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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

EXAMINING GREEN GROWTH CONDITIONS AND ACHIEVEMENTS OF THE OECD COUNTRIES: A DESCRIPTIVE ANALYTICAL APPROACH

OECD ÜLKELERİNİN YEŞİL BÜYÜME DURUMLARININ VE İLERLEMELERİNİN İNCELENMESİ: TANIMLAYICI ANALİTİK BİR YAKLAŞIM

Mehmet ÇAĞLAR*

Abstract

The Organisation for Economic Co-operation and Development (OECD) is the leading actor for green growth. The OECD has been taking important actions to promote, monitor, and support green growth. The main objective of this study is to analyze the green growth conditions and achievements of the OECD countries. The Green Growth Index 2022, proposed by the Global Green Growth Institute, is used for the analysis. 34 OECD countries are included in the analysis. The OECD countries are examined using the Green Growth Index, the dimensions and indicators of the Green Growth Index. This study uses a descriptive analytical approach to analyze green growth conditions and the achievement of OECD countries. The results show that OECD countries generally have high achievement levels in green growth. On the other hand, OECD countries show statistically significantly different achievement levels in the green growth dimensions. The main strength of OECD countries in achieving green growth is social inclusion and their main weakness is green economic opportunities. The selected OECD countries can be divided into 5 clusters. These clusters have different weaknesses and strengths in terms of green growth.
Keywords: Green Growth, OECD, Green Growth Index
JEL Classification: O43, O44, Q01, Q56

Öz

Ekonomik İşbirliği ve Kalkınma Teşkilatı (OECD) yeşil büyüme konusunda önde gelen aktördür. OECD yeşil büyümeyi teşvik etmek, izlemek ve desteklemek için önemli adımlar atmaktadır. Bu çalışmanın temel amacı, OECD ülkelerinin yeşil büyüme durumlarını ve ilerlemelerini analiz etmektir. Analiz için Küresel Yeşil Büyüme Enstitüsü tarafından önerilen Yeşil Büyüme Endeksi 2022 kullanılmıştır. Analize 34 OECD ülkesi dahil edilmiştir. OECD ülkeleri Yeşil Büyüme Endeksi, Yeşil Büyüme Endeksi'nin boyutları

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ve göstergeleri kullanılarak incelenmiştir. Bu çalışma, OECD ülkelerinin yeşil büyüme koşullarını ve başarılarını analiz etmek için tanımlayıcı analitik bir yaklaşım kullanmaktadır. Sonuçlar, OECD ülkelerinin yeşil büyüme konusunda genel olarak yüksek başarı seviyelerine sahip olduğunu göstermektedir. Öte yandan, OECD ülkeleri yeşil büyüme boyutlarında istatistiksel olarak önemli ölçüde farklı başarı düzeyleri göstermektedir. OECD ülkelerinin yeşil büyümeyi gerçekleştirmedeki temel gücü sosyal içerme, temel zayıflığı ise yeşil ekonomik fırsatlardır. Seçilen OECD ülkeleri 5 kümeye ayrılabilir. Bu kümeler yeşil büyüme açısından farklı zayıf ve güçlü yönlere sahiptir.
Anahtar Kelimeler: Yeşil Büyüme, OECD, Yeşil Büyüme Endeksi
JEL Sınıflandırması: O43, O44, Q01, Q56

1. Introduction

Ensuring a sustainable life on earth is one of the most important issues of our time. Individuals, companies, organizations, international agencies, policymakers, researchers, and countries must work together to ensure sustainability while striving for high prosperity. Thus, sustainable development has become one of the common focuses and goals of policy makers (Li et al., 2022). In promoting economic development, policymakers should take the necessary measures and guide economic actors to ensure the sustainability of natural resources (Munier, 2006). In this sense, many actors consider sustainable development a priority. Some companies are trying to adopt environmentally friendly practices and apply green techniques, such as reducing energy consumption, using renewable energy sources, and introducing green products or technologies (Albertini, 2013; Khan et al., 2020). In addition, some international organizations and agencies such as the United Nations (2015), the European Union (European Commission, 2010), the OECD (2011), the World Bank Group (2017) and the International Monetary Fund (IMF, 2020) are taking actions to promote, monitor and support the sustainable development of nations.

The main concerns of sustainable development are economic growth, social protection, and environmental quality protection (Bak et al., 2019). However, it is not easy to strike a balance between these components of sustainable development. For example, the acceleration of economic growth and industrialization promotes the extensive use of natural resources and traditional energy sources, which leads to waste and pollution (Dwivedi et al. 2022). High economic development and growth may result in overconsumption and neglect of resource efficiency (Coscieme et al., 2020; Eisenmenger et al., 2020). Therefore, there is a need to promote environmental practices for high-income countries (EEA, 2016; Pineiro-Villaverde & García-Álvarez, 2020). This led to the proposal for a new agenda: Green Growth. The United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP, 2011) defines green growth as the process of greening the conventional economic system and a strategy to move towards a green economy. The OECD (2011a) defines green growth as "*fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies.*". While sustainable development seeks to incorporate environmental sustainability into economic strategies, green growth focuses on transforming the economic system into a green one (UNESCAP, 2011). Green growth provides new economic opportunities (Kasztelan, 2017a) and contributes to sustainable development by combining social and environmental protection with consideration of economic

development (Gavurova et al., 2021). Green growth is a more attractive approach for policymakers than traditional environmental protection approaches, as traditional approaches are often associated with an economic slowdown (Capasso, 2019). This aspect of traditional environmental protection approaches could be an obstacle to development. Green growth effectively reduces pressure on the environment (Capasso, 2019; Kasztelan, 2017a; Reilly, 2012) and is critical to achieving sustainable development (World Bank, 2012).

