0,017	0,038	0,075	0,013	0,072
TR32	0,029	0,052	0,058	0,030	0,029
TR33	0,032	0,048	0,029	0,025	0,015
TR41	0,020	0,049	0,051	0,015	0,045
TR42	0,014	0,062	0,039	0,018	0,050
TR51	0,032	0,038	0,058	0,010	0,062
TR52	0,027	0,050	0,024	0,028	0,011
TR61	0,025	0,059	0,040	0,025	0,040
TR62	0,034	0,071	0,047	0,015	0,040
TR63	0,021	0,022	0,018	0,027	0,010
TR71	0,035	0,041	0,018	0,051	0,012
TR72	0,034	0,032	0,020	0,027	0,022
TR81	0,018	0,009	0,005	0,090	0,006
TR82	0,042	0,015	0,004	0,115	0,000
TR83	0,048	0,049	0,023	0,027	0,008
TR90	0,048	0,025	0,006	0,033	0,006
2011	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,054	0,006	0,006	0,072	0,001
TRA2	0,097	0,003	0,004	0,087	0,000
TRB1	0,045	0,011	0,011	0,043	0,013
TRB2	0,083	0,005	0,009	0,048	0,006
TRC1	0,031	0,014	0,025	0,024	0,024
TRC2	0,067	0,029	0,020	0,023	0,010
TRC3	0,071	0,009	0,005	0,037	0,003
TR10	0,029	0,053	0,174	0,003	0,250
TR21	0,013	0,077	0,028	0,045	0,000
TR22	0,018	0,039	0,023	0,050	0,009
TR31	0,016	0,037	0,074	0,013	0,067
TR32	0,029	0,053	0,055	0,030	0,029
TR33	0,031	0,047	0,028	0,026	0,015
TR41	0,020	0,047	0,049	0,015	0,041
TR42	0,014	0,063	0,042	0,018	0,049
TR51	0,033	0,038	0,062	0,010	0,070

TR52	0,029	0,051	0,024	0,028	0,013
TR61	0,024	0,060	0,043	0,025	0,039
TR62	0,032	0,072	0,044	0,015	0,041
TR63	0,019	0,024	0,018	0,027	0,009
TR71	0,036	0,041	0,017	0,051	0,009
TR72	0,035	0,032	0,018	0,027	0,021
TR81	0,018	0,008	0,005	0,093	0,006
TR82	0,041	0,017	0,004	0,115	0,000
TR83	0,044	0,049	0,025	0,027	0,008
TR90	0,046	0,024	0,006	0,033	0,006
2012	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,056	0,006	0,006	0,072	0,001
TRA2	0,105	0,003	0,003	0,088	0,000
TRB1	0,045	0,012	0,009	0,043	0,011
TRB2	0,083	0,005	0,007	0,047	0,005
TRC1	0,030	0,014	0,029	0,024	0,023
TRC2	0,064	0,037	0,025	0,023	0,008
TRC3	0,068	0,010	0,005	0,036	0,004
TR10	0,030	0,050	0,180	0,003	0,255
TR21	0,013	0,075	0,027	0,045	0,000
TR22	0,017	0,040	0,022	0,050	0,008
TR31	0,017	0,036	0,074	0,013	0,062
TR32	0,028	0,052	0,051	0,029	0,030
TR33	0,030	0,047	0,024	0,026	0,014
TR41	0,021	0,048	0,047	0,015	0,038
TR42	0,014	0,063	0,040	0,018	0,048
TR51	0,034	0,036	0,060	0,010	0,077
TR52	0,028	0,057	0,020	0,028	0,015
TR61	0,025	0,058	0,044	0,025	0,038
TR62	0,032	0,071	0,045	0,015	0,042
TR63	0,019	0,023	0,018	0,027	0,008
TR71	0,035	0,041	0,017	0,051	0,006
TR72	0,036	0,030	0,017	0,027	0,020
TR81	0,018	0,009	0,003	0,093	0,006
TR82	0,039	0,018	0,003	0,116	0,000
TR83	0,043	0,047	0,024	0,027	0,007
TR90	0,047	0,024	0,005	0,033	0,006

