Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi
Yıl: 2023 Cilt-Sayı: 16(4) ss: 950–969

Academic Review of Economics and Administrative Sciences
Year: 2023 Vol-Issue: 16(4) pp: 950–969

http://dergipark.org.tr/tr/pub/ohuiibf

Araştırma Makalesi
Research Article

ISSN: 2564-6931
DOI: 10.25287/ohuiibf.1256846
Geliş Tarihi / Received: 27.02.2023
Kabul Tarihi / Accepted: 18.08.2023
Yayın Tarihi / Published: 29.10.2023

BRICS-T ÜLKELERİNDE EKOLOJİK AYAK İZİNİN EĞİLİMİ VE EKOLOJİK AYAK İZİNİN BİLEŞENLERİ ÜZERİNE BİR DEĞERLENDİRME[1]

Ahmet Mesut BÜYÜKSARIKULAK [2]
Seher SULUK [3]
Mustafa BÜBER [4]

Öz

Son elli yılda ortaya çıkan ve hızlanan ekonomik faaliyetler, nüfus artışı ve teknolojik gelişmeler başta olmak üzere birçok faktör çevreyi olumsuz etkilemiş ve günümüzün önemli sorunlarından biri haline gelmiştir. Olumsuz etkinin değerlendirilmesinde kullanılan ölçütlerden biri de ekolojik ayak izidir. Ekolojik ayak izinin biyolojik kapasite ile karşılanması gerekmektedir. BRICS ülkeleri dünya nüfusunda önemli bir paya sahiptir ve ekonomik ağırlığının gelecekte daha da artması beklenmektedir. Bu sebeple bu ülkelerde ekolojik ayak izinin gelecekte büyüyerek önemli çevre sorunlarını beraberinde getirmesi öngörülmektedir. Bu çalışmada BRICS ülkelerine Türkiye'yi de ekleyerek ekolojik durumları ile ekolojik ayak izini oluşturan bileşenlerin seyri tespit edilip, sebepleriyle değerlendirilmeye çalışılmıştır. Sonuç olarak ele alınan tüm ülkelerin ekolojik ayak izi artma eğilimindedir. Brezilya ve Rusya ekolojik fazla verirken, diğer ülkeler ekolojik açık vermektedir. Ülkelerin ekonomik ağırlıklarının gelecekte daha da artacağı düşünüldüğünde ekolojik ayak izi daha da büyüyecektir. Dolayısıyla yenilenebilir enerji kaynaklarına ağırlık verilmesi önerilmektedir.

Anahtar Kelimeler **:** *Ekolojik Ayak İzi, BRICS Ülkeleri, Türkiye.*

JEL Sınıflandırması **:** *F-64, S-51, R-11.*

[1] This study is an extended version of the paper presented at the International Congress of Climate Change Effects on Health, Life, Engineering and Social Sciences (ICLIC 2022), 27-30 September 2022, Konya/Turkey.

[2] Öğr. Gör., Selçuk Üniversitesi Doğanhisar MYO, mbuyuksarikulak@selcuk.edu.tr, ORCID: 0000-0001-8729-9612.
[3] Dr., sehersuluk119@gmail.com, ORCID: 0000-0002-3253-1098.
[4] Öğr. Gör., Selçuk Üniversitesi Doğanhisar MYO, mbuber@selcuk.edu.tr, ORCID: 0000-0003-2750-4068.

Atıf/Citation (APA 6):
Büyüksarıkulak, A. M., Suluk, S., & Büber, M. (2023). An assessment on the trend of the ecological footprint and the components of ecological footprint in BRICS-T countries. *Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 16*(4), 950–969. http://doi.org/10.25287/ohuiibf.1256846.

Büyüksarıkulak, A. M., Suluk, S., & Büber, M. (2023). An assessment on the trend of the ecological footprint and the components of ecological footprint in BRICS-T countries. *Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 16*(4), 950–969.

AN ASSESSMENT ON THE TREND OF THE ECOLOGICAL FOOTPRINT AND THE COMPONENTS OF ECOLOGICAL FOOTPRINT IN BRICS-T COUNTRIES

Abstract

Many factors, especially economic activities, population growth, and technological developments that have emerged and accelerated in the last fifty years, have negatively affected the environment and have become one of the important problems today. One of the criteria used to evaluate the negative impact is the ecological footprint. The ecological footprint needs to be met with biocapacity. BRICS countries have a significant share in the world population and their economic weight is expected to increase further in the future. For this reason, it is foreseen that the ecological footprint in these countries will grow in the future and bring important environmental problems. In this study, by adding Turkey to the BRICS countries, the ecological status and the course of the components that make up the ecological footprint were tried to be determined and evaluated with their reasons. As a result, the ecological footprint of all the countries involved in the study tends to increase. Brazil and Russia have an ecological surplus, while other countries have an ecological deficit. Considering that the economic weight of the countries will increase in the future, the ecological footprint will grow even more. Therefore, it is recommended to focus on renewable energy sources.

Keywords *: Ecological Footprint, BRICS Countries, Turkey.*

JEL Classification *: F-64, S-51, R-11.*

INTRODUCTION

With the rapid development of the economy and population growth, the effects of human activities on the earth's ecosystem have been increasingly intensifying. Increasing conflict among natural resources, the environment, and the economy disrupts the ecosystem. In this context, the concept of sustainable development, which aims to maintain a balance among environment, society and economy has an important place today and has more and more become the society's development goal (Guo et al., 2020: 1).

Environmental pollution, especially as a result of human activities is increasing and the deterioration of the ecosystem is becoming gradually visible. It is a fact that the deterioration of the ecological balance has reached dimensions that threaten all living things. The ecological footprint, which is a comprehensive measure used as an indicator of environmental degradation in the literature, helps to highlight the direct and indirect impacts of production and consumption activities on the environment (Fakher, 2019). Ecological footprint is about how much space people occupy on the earth, in other words, how much they cover the nature with their consumption and shows the size of the pressure of a person, society or country on ecosystems in different regions (WWF, 2019: 2; Palmberg, 2006: 5). The ecological footprint, which includes the quantitative aspect of resource consumption by the population of a region or a country is the area of biologically productive land and water required to produce the resources consumed by an individual, population or activity and to dispose of the waste it creates (Gaaliche, 2012: 77; WWF, 2012: 74). We need the concept of biocapacity to better evaluate the ecological footprint. Biocapacity is the world's capacity to produce renewable natural resources (Koru, 2012: 14).

The main goal of this study is to investigate the ecological footprint, biocapacity, ecological deficit or surplus status, the components that make up the ecological footprint, carbon emission and energy consumption criteria of Turkey and the BRICS countries consisting of Brazil, Russia, India, China and South Africa, which are expected to increase their weight on the world in the coming years. Although there are many theoretical and empirical studies on the ecological footprint in the literature,

no study has been found in the literature on the evaluation of the ecological footprint of BRICS countries and Turkey. Therefore, it is expected that this study will contribute to the related literature by filling this gap in the literature. The study consists of five sections. In the second section, the concept of ecological footprint and in the third section, the BRICS countries will be mentioned. After the literature review is included in the fourth section, the ecological footprint and biocapacity of Turkey and the BRICS countries will be compared with the biocapacity of the components that make up the ecological footprint in the fifth section. The study will be completed with conclusion and recommendations.

I. ECOLOGICAL FOOTPRINT

The concept of ecological footprint was developed by Mathis Wackernagel and William Rees in the 1990s and came to the fore as an indicator of environmental sustainability. The basic concept underlying ecological footprint is that although the earth's land area is limited, the number of people and land use are increasing. The ecological footprint can be defined as "the aggregate area of productive land (and aquatic ecosystems) needed to produce the resources used, and to assimilate the wastes generated, by a defined population, wherever on Earth that land is located" (Dam et al., 2017: 10; Aall & Norland, 2005: 162; Curry et al., 2011: 168). Ecological footprint can be expressed in general as a method of measuring the overall impact of human activities on the earth (Kutlu & Kutlu, 2022: 235). The basic idea of the concept is that every individual, process, activity, and region has an influence on the earth through the use of resource, the waste generation and the use of services provided by nature (Van den Bergh & Verbruggen, 1999: 63).

Ecological footprint and biocapacity are expressed in global hectares. Usually, a comparison is made between a country's ecological footprint and its biocapacity and looking at the difference between them. If the ecological footprint is greater than the biocapacity (EF > BC) it is referred to as ecological deficit, whereas if the ecological footprint is less than the biocapacity (EF < BC) it is referred as ecological surplus. The country that has an ecological reserve is called an environmental creditor and the country with an ecological deficit is called ecological debtor (Global Footprint Network, 2022; Rugani et al., 2014: 294; Ghita et al., 2018: 3). It is important for a sustainable life that the ecological footprint of countries does not exceed their biocapacity (Bayraktar, 2020: 62). A large ecological footprint, that is, a footprint that exceeds the world's global carrying capacity, indicates that the damage to the environment is high and that nature is consumed at an unsustainable rate globally (Wilson & Anielski, 2005: 7; Topdağ et al., 2020: 341-342). The ecological footprint is calculated based on two pillars: the monitoring of the consumed resources and the waste produced, and the measurement of the biological productive area required for the production of the requirements and the disposal of the wastes. The ecological footprint reached in this calculation show how much biological productive area individuals use on the axis of production and consumption. Ecological footprint is calculated using the formula below (Akıllı et al., 2008: 6):

Ecological Footprint = Consumption x Production Area x Population

Countries can measure, monitor and manage the value of their ecological assets by making ecological footprint calculations. Countries can find ways to eliminate the risks associated with ecological deficit by evaluating their ecological footprints with all their components, causes and consequences. There are six components of ecological footprint, these are: the carbon footprint, the cropland footprint, the forest area footprint, the grazing land footprint, the built-up land footprint and the fishing grounds footprint (WWF, 2012: 4-9; https:// www.footprintnetwork.org). These components are explained in table 1.