Over the last decades, the OECD countries have been among the fastest growing economies (Wang et al., 2020). However, fast economic growth may result in high damage to the environment. Thus, green growth must be the focus of countries. which prioritizes sustainable economic growth while minimizing resource use and carbon emissions (Arzova & Şahin, 2024). There are some studies focusing on measuring and analyzing green growth achievements of the OECD countries. Kim et al. (2014) used a total of 12 indicators to measure overall achievement of green growth of the OECD countries. Kasztelan (2017b) analyzed the level of green growth in some selected OECD countries using Hellwig's method based on 33 indicators. Bak et al. (2019) analyzed the green growth development of the OECD countries using the multi-dimensional correspondence analysis based on a total of 7 indicators. Koçak (2020) measured the dynamics of the green growth in the OECD countries using grey relational analysis based on a total of 22 indicators. Wang et al. (2020) compared the development trends of green growth in some selected OECD from 2004 to 2010 using green productivity approach. Ates and Derinkuyu (2021) evaluated the green growth performance of the OECD countries using the I-distance method based on a total of 11 indicators. Gavurova et al. (2021) analyzed the condition and development of the OECD countries using a total of 15 indicators. These studies mainly focused on measuring green growth performance of the OECD countries. Gavurova et al. (2021) used univariate and multivariate statistical approaches in evaluation green growth achievements of the OECD countries. Besides, Veysikarani and Akdağ (2024) analyzed the relationship between green future and prosperity in the OECD using The Green Future Index and the Legatum Prosperity Index. Tufail et al. (2024) analyzed the relationship between green finance and green growth for some selected OECD countries. There is a need for more efforts in understanding the level of achievements, challenges, needs, strengths, and weaknesses of OECD countries in relation to green growth. For this purpose, this study tries to enhance current knowledge using a descriptive analytical approach.

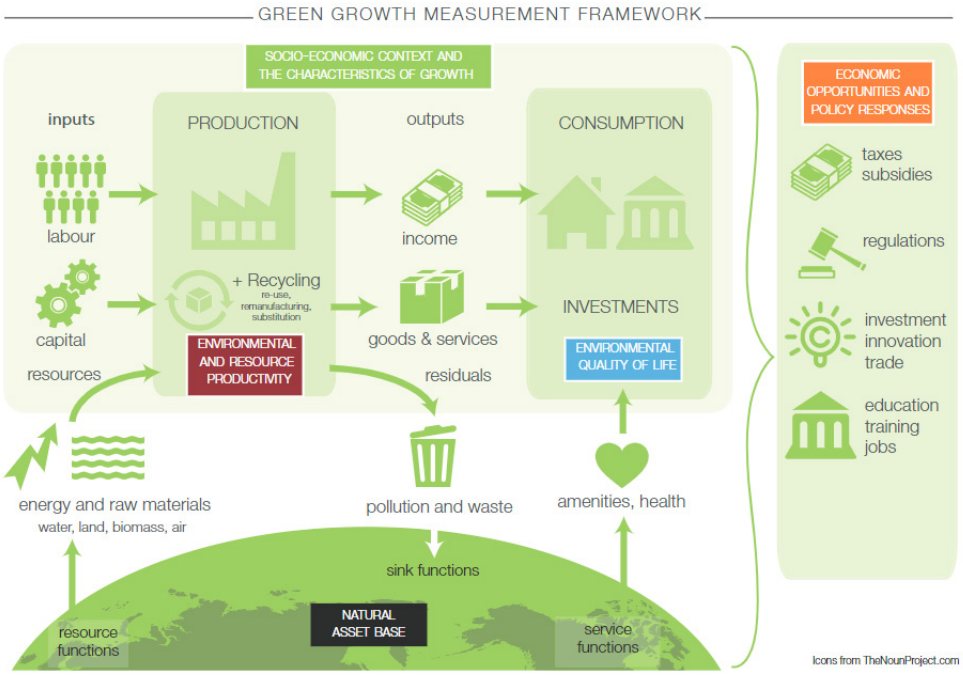
This study aims to analyze the green growth conditions and achievements of OECD countries. For this purpose, the Green Growth Index 2022 (Acosta et al., 2022) is used. First, the green growth achievements of some selected OECD countries were analyzed using a descriptive approach. Then, a cluster analysis is applied to the countries based on green growth indicators. The paper is structured into four main sections. The next section briefly introduces green growth efforts in the OECD. Then the methodological approach of the paper, including the sample, data, indicators, and methods, is explained. The results of the analysis are then presented in detail. The final section presents the conclusions and recommendations.

2. OECD Green Growth Strategy

In 2009, the OECD countries adopted the Declaration on Green Growth in which they stated that they intend to step up their efforts to pursue green growth strategies (OECD, 2009). The OECD argues that "green" and "growth" can go hand – in – hand in this declaration (OECD, 2009). Later, the OECD (2011a) launched the Green Growth Strategy, which contains concrete recommendations, guidelines, and measurement approaches to support countries' green growth efforts. The OECD (2011b, 2014, 2015, 2017) proposed some measurement tools and indicators to measure and monitor countries' green growth efforts and progress. The OECD created a framework for measuring green growth and proposed a set of indicators. These studies have since been updated. The OECD, which publishes studies on measuring and monitoring green growth, is the leading agency in the field of green growth (Hu et al., 2024; Kasztelan, 2017a; Kim et al., 2014; Šneiderienė et al., 2020). The OECD publishes its work on green growth as OECD Green Growth Studies. In its most recent report, the OECD identified 26 indicators to measure green growth and monitor progress in the following 4 main areas (OECD, 2017).