2013	Total electricity consumption per person (KWh)	Agriculture, forestry and fishing (number of ventures/year)	Water supply (number of ventures/year)	Urban Population	Amount of wastewater treated by municipalities (1000 cubic meters/year)
TRA1	0,058	0,006	0,004	0,064	0,001
TRA2	0,105	0,003	0,003	0,106	0,000
TRB1	0,038	0,013	0,009	0,043	0,011
TRB2	0,100	0,005	0,006	0,038	0,007
TRC1	0,028	0,015	0,030	0,025	0,025
TRC2	0,068	0,037	0,030	0,017	0,009
TRC3	0,080	0,009	0,007	0,035	0,004
TR10	0,029	0,050	0,183	0,004	0,254
TR21	0,012	0,074	0,027	0,043	0,001
TR22	0,017	0,039	0,020	0,041	0,009
TR31	0,016	0,036	0,069	0,014	0,063
TR32	0,026	0,051	0,050	0,020	0,033
TR33	0,027	0,049	0,025	0,025	0,014
TR41	0,019	0,045	0,049	0,016	0,035
TR42	0,013	0,063	0,042	0,019	0,048
TR51	0,033	0,037	0,061	0,011	0,072
TR52	0,026	0,060	0,019	0,026	0,015
TR61	0,025	0,060	0,038	0,022	0,037
TR62	0,030	0,070	0,043	0,015	0,041
TR63	0,018	0,023	0,020	0,020	0,008
TR71	0,033	0,041	0,018	0,060	0,006
TR72	0,034	0,029	0,017	0,029	0,020
TR81	0,017	0,008	0,002	0,099	0,006
TR82	0,038	0,017	0,002	0,137	0,000
TR83	0,041	0,047	0,023	0,027	0,008
TR90	0,043	0,022	0,007	0,028	0,006
2014	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,056	0,006	0,004	0,065	0,001
TRA2	0,098	0,003	0,003	0,106	0,000
TRB1	0,040	0,014	0,009	0,043	0,012
TRB2	0,097	0,005	0,006	0,038	0,008
TRC1	0,027	0,015	0,031	0,025	0,026
TRC2	0,071	0,036	0,030	0,017	0,009
TRC3	0,077	0,009	0,007	0,035	0,004

TR10	0,030	0,048	0,179	0,004	0,253
TR21	0,012	0,070	0,026	0,042	0,002
TR22	0,019	0,040	0,021	0,041	0,011
TR31	0,017	0,036	0,065	0,014	0,063
TR32	0,027	0,050	0,048	0,020	0,036
TR33	0,028	0,051	0,026	0,025	0,014
TR41	0,020	0,044	0,053	0,016	0,033
TR42	0,014	0,061	0,046	0,018	0,048
TR51	0,034	0,038	0,057	0,011	0,068
TR52	0,027	0,069	0,020	0,026	0,016
TR61	0,025	0,059	0,039	0,022	0,036
TR62	0,029	0,071	0,043	0,015	0,040
TR63	0,018	0,024	0,022	0,020	0,008
TR71	0,032	0,042	0,017	0,060	0,005
TR72	0,035	0,030	0,019	0,030	0,020
TR81	0,018	0,009	0,002	0,099	0,006
TR82	0,039	0,017	0,003	0,134	0,000
TR83	0,041	0,046	0,022	0,027	0,010
TR90	0,044	0,023	0,008	0,028	0,006
2015	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,058	0,005	0,004	0,066	0,003
TRA2	0,099	0,003	0,003	0,106	0,000
TRB1	0,042	0,016	0,009	0,043	0,013
TRB2	0,098	0,005	0,006	0,038	0,007
TRC1	0,026	0,015	0,035	0,025	0,025
TRC2	0,065	0,031	0,030	0,017	0,010
TRC3	0,077	0,008	0,006	0,035	0,004
TR10	0,031	0,045	0,173	0,004	0,245
TR21	0,012	0,066	0,026	0,042	0,004
TR22	0,019	0,040	0,020	0,041	0,011
TR31	0,017	0,037	0,069	0,014	0,061
TR32	0,027	0,051	0,050	0,021	0,036
TR33	0,028	0,050	0,027	0,025	0,015
TR41	0,019	0,042	0,053	0,016	0,035
TR42	0,014	0,057	0,049	0,018	0,045
TR51	0,035	0,039	0,056	0,011	0,064
TR52	0,026	0,080	0,019	0,026	0,016
TR61	0,025	0,058	0,038	0,022	0,039