Table 1. Ecological Footprint Components

The Carbon Footprint	It is the calculation of forest area required to capture emissions from fossil fuel consumption, land use changes and chemical processes, as well as CO2 emissions captured by the oceans.
The Cropland Footprint	It is the calculation of the area used for the production of food and fibre, animal feed, oil crops and rubber required for human consumption.
The Forest Area Footprint	It is the calculation of the forest area required to meet the amount of log/lumber, pulp, wood products and firewood consumed.
The Grazing Land Footprint	It is the calculation of the livestock area for meat, milk, leather and wool products.
The Built-up Land Footprint	It is the calculation of the area covered with infrastructure and superstructure related to meeting human needs including housing, transportation, industrial structures and power plants.
Fishing Grounds Footprint	It is the calculation of the marine and freshwater area required to supply the fish and seafood consumed.

Source: WWF, 2012: 9.

There are some impacts that the ecological footprint does not include. Pollution from hazardous substances and waste from nuclear energy generation is an example of this. The ecological footprint is an indicator of anthropogenic pressure on the environment. That is, it doesn't directly measure deforestation, species extinction, climate change etc. Rather, it measures the factors that cause these problems, such as wood and crop consumption and fossil fuel combustion (York et al., 2003: 282–283). In other words, it does not deal with all aspects of the relationship between economy and environment, but only certain aspects. Therefore, it is thought that the method will not be sufficient to explain the sustainability. For this reason, it is argued that it should be supported by some complementary indicators (Özsoy and Dinç, 2016: 44–45). However, it is a widely used indicator to evaluate environmental sustainability (Chen and Chang, 2016: 558).

II. BRICS COUNTRIES

The term BRIC consists of the initials of Brazil, Russia, India and China. The term was first coined in 2001 by economist Jim O'Neill, Chairman of the Board of Goldman Sachs (Aşcı, 2019: 40). The first official summit of BRIC countries was held on 16 June 2009. The second summit was held in April 2010 (Parmaksız & Kocabıyık, 2020: 316; Hashiru & Tüfekçi, 2018: 12). At the third summit held in China in 2011, the name of the group was changed to BRICS with the participation of South Africa (Gürcan, 2019: 557). While the total area of the BRICS countries is more than a quarter of the world's surface areas, these countries constitute approximately 43% of the world's population and approximately 30% economically (Güney, 2017: 31; Battal & Akan, 2019: 2). Generally, BRICS countries show a successful economic performance. Besides, it is argued that BRICS countries will have a say in the world's economic system in the future (Karaş, 2020: 206).

The BRICS countries are the fastest growing economies in the world. Among these countries, China and India are the countries that have come to the fore in recent years in terms of economic performance. This development is also influential on environmental factors. China and India, which are in the BRICS group are the largest emitters of CO2 emissions in the developing world. As a matter of fact, in 2016, 44.2% of the total CO2 emissions of the developing world were created by China and 10.6% by India. Over the past decade, they have in total contributed 70.5% of rising emissions in the developing world and 83.7% of rising emissions worldwide (Jiang et al., 2019: 187). China and India make up 82% of the BRICS country group's emissions, and both countries' CO2 emissions increased in all their sectors in 2019 (https://www.corporateknights.com). Table 2 shows the GDP, population and land use data of the BRICS-T countries for the years 2000, 2005, 2010, 2015, 2020 and 2021.

Table 2. GDP, Population and Land Use of BRICS-T Countries

		2000	2005	2010	2015	2020	2021
Brazil	GDP (000.000)	655.448	891.633	2.208.838	1.802.211	1.448.565	1.608.981
	GDP per capita	3749	4790	11286	8813	6814	7518
	Population (000)	174.790	186.127	195.713	204.471	212.559	213.993
	Population growth (annual %)	1,42	1,14	0,93	0,83	0,71	0,67
	Urban population (% of total population)	81,19	82,83	84,34	85,77	87,07	87,32
	Agricultural land (% of land area)	27,32	27,38	27,74	28,17		
	Forest area (% of land area)	65,93	63,57	61,21	60,29	59,42	
China	GDP (000.000)	1.211.346	2.285.965	6.087.163	11.061.553	14.687.673	17.734.062
	GDP per capita	959	1753	4550	8016	10409	12556
	Population (000)	1.262.645	1.303.720	1.337.705	1.379.860	1.411.100	1.412.360
	Population growth (annual %)	0,79	0,59	0,48	0,58	0,24	0,09
	Urban population (% of total population)	35,88	42,52	49,23	55,50	61,43	62,51
	Agricultural land (% of land area)	55,57	55,88	56,12	56,09		
	Forest area (% of land area)	18,78	20,03	21,29	22,31	23,34	
India	GDP (000.000)	468.394	820.381	1.675.615	2.103.587	2.667.687	3.173.397
	GDP per capita	443	715	1358	1606	1933	2277
	Population (000)	1.056.575	1.147.609	1.234.281	1.310.152	1.380.004	1.393.409
	Population growth (annual %)	1,77	1,58	1,35	1,12	0,99	0,97
	Urban population (% of total population)	27,67	29,24	30,93	32,78	34,93	35,39
	Agricultural land (% of land area)	60,87	60,58	60,40	60,43		
	Forest area (% of land area)	22,73	23,05	23,37	23,82	24,27	
Russia	GDP (000.000)	259.710	764.017	1.524.917	1.363.481	1.488.321	1.775.799
	GDP per capita	1772	5323	10675	9313	10162	12173
	Population (000)	146.596	143.518	142.849	144.096	144.073	143.446
	Population growth (annual %)	-0,42	-0,38	0,04	0,19	-0,23	-0,44
	Urban population (% of total population)	27,67	29,24	30,93	32,78	34,93	35,39
	Agricultural land (% of land area)	13,26	13,17	13,16	13,16		
	Forest area (% of land area)	49,40	49,58	49,77	49,76	49,78	
South Africa	GDP (000.000)	151.753	288.868	417.365	346.709	335.442	419.946
	GDP per capita	3375	6033	8149	6260	5656	6994
	Population (000)	44.967	47.880	51.216	55.386	59.308	60.041
	Population growth (annual %)	1,41	1,24	1,46	1,53	1,27	1,23
	Urban population (% of total population)	56,89	59,54	62,22	64,83	67,35	67,85
	Agricultural land (% of land area)	80,89	80,36	79,87	79,42		
	Forest area (% of land area)	14,66	14,51	14,36	14,21	14,06	
Turkey	GDP (000.000)	274.302	506.308	776.992	864.316	719.954	815.271
	GDP per capita	4337	7456	10743	11006	8536	9587
	Population (000)	63.240	67.903	72.326	78.529	84.339	85.042
	Population growth (annual %)	1,52	1,32	1,40	1,67	1,08	0,83
	Urban population (% of total population)	64,74	67,84	70,83	73,61	76,11	76,57
	Agricultural land (% of land area)	52,60	53,56	50,69	50,09		
	Forest area (% of land area)	26,18	26,79	27,39	28,10	28,87	

Source: https://data.worldbank.org (Accessed: 17.08.2022).

According to a study prepared by PWC, by 2030, China is expected to be the world's largest economy by purchasing power parity, while India is expected to rank third, Russia sixth, Brazil eighth, and South Africa thirtieth. Turkey has approached the economic level of the BRICS countries with its economic success, especially in the last two decades, and it is expected to be in the twelfth place in the world economy in 2030 (PWC, 2017: 23). Therefore, it has been suggested that Turkey should be included in the BRICS country group along with the so-called "emerging markets" such as South Korea, Mexico and Indonesia (Sandalcılar, 2012: 164). In July 2020, it was reflected in the press that Turkey

was preparing to apply for participation in the BRICS. For all these reasons, Turkey has been included in this research, although it is not currently a member of the BRICS.

III. LITERATURE REVIEW

Akıllı et al. (2008) applied a questionnaire to the students and members of Akdeniz University, Faculty of Economics and Administrative Sciences. Individual ecological footprint questionnaire was applied to 241 individuals out of the research population consisting of 1886 individuals. They used T Test and Kruskal Wallis H Test in the study. According to the results obtained, ecological footprints do not have a significant relationship with gender. In spite of that, it has been determined that the ecological footprint increases with increasing income, property and automobile ownership.

Hoekstra (2009) reviewed and compared the methodologies in ecological footprint and water footprint studies. As a result of the study, it is stated that both concepts should be seen as complementary in the sustainability debate.

Altıparmak and Avcı (2011) evaluated the developments in world trade on the axis of environmental problems and sustainability discussions together with the trade volume and ecological footprint. For this, they made comparative observation using ecological footprint and trade statistics. It has been concluded that since the increases in trade volume is higher in Turkey than in the world, the pressure of national ecosystem on carrying capacity in Turkey is lasting due to the difference between biocapacity and the ecological footprint.