The Green Growth Measurement Framework is given in Figure 1 (OECD, 2017).

Figure 1: Green Growth Measurement Framework



Source: OECD (2017). *Green Growth Indicators 2017*. OECD Publishing, Paris. https://doi.org/10.1787/978.926.4268586-en

The production and consumption of the economy are at the heart of the OECD's approach to monitoring green growth. The OECD framework reflects a "network" concept (Kim et al., 2014), which describes the interactions between the economy, the natural asset base and policy action (OECD, 2017).

3. Methodology

3.1. Sample and Data

The main objective of the study is to analyze the green growth conditions and achievements of OECD countries. There are various proposals for measuring green growth. The most well-known proposals for measuring and monitoring green growth are the Green Growth Measurement Framework proposed by the OECD (2011b, 2014, 2015, 2017), the Measuring Progress Towards an Inclusive Green Economy proposed by the United Nations Environment Programme (UNEP, 2012) and the Green Growth Index proposed by the Global Green Growth Institute (Acosta et al., 2019). The latest Green Growth Index 2022 (Acosta et al., 2022) is used in this study. The framework of the Green Growth Index is shown in Table 1.

Table 1: Indicator Framework for the Green Growth Index (2022)

Index	Dimensions (n=4)	Indicator Categories (n=16)	# of Indicators (n=40)
Green Growth Index	Efficient and Sustainable Resource Use	EE – Efficient and Sustainable Energy	3
		EW – Efficient and Sustainable Water Use	3
		ME – Material Use Efficiency	3
		SL – Sustainable Land Use	3
	Natural Capital Protection	BE – Biodiversity and Ecosystem Protection	3
		CV – Cultural and Social Value	3
		EQ – Environmental Quality	3
		GE – Greenhouse gas Emissions Reduction	3
	Green Economic Opportunities	GJ – Green Employment	1
		GN – Green Innovation	1
		GT – Green Trade	1
		GV – Green Investment	1
	Social Inclusion	AB – Access to Basic Services and Resources	3
		GB – Gender Balance	3
		SE – Social Equity	3
		SP – Social Protection	3

Source: Acosta, L.A., Nzimenyera I., Sabado Jr., R., Munezero, R.M., Nantulya, A., Shula, K., Quiñones, S.G.L., Luchtenbelt, H.G.H., Czvetkó, T., Lee, S. & Adams, G.P. (2022). *Green Growth Index (2022) – Measuring performance in achieving SDG targets*. GGGI Technical Report No. 27, Green Growth Performance Measurement Program, Global Green Growth Institute (GGGI), Seoul, South Korea. https://greengrowthindex.gggi.org/wp-content/uploads/2023/02/2022-Green-Growth-Index-1.pdf

The Global Green Growth Institute (GGGI) uses 4 dimensions to calculate an aggregated Green Growth Index (GGI) for countries. These dimensions are efficient and sustainable resource use, natural capital protection, green economic opportunities, and social inclusion. These dimensions are calculated using 16 indicator categories, and a total of 40 indicators are calculated. (Table 1). The GGI, dimensions and indicator categories are scored on a scale of 1 to 100, with a high score indicating high performance (Acosta et al., 2022). The GGI uses a very high number of indicators for all countries. This makes it possible to compare countries and country groups with the whole world. It also has a reliable methodological background. For these reasons, the GGI is used to examine OECD countries in terms of green growth achievements and conditions. A total of 39 OECD countries are included in the GGI data. However, 5 of these countries (Czechia, South Korea, Slovak Republic, Türkiye, and United States of America) were excluded from the analysis due to missing data. In conclusion, 34 OECD countries are included in the analysis.

3.2. Method

This study uses a descriptive analytical approach to analyze green growth conditions and achievements of OECD countries. Descriptive analytics helps decision makers to understand the past and current conditions of the units (Bayrak, 2015; Delen & Demirkan, 2013; Kunc & O'Brien, 2019). Therefore, this study uses the descriptive analytics approach to identify the current conditions and analyze the achievement level of OECD countries in terms of green growth. Descriptive analytics mainly involves summarizing and visualizing data. In this sense, some summary measures, charts, and graphs are used to analyze the Green Growth Index and its components for the selected OECD countries. In addition, cluster analysis is used to identify differences and similarities between the countries by classifying the OECD countries based on green growth achievement level. The K-Means algorithm is used to classify the OECD countries.

4. Results

Green growth conditions and achievements of OECD countries are analyzed in two main steps. In the first step, the green growth index and the sub-indices of the green growth index are examined. The average scores of these indices were compared using a descriptive statistical approach. Index-based and country-based comparisons were made in order to show the current conditions and achievements of the countries. In the second step, the selected OECD countries were clustered based on the Green Growth indicators using the k-means clustering method. The main purpose of applying cluster analysis is to identify similarities and differences in green growth achievement of the countries.

4.1. Green Growth Achievements of the OECD Countries

In the first step, the achievements of OECD countries in terms of green growth are examined. The average index scores of the OECD countries and the world average are shown in Table 2 on the basis of the GGI and the dimensions of green growth.