TR62	0,029	0,069	0,043	0,015	0,040
TR63	0,017	0,024	0,022	0,020	0,009
TR71	0,031	0,045	0,020	0,060	0,006
TR72	0,036	0,028	0,019	0,030	0,020
TR81	0,018	0,008	0,002	0,099	0,006
TR82	0,043	0,017	0,003	0,132	0,000
TR83	0,040	0,044	0,023	0,027	0,014
TR90	0,044	0,021	0,008	0,028	0,014
2016	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,059	0,006	0,004	0,066	0,005
TRA2	0,101	0,003	0,002	0,108	0,000
TRB1	0,043	0,020	0,009	0,043	0,014
TRB2	0,098	0,006	0,006	0,039	0,006
TRC1	0,025	0,017	0,036	0,025	0,025
TRC2	0,061	0,033	0,028	0,017	0,011
TRC3	0,068	0,008	0,009	0,036	0,004
TR10	0,033	0,045	0,168	0,004	0,239
TR21	0,011	0,054	0,027	0,041	0,005
TR22	0,020	0,041	0,018	0,042	0,012
TR31	0,018	0,038	0,067	0,014	0,059
TR32	0,027	0,051	0,053	0,021	0,036
TR33	0,027	0,051	0,027	0,025	0,015
TR41	0,020	0,043	0,054	0,016	0,037
TR42	0,015	0,055	0,053	0,018	0,043
TR51	0,037	0,044	0,055	0,011	0,060
TR52	0,024	0,0786	0,022	0,027	0,017
TR61	0,026	0,0579	0,040	0,022	0,042
TR62	0,030	0,070	0,040	0,015	0,040
TR63	0,018	0,025	0,021	0,020	0,011
TR71	0,033	0,046	0,022	0,059	0,007
TR72	0,034	0,026	0,020	0,030	0,019
TR81	0,018	0,009	0,002	0,100	0,006
TR82	0,039	0,017	0,003	0,130	0,000
TR83	0,042	0,043	0,023	0,027	0,018
TR90	0,048	0,021	0,010	0,027	0,021
2017	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities**

					(1000 cubic meters/year)
TRA1	0,062	0,007	0,004	0,068	0,006
TRA2	0,097	0,003	0,001	0,108	0,000
TRB1	0,043	0,021	0,009	0,043	0,014
TRB2	0,098	0,006	0,008	0,039	0,006
TRC1	0,026	0,018	0,036	0,025	0,025
TRC2	0,056	0,035	0,030	0,017	0,009
TRC3	0,066	0,009	0,009	0,035	0,006
TR10	0,034	0,047	0,163	0,004	0,246
TR21	0,012	0,051	0,027	0,041	0,007
TR22	0,020	0,038	0,020	0,041	0,012
TR31	0,019	0,038	0,069	0,014	0,053
TR32	0,027	0,054	0,057	0,021	0,031
TR33	0,027	0,052	0,031	0,025	0,016
TR41	0,020	0,043	0,052	0,016	0,038
TR42	0,016	0,055	0,053	0,018	0,045
TR51	0,035	0,047	0,056	0,011	0,051
TR52	0,026	0,070	0,021	0,027	0,017
TR61	0,027	0,056	0,037	0,022	0,042
TR62	0,031	0,074	0,038	0,015	0,039
TR63	0,018	0,026	0,021	0,020	0,012
TR71	0,033	0,046	0,022	0,058	0,007
TR72	0,035	0,026	0,020	0,030	0,018
TR81	0,018	0,009	0,003	0,099	0,006
TR82	0,038	0,020	0,004	0,131	0,000
TR83	0,042	0,040	0,023	0,027	0,017
TR90	0,048	0,021	0,010	0,028	0,020
2018	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,063	0,007	0,004	0,065	0,007
TRA2	0,097	0,003	0,002	0,109	0,000
TRB1	0,0441	0,019	0,009	0,044	0,014
TRB2	0,103	0,006	0,009	0,038	0,006
TRC1	0,027	0,018	0,038	0,025	0,025
TRC2	0,047	0,038	0,032	0,017	0,008
TRC3	0,057	0,009	0,008	0,035	0,008
TR10	0,034	0,044	0,164	0,004	0,252
TR21	0,014	0,067	0,027	0,040	0,009
TR22	0,020	0,038	0,019	0,041	0,012