Kaypak (2013) who aimed to look at environmental peace from ecological footprint of humanity, stated that in order to reduce ecological footprints, it should be fulfilled with peaceful methods with an understanding of international responsibility intended environmental values.

Özsoy and Dinç (2016) examined the ecological footprint that creates a significant awareness in ensuring sustainable development. Consequently, it was stated that the ecological deficit has increased significantly throughout the world, and that policies should be prepared in order to reduce the carbon footprint in Turkey.

Chen and Chang (2016) analyzed what factors affect the ecological footprint for 99 countries with the help of panel data analysis based on the years 1981-2006. According to the empirical findings, it has been determined that the impact of GDP per capita on the ecological footprint varies for different income levels. In addition, the effect of urbanization was found to be significantly positive across income levels.

Başoğlu (2018) investigated the determinants of the ecological footprint in Turkey with the help of the STIRPAT model using the data from 1971 to 2014. As a result of the empirical tests applied, it is found that the variables are cointegrated. Besides, the most important factors determining the ecological footprint in the long and short term are energy consumption, service sector and population size, respectively. In addition, it has been determined that human capital has a significant and negative effect on the ecological footprint both in the long and short term.

Ghita et al. (2018) aimed to identify and forecast patterns of environmental footprint behavior in European countries, depending on factors reflecting the innovation activity, the degree of economic freedom, and EU membership status. They used the Proportional-Odds Cumulative Logistic regression model to achieve this goal. The study concludes that both the share of the employed population in the foreign-controlled enterprises and the eco-innovation index will have a significant direct impact on the variability in the ecological footprint. The results also showed that non-EU member countries or newer EU member countries are predominantly assigned low ecological footprint scores.

Şimşek and Bursal (2019) analyzed the interaction between ecological footprint and biocapacity in Turkey for the period of 1961-2016 using the Bootstrap Rolling Window Causality test. According

to the empirical findings, causality was found both from ecological capacity to biocapacity and from biocapacity to ecological capacity. It was concluded that these two variables act together in the long run.

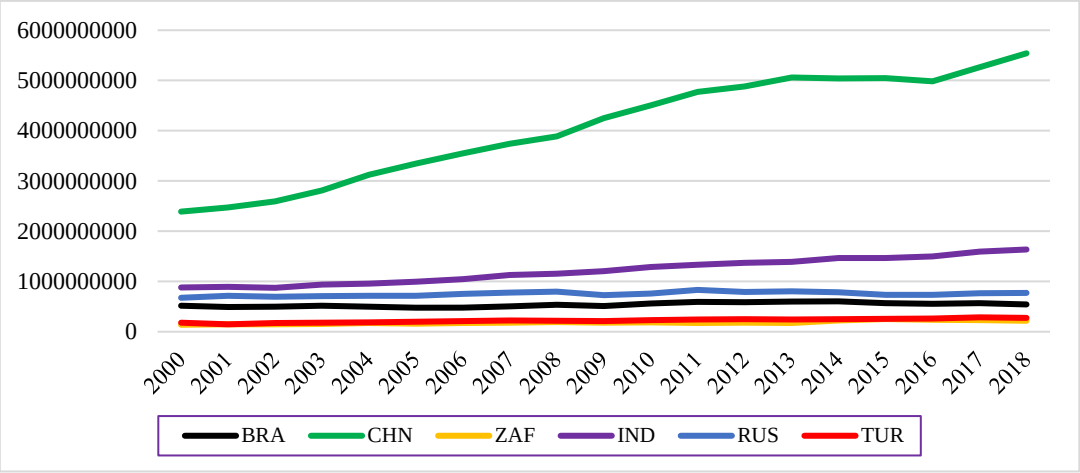
Yurtkuran (2020) investigated the convergence of per capita ecological footprint in N11 countries using the panel Cross-sectional Augmented Dickey Fuller unit root and newly developed panel Fourier stationary tests. The study covers the period from 1971 to 2016. According to the empirical findings, per capita ecological footprint is stationary in Indonesia, Pakistan and the Philippines. In Turkey, Bangladesh, Egypt, Iran, Mexico, Nigeria, South Korea and Vietnam, the impact of shocks on environmental pollution has been determined to be permanent.

Usavaş (2021) investigated the effect of democracy on environmental degradation in Turkey using the ARDL method for the period of 1980-2017. A long-run significant relationship among GDPs per capita, gross capital formation and ecological footprint was found. Besides, a positive and significant relationship between democracy and ecological footprint was determined.

Kutlu and Kutlu (2022) examined the impacts of tourism activities on the ecological footprint in the context of Turkey, using data from 1970 to 2017. ARDL bounds test approach was used in the study. According to the findings, long-term effects of energy consumption and tourism expenditures on the ecological footprint are positive. However, it has been determined that the effect of per capita income and tourism revenues on the ecological footprint in the long run is negative. In the study, it was also determined that the natural resource rent affects the ecological footprint only in the short run.

IV. ECOLOGICAL FOOTPRINT IN TURKEY AND BRICS COUNTRIES

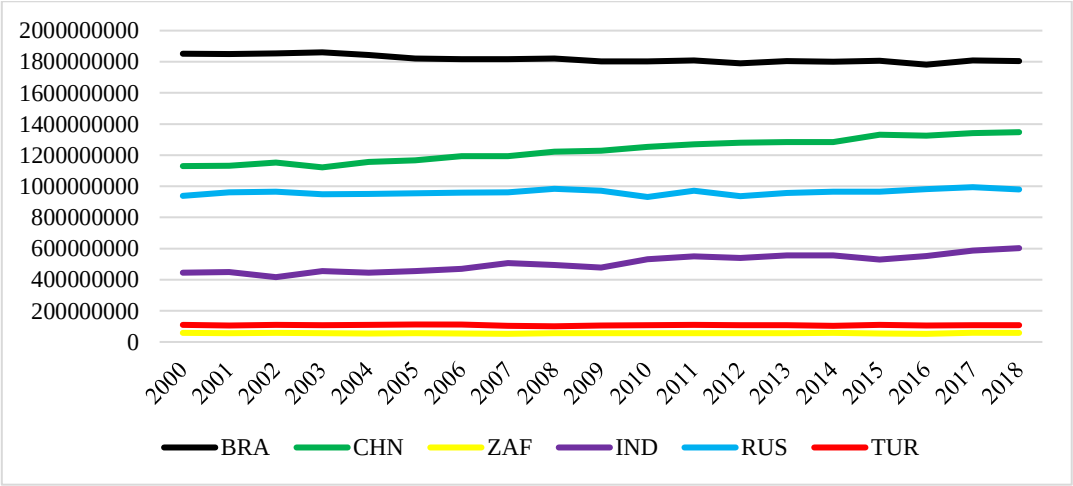
In this section, ecological footprint, biocapacity, ecological deficit or surplus status and the components that make up the ecological footprint in Turkey and BRICS countries will be evaluated. The abbreviations BRA, CHN, ZAF, IND, RUS and TUR in the charts refer to Brazil, China, South Africa, India, Russia and Turkey, respectively. Accordingly, the ecological footprint of the BRICS-T countries is shown in graph 1. As seen in the graph, China is by far the country with the largest ecological footprint among the BRICS-T countries. In addition, the country differs from other countries when looking at the increasing trend over the years. This situation can be explained by the fact that China still has the largest population in the world, although its population growth rate has decreased in recent years, its weight in the world economy has gradually increased in recent years and its economy has grown rapidly. It is not difficult to predict that the ecological footprint of China, which is expected to be the world's largest economy in the coming years, will increase even more. In the name of sustainability, it is considered necessary for China to reverse this situation in the future and reduce its ecological footprint, not only for China itself, but also for its region and the world. India ranks second in terms of ecological footprint. The population growth rate of India is also decreasing, but having the second largest population in the world and increasing income over time has increased its ecological footprint. Although there is no significant increase in other countries, the ecological footprint of all of them tends to increase. Russia takes the third place in the countries subject to the analysis, Brazil is in the fourth, Turkey is in the fifth and South Africa is in the sixth and last place.



Graph 1. Ecological Footprint in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

Graph 2 shows the biocapacity of BRICS-T countries. It is seen that Brazil has a serious advantage compared to other countries and ranks first in terms of biocapacity. However, there is a decrease by years. Although this situation is normal for Brazil, which is the world's leading country in terms of biodiversity and forest, the decrease is seen as an important problem not only for Brazil itself but also for the whole world. China ranks second in terms of biocapacity. Despite the economic growth and population by years, the increase in the biocapacity of China is a positive situation. In Russia, which ranks third, the biocapacity has increased, albeit slightly, following a horizontal course. Similar situation is true for India, which ranks fourth. There is a horizontal course in Turkey and South Africa, which are in the fifth place, and as of 2018, it is seen that the biocapacity in both countries has decreased, albeit slightly.