Table 2: OECD and World Comparison in terms of Green Growth (2022)

Measure	OECD Average	World Average
GGI – Green Growth Index	64.83	55.02
ESRU – Efficient and Sustainable Resource Use	63.58	56.65
NCP – Natural Capital Protection	72.01	63.03
GEO – Green Economic Opportunities	45.04	40.78
SI – Social Inclusion	87.20	65.45

While the global GGI average is 55.02, the OECD average is 64.22 in 2022. The OECD averages are higher than the global averages for all dimensions of the GGI. OECD countries appear to have different achievement levels in the green growth dimension. To test whether the achievement levels of the countries in the green growth dimensions are significantly different, the Friedman test was applied. The results of the Friedman test are shown in Table 3.

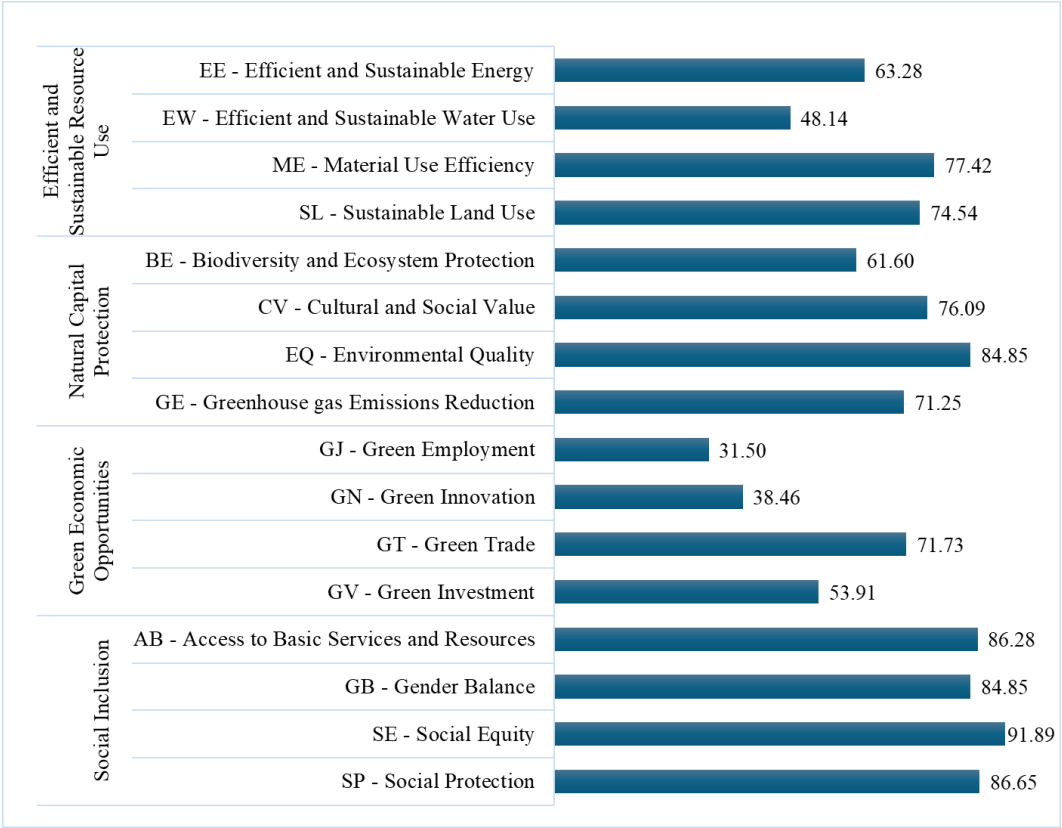
Table 3: Comparison of Green Growth Dimension Achievements in the OECD

Friedman Test Results			Pairwise Comparisons (Durbin-Conover)		
χ^2	df	p-value	Compared Variables	Test Statistic	p-value
91.7	3	< 0.001	ESRU – NCP	7.62	< 0.001
			ESRU – GEO	13.51	< 0.001
			ESRU – SI	20.44	< 0.001
			NCP – GEO	21.13	< 0.001
			NCP – SI	12.82	< 0.001
			GEO – SI	33.95	< 0.001

The results of the Friedman test and the pairwise comparison (Table 3) show that the OECD countries have significantly different achievement levels in the dimensions of green growth. The OECD has the highest achievement in the social inclusion dimension ($\bar{x}_{SI}$ = 87.2). The second highest achievement level belongs to natural capital protection ($\bar{x}_{NCP}$ = 72.01), and the third highest achievement level belongs to efficient and sustainable resource use ($\bar{x}_{ESRU}$ = 63.58). On the other hand, the OECD has the lowest achievement in green economic opportunities ($\bar{x}_{GEO}$ = 45.04). The green economic opportunities dimension is also the least achieved green growth dimension in the world ($\bar{x}$ = 40.78). Therefore, the OECD countries need to prioritize green economic opportunities and efficient and sustainable resource use for green growth.

Average green growth indicator category scores are given in Figure 2.