TR31	0,018	0,036	0,067	0,015	0,048
TR32	0,027	0,047	0,054	0,020	0,027
TR33	0,028	0,049	0,033	0,025	0,016
TR41	0,021	0,040	0,051	0,016	0,039
TR42	0,016	0,049	0,055	0,018	0,046
TR51	0,033	0,045	0,058	0,011	0,043
TR52	0,025	0,070	0,019	0,027	0,017
TR61	0,027	0,053	0,034	0,022	0,042
TR62	0,030	0,077	0,035	0,016	0,037
TR63	0,020	0,026	0,024	0,020	0,014
TR71	0,033	0,048	0,022	0,058	0,007
TR72	0,038	0,028	0,020	0,030	0,016
TR81	0,019	0,009	0,004	0,101	0,006
TR82	0,040	0,019	0,005	0,131	0,000
TR83	0,044	0,042	0,021	0,027	0,017
TR90	0,050	0,022	0,010	0,028	0,019
2019	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,057784307	0,006946706	0,00418002	0,066556429	0,007
TRA2	0,094652822	0,00312059	0,00292601	0,110261831	0,000
TRB1	0,044893531	0,018425052	0,01017138	0,044463048	0,014
TRB2	0,100076173	0,006214045	0,00863871	0,038902708	0,006
TRC1	0,026	0,018	0,039	0,025	0,025
TRC2	0,046	0,040	0,031	0,017	0,012
TRC3	0,052	0,009	0,008	0,035	0,008
TR10	0,036	0,045	0,157	0,004	0,247
TR21	0,015	0,065	0,028	0,040	0,011
TR22	0,021	0,037	0,018	0,042	0,013
TR31	0,019	0,036	0,067	0,015	0,048
TR32	0,029	0,048	0,066	0,021	0,028
TR33	0,028	0,050	0,037	0,025	0,018
TR41	0,021	0,039	0,050	0,016	0,037
TR42	0,017	0,048	0,056	0,018	0,046
TR51	0,034	0,044	0,057	0,011	0,039
TR52	0,026	0,069	0,020	0,027	0,017
TR61	0,027	0,054	0,033	0,021	0,042
TR62	0,030	0,078	0,034	0,016	0,037
TR63	0,020	0,026	0,025	0,020	0,017
TR71	0,034	0,049	0,021	0,057	0,007

TR72	0,040	0,027	0,020	0,030	0,017
TR81	0,019	0,008	0,005	0,102	0,006
TR82	0,040	0,019	0,002	0,130	0,000
TR83	0,047	0,042	0,021	0,027	0,019
TR90	0,050	0,022	0,010	0,028	0,020
2020	**Total electricity consumption per person (KWh)**	**Agriculture, forestry and fishing (number of ventures/year)**	**Water supply (number of ventures/year)**	**Urban Population**	**Amount of wastewater treated by municipalities (1000 cubic meters/year)**
TRA1	0,056	0,006	0,004	0,067	0,007
TRA2	0,091	0,002	0,002	0,109	0,000
TRB1	0,044	0,019	0,008	0,044	0,014
TRB2	0,098	0,006	0,007	0,038	0,006
TRC1	0,026	0,017	0,038	0,025	0,026
TRC2	0,043	0,041	0,028	0,017	0,017
TRC3	0,052	0,009	0,009	0,034	0,008
TR10	0,037	0,048	0,158	0,004	0,242
TR21	0,015	0,062	0,030	0,040	0,013
TR22	0,021	0,040	0,019	0,042	0,014
TR31	0,027	0,039	0,063	0,015	0,048
TR32	0,030	0,055	0,066	0,021	0,029
TR33	0,028	0,054	0,040	0,025	0,019
TR41	0,022	0,038	0,052	0,015	0,036
TR42	0,017	0,045	0,056	0,017	0,046
TR51	0,035	0,040	0,061	0,011	0,034
TR52	0,025	0,065	0,023	0,027	0,017
TR61	0,031	0,057	0,032	0,021	0,043
TR62	0,029	0,080	0,031	0,016	0,037
TR63	0,020	0,025	0,023	0,020	0,020
TR71	0,032	0,046	0,020	0,057	0,007
TR72	0,039	0,026	0,021	0,030	0,018
TR81	0,017	0,008	0,006	0,102	0,005
TR82	0,038	0,018	0,002	0,130	0,000
TR83	0,046	0,040	0,021	0,027	0,020
TR90	0,051	0,021	0,010	0,028	0,020