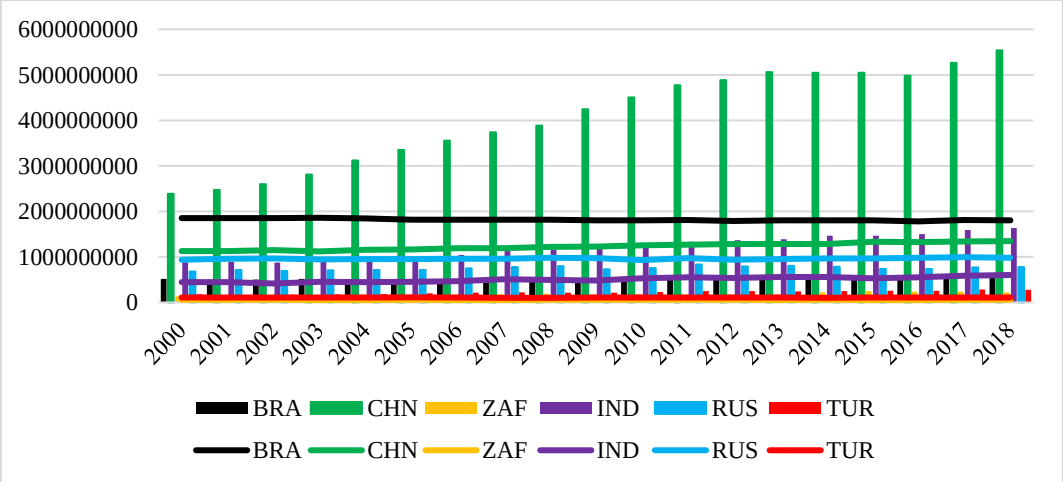


Graph 2. Biocapacity in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

The ecological footprint and biocapacity mentioned above are evaluated together and the ecological deficit and surplus (reserve) status of the countries is shown in graph 3. In the graph, the

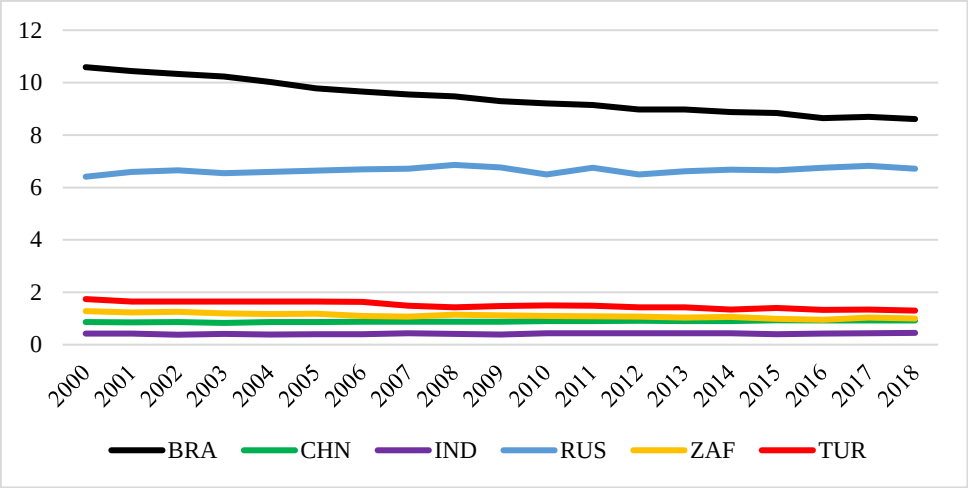
columns show the ecological footprint, while the lines show the biocapacity. While there is an ecological reserve in Brazil and Russia, there is an ecological deficit in China, South Africa, India and Turkey. The country with the largest ecological reserves is Brazil and there is a slight decrease over the years covered in the study. In 2018, Brazil's biocapacity was about 3.3 times the ecological footprint, while this rate was 1.2 in Russia. It is possible to say that there is a parallel course in Russia. Considering that Brazil is home to the Amazon Forest, which is the largest forest in the world, and Russia has the largest lands in the world, ecological surpluses can be considered normal. When the other four countries with ecological deficit are evaluated, it is seen that the deficit has increased over the years in all of them. Although it has a significant geographical size among these countries, China is the fastest growing ecological footprint and ranks first in terms of ecological deficit when 2018 is taken into account. China has an ecological footprint of more than 4 times its current biocapacity in 2018. While India ranks second in terms of ecological deficit, it has an ecological footprint of about 2.7 times its biocapacity. This rate is 2.5 in Turkey, which ranks third. South Africa is fourth in deficit size, but its ecological footprint is about 3.4 times its biocapacity.



Graph 3. Ecological Footprint and Biocapacity in BRICS-T Countries

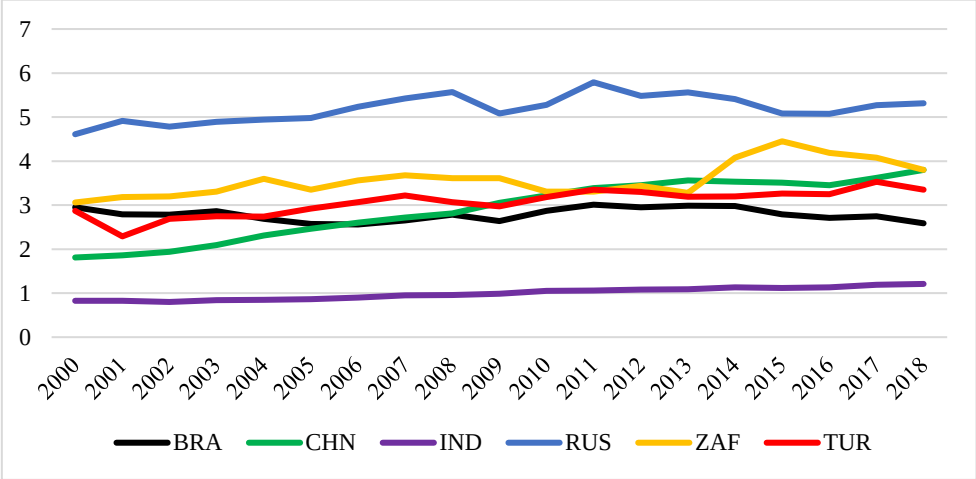
Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

It is possible to access the ecological footprint and biocapacity per capita data from the Global Footprint Network database as well as the general situation of the countries. Graph 3 and graph 4 show this situation. Ranking in terms of ecological footprint when per capita situation is evaluated; Russia, South Africa, China, Turkey, Brazil and India. It is seen that the ecological footprint per capita has increased in all countries over the years except Brazil. Although it is seen that the population growth rate has decreased in the countries, their population is increasing and a significant part of the world's population still lives in these countries. It can be said that the increases in per capita income over time are the most important reason for the increase in the amount of ecological footprints per capita. In addition, the share of the urban population in the total population is increasing in all countries, the energy use per capita is increasing, and therefore the CO2 emission is increasing, which is the most important component of the ecological footprint. In terms of biocapacity per capita, the ranking is Brazil, Russia, Turkey, South Africa, China and India. While there is a decrease in biocapacity per capita in countries other than Russia, the decrease in Brazil is quite remarkable. A situation similar to the total emerges in terms of per capita ecological deficit and reserve. In other words, while Brazil and Russia have per capita ecological reserves, the other countries have per capita ecological deficits. The most remarkable situation is the rapid increase in the deficit in China.



Graph 4. Biocapacity per capita in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

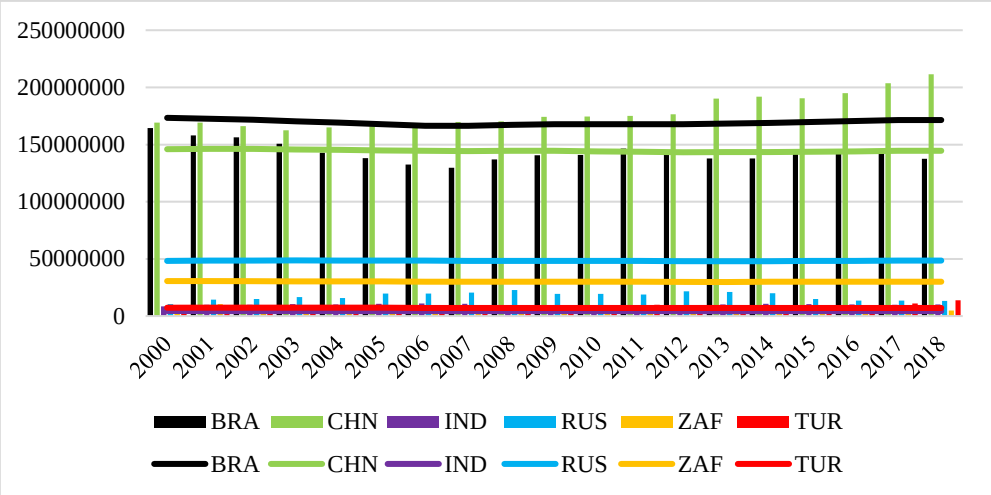


Graph 5. Ecological Footprint per capita in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

Ecological footprint consists of six components. In the next stage of the study, the course of these six components in the BRICS-T countries will be discussed, and their deficit and surplus situation will be tried to be determined. In the graphs, the column shows the footprint of the relevant component and the line shows the biocapacity of the relevant component.