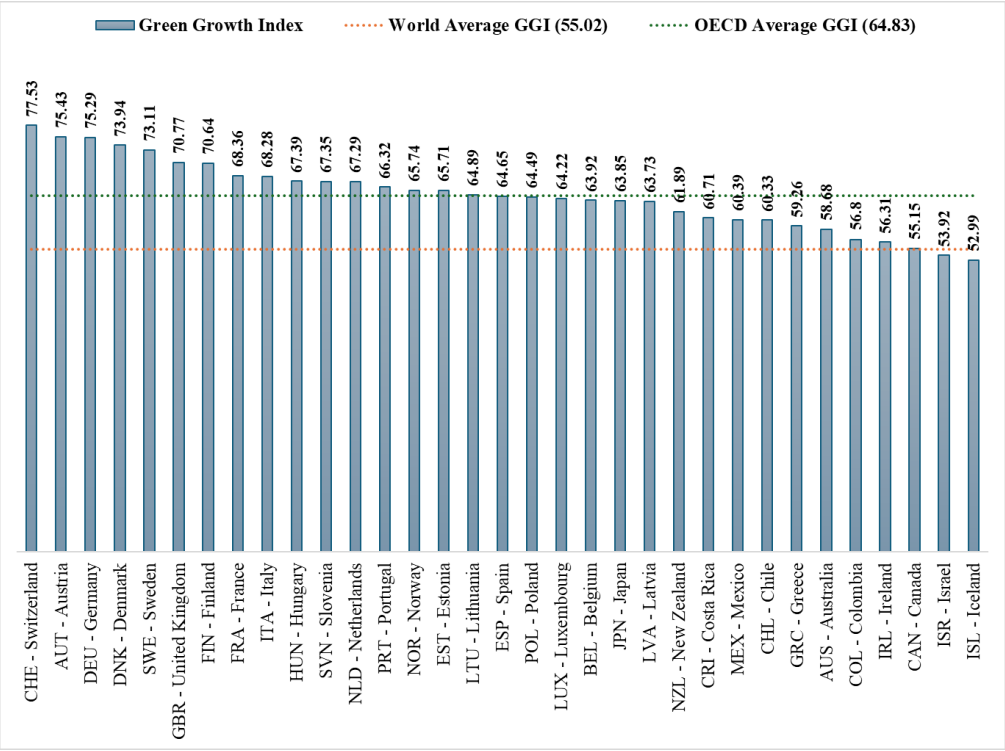
Figure 2: Green Growth Indicator Achievement of the OECD Countries



OECD countries have achieved very high levels of social inclusion indicators. Among the social inclusion indicators and the overall indicators, the highest score belongs to social equity ($\bar{x}$ = 91.89) indicator. In addition to the social inclusion indicators, OECD countries have a very high achievement in the environmental quality ($\bar{x}$ = 91.89), an indicator of the natural capital protection. OECD countries have the lowest scores for green employment ($\bar{x}$ = 31.5), green innovation ($\bar{x}$ = 38.46), efficient and sustainable water use ($\bar{x}$ = 48.14), and green investment ($\bar{x}$ = 53.91) respectively. Green employment, green innovation, and green investment are green economic opportunity indicators. Therefore, we can say that the most important obstacle in achieving green growth is green economic opportunity for OECD countries. In achieving green growth, the main strength of OECD countries is social inclusion, and their main weakness is green economic opportunities.

Each of the OECD countries' green growth indexes are given in Figure 3.

Figure 3: Green Growth Index Score of the OECD Countries



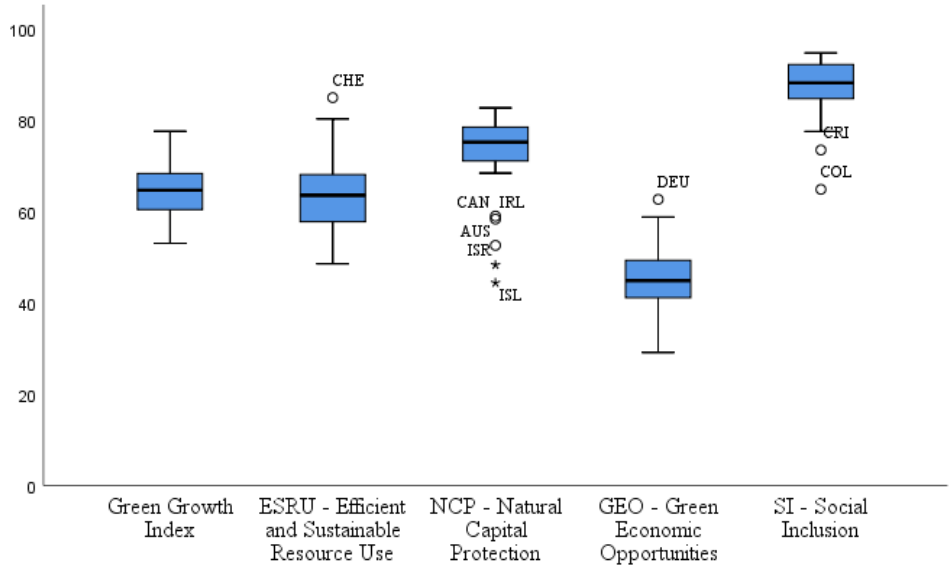
Among the OECD countries, Switzerland (score = 77.53), Austria (score = 75.43), Germany (score = 75.29), Denmark (score = 73.94) and Sweden (score = 73.11) have the highest green growth index scores. Besides, these countries are also the top 5 countries based on the green growth index. On the other hand, Iceland (score = 52.99), Israel (score = 53.92), and Canada (score = 55.15) have the lowest green growth index scores. Iceland and Israel have lower green growth index scores than the world average ($\bar{x}$ = 55.02). The remaining 32 countries have higher green growth index scores than the world average.

Among the OECD countries, Switzerland (score = 77.53), Austria (score = 75.43), Germany (score = 75.29), Denmark (score = 73.94) and Sweden (score = 73.11) have the highest scores on the green growth index. These countries are also in the top 5 of the green growth index. On the other hand, Iceland (score = 52.99), Israel (score = 53.92) and Canada (score = 55.15) have the lowest green growth index scores. Iceland and Israel have a lower green growth index score than the world average ($\bar{x}$ = 55.02). The remaining 32 countries have higher green growth index scores than the world average.