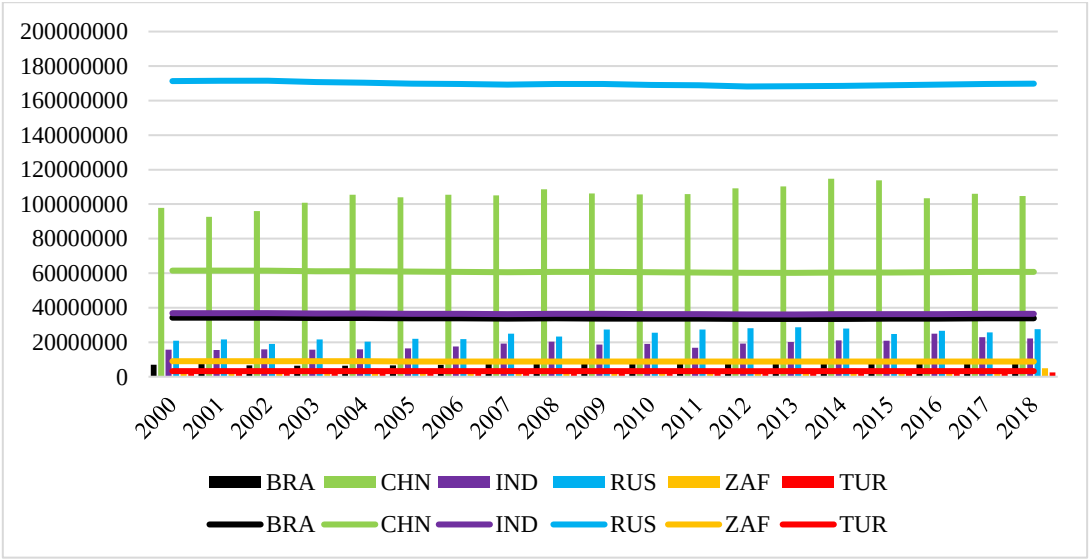
The grazing land footprint, which is one of the components that make up the ecological footprint is shown in graph 6 together with the grazing land biocapacity. The country with the highest grazing land footprint is China. There has been a deficit in this area by years and the level of deficit is increasing. Brazil is in the second place. Brazil's grazing land footprint tends to decrease and is in surplus in this area. When compared these two countries with other countries, it is seen that there is quite a difference between them in both titles. While there is a deficit in Turkey and India, there is a surplus in Russia and South Africa. The grazing land footprint tends to increase in all of these countries except South Africa.



Graph 6. Grazing Land Footprint-Grazing Land Biocapacity in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

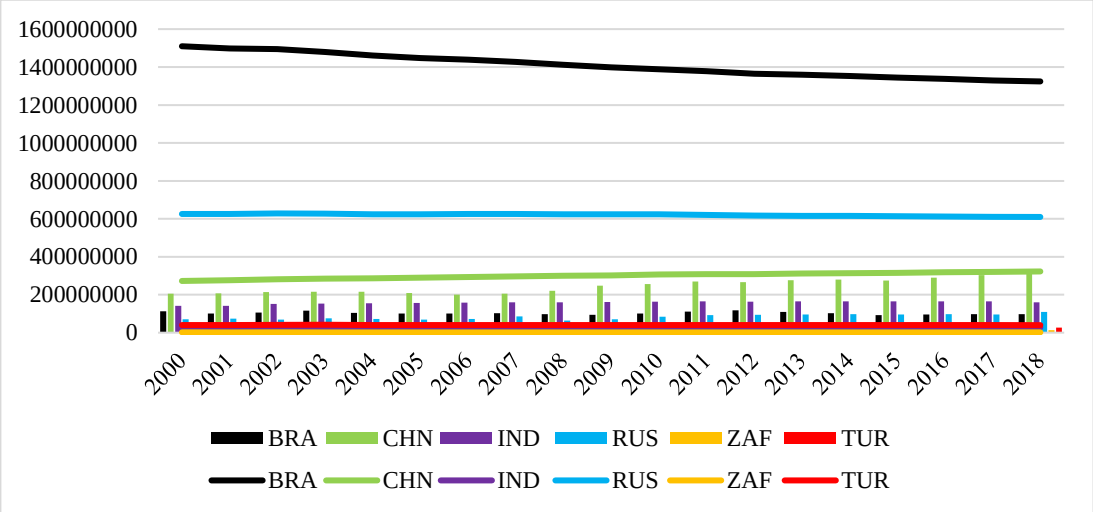
Graph 7 shows the fishing grounds footprint and the fishing grounds biocapacity of the BRICS-T countries. In terms of fishing grounds biocapacity, Russia is in a good position compared to all other countries and has a surplus. This is due to the fact that Russia is in the third in the list of countries with the longest coastline in the world. The only country that has a deficit in all years is China, and the amount of the deficit is significant. China is in the top 10 in the world in terms of coastline. The deficit show how large the fishing grounds footprint is. Part of this situation can be explained by the fact that China is the most populated country in the world. Brazil, India, Russia and South Africa had surpluses in fishing grounds in all years. On the other hand, Turkey had a deficit only between 2004-2006, but had a surplus in other years. However, the surplus Turkey has given is not very large and is far behind other countries.



Graph 7. Fishing Grounds Footprint-Fishing Grounds Biocapacity in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

Graph 8 shows the forest area footprint and the forest area biocapacity of the BRICS-T countries. The country with the largest forest area footprint is China, and it shows a great increase especially after 2007. Notwithstanding this, the country was switched to deficit position in 2018. India, which ranks second has always had a deficit by years. Brazil, which ranks third in terms of footprint, had a surplus as it has the highest biocapacity by far from other countries. Brazil is home to nearly 60% of the Amazon Forest, one of the largest and most important forest lands in the world, and this forest covers 49% of Brazil's territory (Raftopoulos and Morley, 2020: 1629). Therefore, when it is considered, it is quite natural that it gives a surplus about the forest. However, the decrease in the forest biocapacity in recent years is an important and negative situation not only for Brazil but also for the whole world. The data we have is until 2018 and the former president of Brazil, Jair Bolsonaro who took office on 1 January 2019 but lost the presidency in the election held on 30 October 2022, softened the regulations protecting the Amazon Forest due to economic reasons. The rapid increase in the number of forest fires after this period suggesting that the decrease in Brazil's forest surplus is occurring more rapidly (Uysal Oğuz and Kışlalıoğlu, 2022). Ecologist Dr. Bernardo M. Flores states that if the deforestation reaches 20%, the global temperature will increase, fires will increase due to drought, and this cycle will further increase global warming (Fox, 2019). While India and South Africa have deficit in terms of forest area, there has been a decrease in forest area footprint in South Africa since 2006. The forest area biocapacity is larger than the forest footprint by years and there has been a surplus in Russia and Turkey. While a horizontal course is observed in Russia, the forest area footprint tends to increase by years in Turkey.

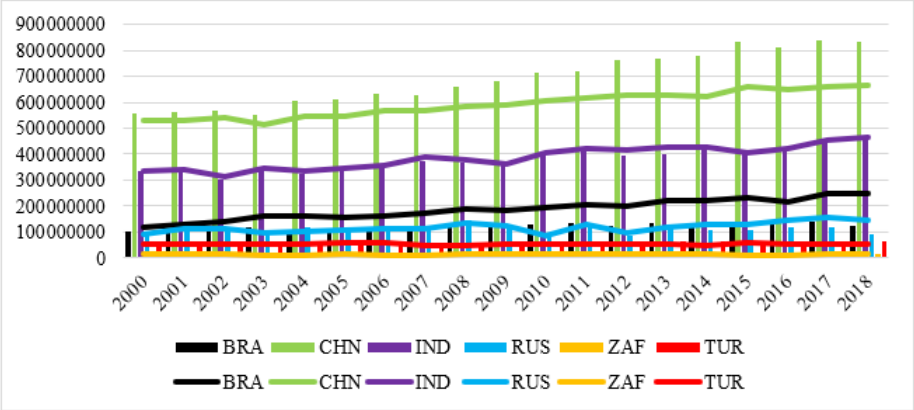


Graph 8. Forest Area Footprint-Forest Area Biocapacity in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

In graph 9, the cropland footprint and the cropland biocapacity of BRICS-T countries are shown together. In terms of cropland footprint, China takes the first place, while India takes the second place. Besides, China is the country whose cropland footprint has increased the most by years, thus running a deficit. On the other hand, there is a horizontal situation in India. Brazil is in the third place for some years and Russia for some years in terms of cropland footprint. However, while there is a surplus in all years in Brazil, it is also seen that there is a surplus in Russia in some years, although there is a surplus in recent years. Turkey ranks fifth in terms of cropland footprint, followed by South Africa in the sixth and last place. There are cropland deficit in both countries. It is seen that the cropland footprint sizes are directly related to the population of the countries. When the share of the cropland areas of the countries in the total areas is evaluated, it is seen that although South Africa allocates the largest amount of land to agriculture, the cropland footprint is low. While China allocate more than half of their lands to

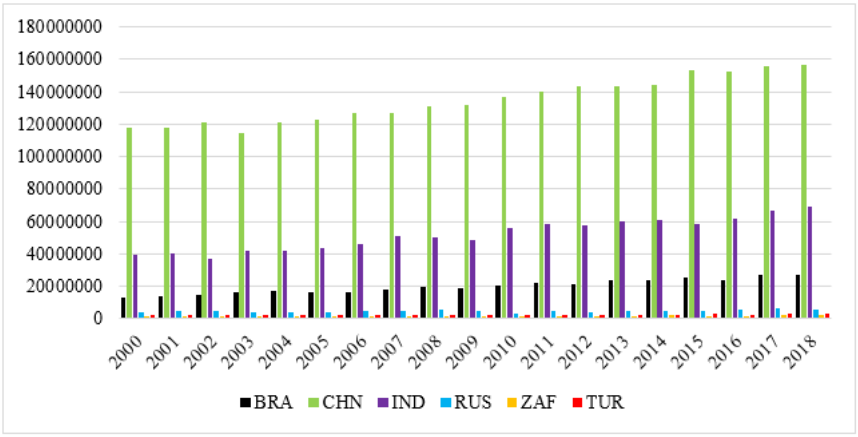
agriculture compared to India and Turkey, while the cropland footprint is quite high in China and India, the same is not true for Turkey. On the other hand, Russia ranks fourth in cropland footprint, and even third in some years, despite devoting about 13% of its land to agriculture by years.