4.2. Clustering the OECD Countries based on Green Growth Indicators

Each of the OECD countries may have different conditions and achievement levels in terms of green growth. To identify these differences, countries need to be examined based on each green growth dimension and indicator. The distribution of the green growth index and the dimensions are shown in Figure 4.

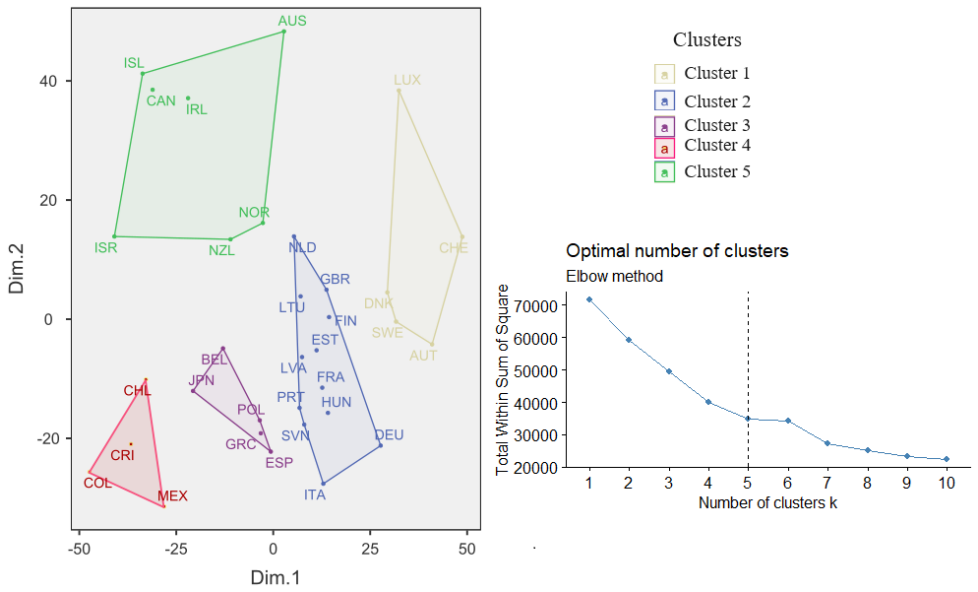
Figure 4: Distribution of Green Growth Achievement of the OECD Countries



The OECD countries appear to be similar in terms of the green growth index. However, these countries perform differently in the dimensions of green growth. Switzerland (CHE) shows a much better achievement in efficient and sustainable resource use compared to the other OECD countries. Iceland (ISL), Israel (ISR), Australia (AUS), Canada (CAN) and Ireland (IRL) have lower achievements in natural capital protection compared to the other OECD countries. Germany (DEU) has achieved much better in terms of green economic opportunities compared to the other OECD countries. Colombia (COL) and Costa Rica (CRI) have lower social inclusion achievements compared to the other OECD countries.

There are different achievement levels in green growth among the OECD countries. In order to identify these differences, a cluster analysis was applied for the OECD countries. In applying the cluster analysis, 16 green growth indicator category (Table 1) scores were used. Cluster plot of the OECD countries are shown in Figure 5.

Figure 5: Cluster Analysis Results



K-Means algorithm is used for clustering countries. K-Means is a non-hierarchical clustering method. In order to apply the K-Means method, the optimal number of clusters must be determined first. The Elbow method is used to determine the optimal number of clusters. The distortion/inertia decreases up to k=5 on the elbow line. Even though there is a small break at k=7 on the elbow line, the inertia starts to decrease linearly after k=5. For this reason, the optimal number of clusters is selected as 5. To summarize, OECD countries can be divided into 5 clusters based on the green growth indicator scores which are shown on the cluster plot (Figure 5). The countries in each cluster and the average green growth index scores of each cluster are listed in Table 4.

Table 4: OECD and World Comparison in terms of Green Growth (2022)

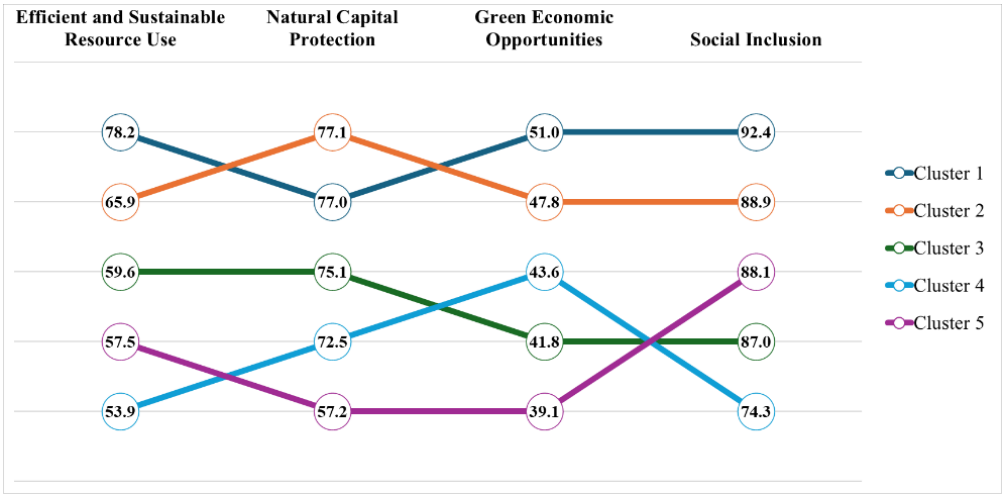
Cluster	Country	Average Green Growth Index
Cluster 1	Austria – Denmark – Luxembourg – Sweden – Switzerland	72.8
Cluster 2	Estonia – Finland – France – Germany – Hungary – Italy – Latvia – Lithuania – Netherlands – Portugal – Slovenia – United Kingdom	68.0
Cluster 3	Belgium – Greece – Japan – Poland – Spain	63.2
Cluster 4	Chile – Colombia – Costa Rica – Mexico	59.6
Cluster 5	Australia – Canada – Iceland – Ireland – Israel – New Zealand – Norway	57.8