Graph 9. Cropland Footprint-Cropland Biocapacity in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

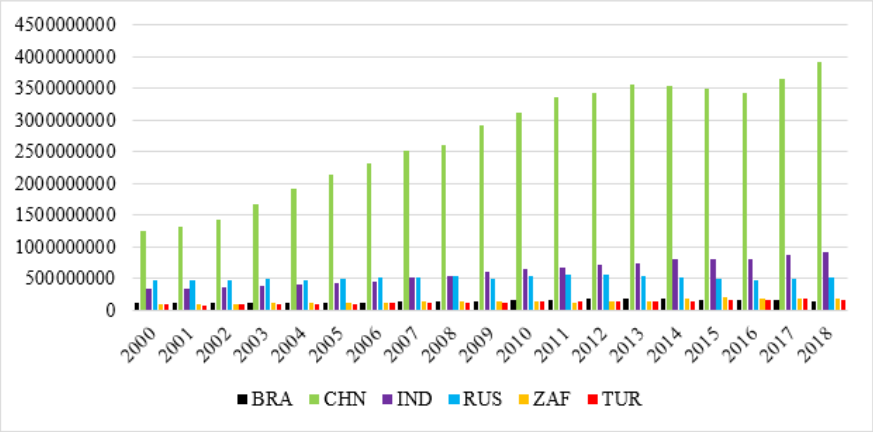
Graph 10 shows the built-up land footprint of the BRICS-T countries. The country that ranks first in this field by years is China. China has nearly in all years three times the footprint of its closest follower which is India and has a continuous increasing trend. According to the World Bank data, 35% of the population lived in cities in 2000 in China and this rate increased to 62% in 2021. Considering this increase in urbanization and the increase in population and income, it is understandable that China is the first in the ranking in terms of built-up land footprint. Therefore, it is important to control the increase in the name of environmental protection and sustainability. There is also a significant upward trend in India which ranks second. It is an interesting development that the built-up land footprint has increased to this extent in India, which is the country with the least urbanization among the BRICS-T countries. Brazil is in the third place and there is an increasing trend in the built-up land footprint of Brazil. Although it is seen that the built-up land footprint of other countries has increased by years, it is less than China, India, Brazil and is listed as Russia, Turkey and South Africa.



Graph 10. Built-up Land Footprint in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

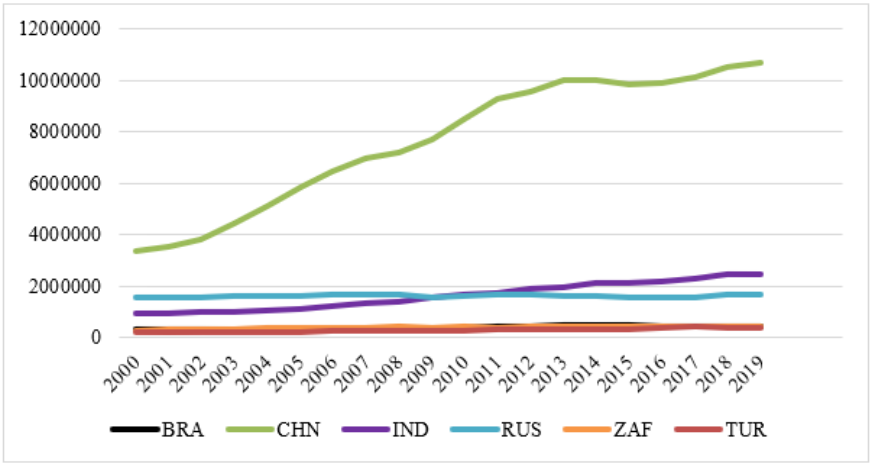
Graph 11 shows the carbon footprint, which is the most important component of the ecological footprint. The country with the largest carbon footprint is China. Although there was relatively little difference among other countries in 2000, this difference increased very rapidly in the following years. China's carbon footprint has increased by 215% from 2000 to 2018. In the years the evaluation is started, Russia was in the second and India in the third place. But these two countries were replaced in 2009. While the increase was 167% in India, it was 12% in Russia and is the country with the least increase. The other countries are listed as South Africa (94% increase), Turkey (81% increase) and Brazil (26% increase). One of the most important greenhouse gases that cause global warming and climate change is carbon dioxide. Carbon dioxide emissions are mainly caused by the use of fossil fuels. It is extremely important to reduce the carbon footprint and thus the ecological footprint.



Graph 11. Carbon Footprint in BRICS-T Countries

Source: https://www.footprintnetwork.org (Accessed: 06.08.2022).

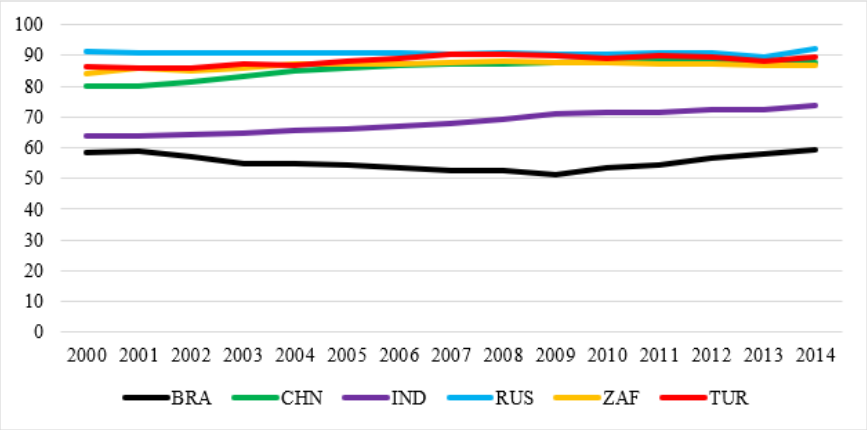
Total carbon emissions of BRICS-T countries are shown in graph 12. It is seen from the graph that the rankings and trends have parallels with the carbon footprint. The only difference in the ranking is the displacement of Turkey in the fifth place and Brazil in the sixth place.



Graph 12. Total Carbon Emissions in BRICS-T Countries

Source: World Bank (Accessed: 06.08.2022).

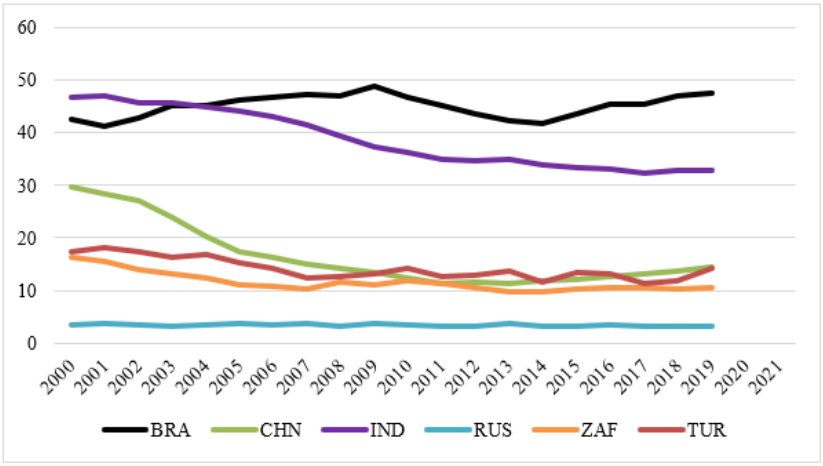
Graph 13 shows the share of fossil fuel energy consumption in total energy consumption for BRICS-T countries. As of 2014, it can be listed as Russia, Turkey, China, South Africa, India and Brazil in fossil fuel use. There is a horizontal course in Russia which is one of the countries with the largest fossil fuel resources in the world. While it is possible to say the same thing for Brazil, there is an increasing trend in other countries by years. As it is seen in the graph, the use of fossil fuels has reached significant rates in other countries except Brazil, and instead of producing energy from fossil fuels, it should be preferred to produce energy from renewable sources in order to reduce the carbon footprint.



Graph 13. Fossil Fuel Energy Consumption in BRICS-T Countries (% of Total)

Source: World Bank (Accessed: 06.08.2022).

Renewable energy consumption in the final energy consumption of BRICS-T countries is shown in graph 14. The situation in this category is the opposite of fossil fuel energy consumption. While there was a horizontal course in Brazil and Russia, the share of renewable energy consumption decreased over time in other countries. This is not a desirable situation for carbon and thus ecological footprint. Countries should increase their renewable energy investments in parallel with developments such as economic development, population growth, and urbanization and meet their energy needs in this way.



Graph 14. Renewable Energy Consumption in BRICS-T Countries (% of Final Energy Consumption)

Source: World Bank (Accessed: 06.08.2022).

CONCLUSION

In this study, the ecological footprint, the ecological deficit or surplus status and the components that make up the ecological footprint were evaluated by adding Turkey to the BRICS countries whose economic weight has increased in recent years and is expected to increase further in the future. When the ecological footprint is evaluated, China ranks first and is negatively differentiated compared to other countries. China's ecological footprint has increased by 131% from 2000 to 2018. The growth rate of the ecological footprint in China is considerably higher than in other countries. Therefore, the ecological deficit has been increasing by years. China has the largest footprint in all components that make up its ecological footprint. China actually has the largest ecological footprint not only among the BRICS-T countries, but also the whole world. Although this situation is tried to be explained with the population to some extent, it is insufficient considering the size of the ecological footprint. With the further growth of its economy in the coming years, it is quite natural to expect that China will become a country that causes more damage to the environment, and that these consequences of climate change will emerge as a result. Because as of August 2022, due to the drought that lasted for more than two months, various problems arose in areas such as agriculture, animal husbandry and electricity production. It was reflected in the media that cloud seeding activities were carried out in various regions of the country in order to overcome the problems and increase precipitation (https://www.bbc.com). China's renewable energy consumption has decreased by more than half compared to 2000, and this is an indicator that focused on meeting its energy needs with fossil fuels. In this case, it is thought that the ecological footprint will increase in the coming years with economic growth.

India is the second country in terms of ecological footprint. The rate of increase in India is about 85% and is one of the countries with ecological deficit. India, which has a surplus in fishing grounds and cropland, which is one of the components that make up the ecological footprint, has a forest and grazing land footprint deficit. The country follows China in built-up land footprint and carbon footprint. India which is the second most populous country in the world, ranks second among the BRICS-T countries in terms of GDP. In India, where the urbanization rate is quite low compared to other countries, it is thought that urbanization and energy need will increase with economic development; considering the decrease in renewable energy consumption by years, it is thought that the ecological footprint will increase more. Because it is stated that the air pollution in India has reached significant levels and that it is one of the most polluted countries according to the World Air Pollution Report, and that the capital New Delhi is the most polluted capital in the world (IQAir, 2022).

Despite being in the third place in terms of ecological deficit, Russia has an ecological surplus. Based on the year 2000, the ecological footprint increased by 14% in 2018. The country with a surplus in fishing grounds, forest area, grazing land and cropland is the third most polluting country in built-up land and the third most polluting country in carbon footprint among BRICS-T countries. Russia which has the world's richest fossil fuel resources and meets the majority of the energy needs from these resources, has a great biocapacity and manages to give an ecological surplus with the effect of being the largest country in the world in terms of surface area. Considering that the ecological footprint and biocapacity move in parallel in Russia by years, it is very important that the ecological footprint does not increase further in order to protect the ecological surplus. In this regard, it is necessary to increase the renewable energy consumption which is about 3%.

Brazil which ranks fourth in terms of ecological footprint has a surplus just like Russia. Brazil's ecological footprint has increased by only about 5% from 2000 to 2018. Brazil is the country in the best condition in all other ecological footprint components except built-up land and grazing land footprint. However, although the ecological footprint does not reach very large sizes by years, the decrease in biocapacity can be considered as a negative. It is very important for the country, which is home to most of the world's largest and most important forests, to protect forests in order to protect this biocapacity. The forest rate, which covered 65.93% of its lands in 2000, decreased to 59.42% in 2020 (World Bank, 2022).

Turkey ranks fifth in the ranking. Turkey gives an ecological deficit although its ecological footprint is not more than other countries. Based on the 2000, Turkey's ecological footprint increased by 51% in 2018. While Turkey gives surplus in fishing grounds and forest area components, it gives deficit in grazing land and cropland components. Turkey is the second best country in terms of built-up land and carbon footprint. The increase in forest area footprint is in particular remarkable. In addition, there has been a decrease in renewable energy consumption by years.

The country in the last place in terms of ecological footprint is South Africa. However, the country has an ecological deficit and its ecological footprint has increased by about 59% from 2000 to 2018. While there is an ecological surplus in fishing grounds and grazing land footprints, there is a deficit in forest area and cropland footprint. The country, which is in the best position among the countries subject to analysis in terms of built-up land footprint, is in the third best position in terms of carbon footprint. The most remarkable situation for South Africa is that its carbon footprint has nearly doubled, while its forest land footprint has decreased. Among the countries covered in the study, the highest population growth rate is in South Africa. Considering this situation, it is possible that the ecological footprint will increase further in the future. In addition, renewable energy consumption has been decreasing by years.

When evaluated in general, when considered that BRICS-T countries cover a significant part of the world's population, have reached a certain size economically and this size will increase in the coming years, it is expected that their ecological footprints will reach larger amounts. The developments in Brazil and Russia, which currently have an ecological surplus are not very encouraging. The rapid destruction of forest areas and decrease in biocapacity in Brazil, excessive fossil fuel consumption and the low difference between ecological footprint and biocapacity in Russia can be interpreted as negative developments. In order to reduce the ecological footprint, priority should be given to renewable energy sources instead of fossil fuel sources. This is the main objective of the Paris Agreement, which entered into force in 2016. Except for Brazil, other countries are going backwards by years in the field of renewable energy. In this context, studies for high resource efficiency should be carried out, individuals and institutions should be informed about issues such as the environment and recycling, and necessary policies should be prepared. In addition, no country is solely responsible for the current situation in the world, and the solution is not in the hands of individual countries. Therefore, it is extremely important to prepare and implement the necassary plans with cooperation among countries.

Although the BRICS-T countries are a side of the Paris Climate Agreement, they also engaged in activities on climate change, environment and natural resources among themselves and tried to take decisions on this issue at the summits they met. For example, at the Goa Summit, mutual cooperation and sustainability were emphasized, and as a result of the Tianjin Summit, it was stated that action plans on air, water and soil pollution were implemented (Tunçarslan, 2018: 42). Despite these and similar decisions have been taken, success has not been achieved yet. For this reason, it is necessary to take the essential precautions and arrangements with a collective effort.

REFERENCES

Aall, C. & Norland, I. T. (2005). The Use of the Ecological Footprint in Local Politics and Administration: Results and Implications from Norway, *Local Environment*, 10(2), 159–172.

Akıllı, H., Kemahlı, F., Okudan, K. & Polat, F. (2008). Ekolojik Ayak İzinin Kavramsal İçeriği ve Akdeniz Üniversitesi İktisadi ve İdari Bilimler Fakültesi'nde Bireysel Ekolojik Ayak İzi Hesaplaması, *Akdeniz İİBF Dergisi,* 08(15), 1–25.

Altıparmak, A. & Avcı, Z. (2011). Uluslararası Ticaret, Ekolojik Ayakizi ve Türkiye, *Ekonomi Bilimleri Dergisi,* 3(2), 35–45.

Aşcı, M. E. (2019). BRICS Ülkelerinin Küresel Güç Olma Potansiyelleri ve Türkiye, *Uluslararası Hukuk ve Sosyal Bilim Araştırmaları Dergisi,* 1(1), 39–60.

Başoğlu, A. (2018). STIRPAT Modeli Kapsamında Türkiye'de Ekolojik Ayak İzinin Belirleyicileri, İktisat Seçme Yazılar (içinde), (Editörler: Havvanur Feyza Erdem & Aykut Başoğlu), 1. Basım, Trabzon: Celepler Matbaacılık Yayın ve Dağıtım.

Battal, T. & Akan, E. (2019). BRICS Ülkeleri ile Türkiye'nin Performans ve Potansiyel Kriterleri Çerçevesinde Değerlendirilmesi, *Beykoz Akademi Dergisi,* 7(1), 1–35.

Bayraktar, Ş. (2020). Factors Contributing Ecological Footprint Awareness of Turkish Pre-Service Teachers, *International Education Studies,* 13(2), 61–70.

BBC. (2022). Çin Kuraklıkla Başa Çıkmak İçin 'Bulut Tohumlamaya' Başladı. Erişim adresi: https://www.bbc.com/turkce/articles/cd1yv0ldez2o (Erişim Tarihi: 12.12.2022).

Chen, S-T. & Chang, H-T. (2016). Factors That Affect the Ecological Footprint Depending on the Different Income Levels, *AIMS Energy,* 4(4), 557–573.

Curry, R., Maguire, C., Simmons, C. & Lewis, K. (2011). The Use of Material Flow Analysis and the Ecological Footprint in Regional Policy-making: Application and Insights from Northern Ireland, *Local Environment,* 16(2), 165–179.

Dam, T. A., Pasche, M. & Werlich, N. (2017). Trade Patterns and the Ecological Footprint a Theory-based Empirical Approach, Working Paper, Jena Economic Research Papers, No. 2017–005, Friedrich Schiller University Jena, Jena.