The clusters were numbered on the basis of the average scores of the Green Growth Index, i.e., Cluster 1 has the highest average GGI score, and Cluster 5 has the lowest average GGI score. The

countries in cluster 1 have high achievements in the green growth index. These countries can serve as a benchmark for the other OECD countries. On the other hand, the countries in cluster 5 have low achievement in green growth index in average compared to other OECD countries.

Each cluster has its own strengths and weaknesses. To find out these characteristics of the cluster, we need to examine them using the dimensions of green growth and the indicators of green growth. The average score of the clusters for the dimensions of green growth and their ranking are shown in Figure 6.

Figure 6: Average GGI Dimension Scores of the Clusters



Cluster 1 and Cluster 2 are high achiever clusters in terms of green growth dimensions. Cluster 1 has the highest average scores on efficient and sustainable resource use ($\bar{x}$ = 78.2), green economic opportunities ($\bar{x}$ = 51), and social inclusion ($\bar{x}$ = 92.4) and the second highest average score on natural capital protection ($\bar{x}$ = 77). Cluster 2 has the highest average score on natural capital protection ($\bar{x}$ = 77.1) and the second highest average score for efficient and sustainable resource use ($\bar{x}$ = 65.9), green economic opportunities ($\bar{x}$ = 47.8) and social inclusion ($\bar{x}$ = 88.9). The countries in these clusters can be seen as the high achievers.

Cluster 3 ranks third in the efficient and sustainable resource use ($\bar{x}$ = 59.6) and in natural capital protection ($\bar{x}$ = 75.1), but fourth in green economic opportunities ($\bar{x}$ = 41.8) and social inclusion ($\bar{x}$ = 87).

Cluster 4 has the lowest average scores for efficient and sustainable resource use ($\bar{x}$ = 53.9) and social inclusion ($\bar{x}$ = 74.3). Cluster 4 ranks fourth in the natural capital protection ($\bar{x}$ = 72.5) and third in green economic opportunities ($\bar{x}$ = 43.6). The countries in this cluster need to focus on sustainable resource use and social inclusion to make progress on green growth.

Cluster 5 has the lowest average scores for natural capital protection ($\bar{x}$ = 57.2) and for green economic opportunities ($\bar{x}$ = 39.1). Cluster 5 ranks 4th for efficient and sustainable resource use ($\bar{x}$ = 57.5) and 3rd for social inclusion ($\bar{x}$ = 88.1). Countries in this cluster are moderately strong on social inclusion but weak on other dimensions of green growth. The countries in this cluster need to focus on natural capital protection and green economic opportunities to make progress on green growth.

These clusters can also be examined in terms of 16 green growth indicators. The average scores of the clusters for the green growth indicators can be found in Table 5.

Table 5: Average Green Growth Indicator Scores of the Clusters

	Efficient and Sustainable Resource Use				Natural Capital Protection			
Cluster	**Efficient and Sustainable Energy**	**Efficient and Sustainable Water Use**	**Material Use Efficiency**	**Sustainable Land Use**	**Biodiversity and Ecosystem Protection**	**Cultural and Social Value**	**Environmental Quality**	**Greenhouse gas Emissions Reduction**
Cluster 1	74.8^{H}	78.5^{H}	77.3	85.6^{H}	63.6	87.3^{H}	82.7	77.4
Cluster 2	64.0	45.9	80.3	82.8	66.8	82.9	86.2^{H}	74.7
Cluster 3	58.9	35.6	85.7^{H}	72.6	67.2^{H}	73.1	85.9	76.6
Cluster 4	57.7^{L}	32.3^{L}	82.3	57.1^{L}	61.5	64.3^{L}	86.0	82.4^{H}
Cluster 5	60.1	48.2	64.0^{L}	63.8	47.4^{L}	65.2	82.6^{L}	50.7^{L}
OECD Average	**63.3**	**48.1**	**77.4**	**74.5**	**61.6**	**76.1**	**84.8**	**71.3**
	Green Economic Opportunities				**Social Inclusion**			
Cluster	**Green Employment**	**Green Innovation**	**Green Trade**	**Green Investment**	**Access to Basic Services and Resources**	**Gender Balance**	**Social Equity**	**Social Protection**
Cluster 1	32.7	48.1^{H}	75.6^{H}	64.4^{H}	92.3^{H}	93.2^{H}	94.6^{H}	89.8^{H}
Cluster 2	32.0	37.5	75.1	61.5	89.2	86.3	93.3	87.2
Cluster 3	28.8	30.8	75.3	49.4	89.8	80.6	93.9	86.2
Cluster 4	48.0^{H}	30.1^{L}	70.1	36.8^{L}	66.0^{L}	75.0^{L}	79.7^{L}	77.6^{L}
Cluster 5	22.3^{L}	43.5	61.5^{L}	46.5	86.0	85.1	93.1	88.9
OECD Average	**31.5**	**38.5**	**71.7**	**53.9**	**86.3**	**84.8**	**91.9**	**86.7**