Fakher, H.-A. (2019). Investigating the Determinant Factors of Environmental Quality (Based on Ecological Carbon Footprint Index), *Environmental Science and Pollution Research.* DOI: https://doi.org/10.1007/s11356-019-04452-3

Fox, M. (2019). Amazon in Flames (Interview), *NACLA Report on the Americas,* 51(4), 328–332. DOI: https://doi.org/10.1080/10714839.2019.1692937

Gaaliche, M. (2012). Impact of the Qualitative and Quantitative Aspects of Human Activity on the Ecosystem: Demonstration through the Use of Ecological Footprint Approach, *European Journal of Interdisciplinary Studies,* 4(2), 77–83.

Ghita, S. I., Saseanu, A. S., Gogonea, R.-M. & Huidumac-Petrescu, C.-E. (2018). Perspectives of Ecological Footprint in European Context under the Impact of Information Society and Sustainable Development, *Sustainability,* 10(9), 3224, 1–25. DOI: https://doi.org/10.3390/su10093224

Global Footprint Network. (2022). Ecological Footprint. https://www.footprintnetwork.org/our-work/ecological-footprint/ (Accessed: 06.08.2022).

Guo, J., Ren, J., Huang, X., He, G., Shi, Y. & Zhou, H. (2020). The Dynamic Evolution of the Ecological Footprint and Ecological Capacity of Qinghai Province, *Sustainability,* 12(7), 3065. DOI: 10.3390/su12073065

Güney, T. (2017). Türkiye ve BRICS Ülkelerinde Ekonomik Özgürlüğün Ekonomik Büyüme Üzerindeki Etkisi, *International Review of Economics and Management,* 5(2), 30–47.

Gürcan, E. C. (2019). BRICS Ülkelerinin Afrika'daki Yükselişine Jeopolitik Ekonomi Penceresinden Bir Bakış, *Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi,* 10(3), 556–569.

Hashiru, M. & Tüfekçi, Ö. (2018). Putting the 'N' or Replacing the 'S' in the BRICS? Nigeria's Rise as an Emerging Power, *Journal of Management and Economics Research,* 16(3), 11–23.

Hoekstra, A. Y. (2009). Human Appropriation of Natural Capital: A Comparison of Ecological Footprint and Water Footprint Analysis, *Ecological Economics,* 68(7), 1963–1974. DOI: 10.1016/j.ecolecon.2008.06.021

IQAir. (2022). World Air Quality Report.

Jiang, J., Ye, B. & Liu, J. (2019). Research on the Peak of CO_2 Emissions in the Developing World: Current Progress and Future Prospect, *Applied Energy,* 235, 186–203. DOI: https://doi.org/10.1016/j.apenergy.2018.10.089

Karaş, E. (2020). Wagner Kanunu'nun BRICS Ülkeleri ve Türkiye Bazında Geçerliliğinin Sınanması, *Maliye Dergisi,* 178, 199–223.

Kaypak, Ş. (2013). Ekolojik Ayak İzinden Çevre Barışına Bakmak, *Türk Bilimsel Derlemeler Dergisi*, 6(1), 154–159.

Koru, A. T. (2012). Tüketimin Ayak İzleri: Dünyaya Bakış, *İktisat ve Toplum,* 24, 13–19.

Kutlu, Ş. Ş. & Kutlu, M. (2022). Turizm Faaliyetlerinin Ekolojik Ayak İzi Üzerine Etkisi: Türkiye Örneği, *Maliye Dergisi,* 182, 233–249.

Özsoy, C. E. & Dinç, A. (2016). Sürdürülebilir Kalkınma ve Ekolojik Ayak İzi, *Finans Politik & Ekonomik Yorumlar,* 53(619), 35–55.

Palmberg, I. (2006). Ekologiska Fotavtryck och Matematiskt Tänkande i Utbildning för Hållbar Utveckling, L. Häggblom, L. Burman & A-S. Röj-Lindberg (red.) Perspektiv på Kunskapens och Lärandets Villkor. Festskrift Tillägnad Professor Ole Björkqvist. Åbo Akademi, Pedagogiska Fakulteten, Specialutgåva Nr 1/2006.

Parmaksız, S. & Kocabıyık, T. (2020). BRICS Ülke Borsaları ile Türk Borsası Arasındaki İlişkinin Keşfi, *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi,* 25(3), 315–341.

PWC. (2017). The Long View: How Will The Global Economic Order Change by 2050?.

Raftopoulos, M. & Morley, J. (2020). Ecocide in the Amazon: the Contested Politics of Environmental Rights in Brazil, *The International Journal of Human Rights*, 24(10), 1616–1641. DOI: 10.1080/13642987.2020.1746648

Reserve Bank of India. (2021). BRICS, BRICS Economic Bulletin. Erişim adresi: https://rbidocs.rbi.org.in/rdocs/Publications/PDFs/BRICSE20216DF8FA9335C0495893F0087A8729D73B.PDF

Rugani, B., Roviani, D., Hild, P., Schmitt, B. & Benetto, E. (2014). Ecological Deficit and Use of Natural Capital in Luxembourg from 1995 to 2009, *Science of the Total Environment,* 468–469, 292–301. DOI: https://doi.org/10.1016/j.scitotenv.2013.07.122

Sandalcılar, A. R. (2012). BRIC Ülkelerinde Ekonomik Büyüme ve İhracat Arasındaki İlişki: Panel Eşbütünleşme ve Panel Nedensellik, *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi,* 17(1), 161–179.

Şimşek, T. & Bursal, M. (2019). Türkiye'de Ekolojik Ayak İzi ve Biyokapasite Arasındaki İlişki: Bootstrap Rolling Window Nedensellik Testi, *IBAD Sosyal Bilimler Dergisi,* Özel Sayı, 452–465.

Topdağ, D., Acar, T. & Çelik, İ. E. (2020). Estimation of the Global-Scale Ecological Footprint within the Framework of STIRPAT Models: The Quantile Regression Approach, *Istanbul Journal of Economics*, 70, 339–358.

Tunçarslan, N. (2018). BRICS Ülkelerinin İklim ve Çevre Politikaları: Karşılaştırmalı Bir Analiz, *Beykent Üniversitesi Sosyal Bilimler Dergisi*, 11(2), 36–50.

Ursavaş, N. (2021). Türkiye'de Demokrasinin Ekolojik Ayak İzi Üzerindeki Etkisi, *Üçüncü Sektör Sosyal Ekonomi Dergisi,* 56(4), 2745–2757.

Uysal Oğuz, C. & Kışlalıoğlu, C. (2022). Bolsonaro Döneminde Brezilya'nın Amazonlar Politikası, *Türkiye Siyaset Bilimi Dergisi*, 5(1), 57–72.

Van den Bergh, J.C.J.M. & Verbruggen, H. (1999). Spatial Sustainability, Trade and Indicators: An Evaluation of the 'Ecological Footprint', *Ecological Economics,* 29(1), 61–72. DOI: https://doi.org/10.1016/S0921-8009(99)00032-4

Wilson, J. & Anielski, M. (2005). Ecological Footprints of Canadian Municipalities and Regions, The Federation of Canadian Municipalities, Quality of Life Reporting System.

World Bank. (2022). https://data.worldbank.org/ (Accessed: 17.08.2022).

WWF. (2012). Türkiye'nin Ekolojik Ayak İzi Raporu.

WWF. (2019). Ekologiska Fotavtryck: Vår Påverkan På Planeten.

York, R., Rosa, E. A. & Dietz, T. (2003). Footprints on the Earth: The Environmental Consequences of Modernity, *American Sociological Review,* 68(2), 279–300. DOI: https://doi.org/10.2307/1519769

Yurtkuran, S. (2020). N11 Ülkelerinde Ekolojik Ayak İzi Yakınsaması: Fourier Durağanlık Testinden Yeni Kanıtlar, *Uluslararası Ekonomi ve Yenilik Dergisi*, 6(2), 191–210.

https://www.corporateknights.com/rankings/earth-index/2022-earth-index/earth-index-brics-nations/ (Accessed: 21.08.2022).

Etik Beyanı : *Bu çalışmanın tüm hazırlanma süreçlerinde etik kurallara uyulduğunu yazarlar beyan eder. Aksi bir durumun tespiti halinde ÖHÜİİBF Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarlarına aittir. Bu çalışma, Uluslararası İklim Değişikliği Etkilerinin Sağlık, Yaşam, Mühendislik ve Sosyal Bilimler Kongresi'nde (ICLIC 2022), 27-30 Eylül 2022, Konya/Türkiye'de sunulan bildirinin genişletilmiş versiyonudur.*

Yazar Katkıları : *Yazarlar eşit oranda katkı sunmuşlardır.*

Çıkar Beyanı : *Yazarlar arasında çıkar çatışması yoktur.*

Teşekkür : *Yayın sürecinde katkısı olan hakemlere ve editör kuruluna teşekkür ederiz.*

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, ÖHÜİİBF Journal does not have any responsibility andall responsibility belongs to the authors of the study. This study is an extended version of the paper presented at the International Congress of Climate Change Effects on Health, Life, Engineering and Social Sciences (ICLIC 2022), 27-30 September 2022, Konya/Turkey.*

Author Contributions : *The authors contributed equally.*

Conflict of Interest : *There is no conflict of interest between the authors.*

Acknowledgement : *We thank the referees and editorial board who contributed to the publishing process.*