Note: H: Highest value among the clusters, L: Lowest value among the clusters

Cluster 1 has the highest average achievement in 11 of the green growth indicators. The main strength of this cluster is the efficient and sustainable water use. The countries in this cluster are high achievers in terms of green growth. On the other hand, these countries need to make more efforts to protect biodiversity and ecosystems, improve environmental quality, reduce greenhouse gas emissions, and promote green employment. Cluster 2 is above the OECD average for all green growth indicators except for efficient and sustainable water use and green innovation. This cluster has the highest average achievement in environmental quality. Cluster 3 has the highest average achievement in material use efficiency and biodiversity and ecosystem protection. This cluster is

strong on these indicators but performs moderately on other indicators. Cluster 4 has the highest average achievement in greenhouse gas emissions reduction and green employment. However, cluster 4 has the lowest average scores on 10 of the green growth indicators. The biggest weakness of the countries in this cluster are the social inclusion indicators. Countries in this cluster need to make more efforts in the area of social inclusion to increase their green growth achievement. Cluster 5 has the lowest average achievement on 6 of the green growth indicators. The biggest weakness of the countries in this cluster is the natural capital protection. In addition to the natural capital protection indicators, countries in cluster 5 also need to make more efforts in the areas of green employment and green trade.

5. Conclusion

This study analyzes the conditions and achievements of green growth in OECD countries using a descriptive analytical approach. This study attempts to examine the achievements, challenges, needs, strengths, and weaknesses of OECD countries in relation to green growth. For this purpose, the Green Growth Index 2022 proposed by the Global Green Growth Institute (Acosta et al., 2022) was used. The OECD countries were examined using the aggregated green growth index, the dimensions and indicators of the green growth index.

The results show that OECD countries have high achievements in green growth in general. However, some countries are lagging behind. OECD countries have significantly different achievement levels in the green growth dimensions. The average achievement levels in green growth dimensions are social inclusion ($\bar{x} = 87.2$), natural capital protection ($\bar{x} = 72.01$), efficient and sustainable resource use ($\bar{x} = 63.58$) and green economic opportunities ($\bar{x} = 45.04$) respectively. Compared to the other dimensions, the OECD countries have the highest achievement level in the social inclusion dimension of green growth in general but also have the lowest achievement level in the green economic opportunities dimension of green growth. The main barrier to achieving green growth for OECD countries is green economic opportunities. Therefore, efforts on green economic opportunities need to be strengthened, especially in the areas of green employment, green innovation and green investment. OECD countries need to prioritize green economic opportunities to boost their green growth. They must also do more to promote efficient and sustainable resource use.

OECD countries show varying degrees of success in green growth indicators. In order to identify similarities and differences between OECD countries in terms of green growth, the countries were grouped into clusters. The cluster analysis results show that OECD countries can be grouped into 5 homogeneous clusters based on green growth indicators. These clusters have different strengths and weaknesses. It can be understood that OECD countries have different conditions, strengths and weaknesses in terms of green growth achievement level. The OECD is making great efforts to guide and support countries in green growth. However, OECD countries have different conditions, resulting in different levels of achievements on the various green growth indicators. To achieve a high level of green growth, identifying these differences is an important reference for guidance. By defining countries' conditions and achievement levels, policy makers and relevant stakeholders

can design more effective plans and develop more effective and useful green growth strategies. The results of this study can provide important clues for identifying country – and cluster-based current green growth conditions, achievements, needs, challenges, and strengths and weaknesses related to green growth.

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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

COMPARATIVE EVALUATION OF EMISSIONS TRADING SYSTEMS AND CARBON TAXES: IMPLEMENTATIONS IN CLIMATE CHANGE MITIGATION THROUGH CARBON PRICING

EMİSYON TİCARET SİSTEMLERİ VE KARBON VERGİLERİNİN KARŞILAŞTIRMALI DEĞERLENDİRMESİ: KARBON FİYATLANDIRMASI YOLUYLA İKLİM DEĞİŞİKLİĞİNİN AZALTILMASINA İLİŞKİN UYGULAMALAR

Sefa ÖZTÜRK*

Abstract

This article investigates the role of carbon pricing mechanisms, specifically Emissions Trading Systems (ETSs) and carbon taxes, in addressing climate change— which is a critical issue in international environmental politics. With the increasing concentration of greenhouse gases contributing to global warming and its consequential adverse effects, there is a pressing need for well-designed climate change mitigation policies. Utilizing a systematic review of global implementations post-Kyoto Protocol, this research examines both theoretical and empirical perspectives on ETSs and carbon taxes. The study contributes to the literature by proposing a multi-layered evaluation framework to assess the efficacy, political durability, policy consistency, flexibility, adaptability, predictability, and regulatory reliability of carbon pricing instruments. The findings suggest that although carbon taxes are praised for their cost-effectiveness in reducing greenhouse gas emissions, their implementation may be hindered by political resistance and public opposition. Conversely, ETSs, despite their complexity, offer market flexibility and the potential for cost-effective emission reductions. However, their effectiveness is contingent upon stringent cap settings and robust market mechanisms. The study reiterates that neither instrument is superior in isolation but functions best as a complementary tool within a broader policy framework.

Keywords: International Environmental Politics, Policy Design, Climate Change, Emissions Trading Systems, Carbon Taxes

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Öz

Bu makale, karbon fiyatlandırma mekanizmalarının, özellikle de Emisyon Ticaret Sistemleri (ETS'ler) ve karbon vergilerinin, uluslararası çevre politikasında kritik bir konu olan iklim değişikliğiyle mücadeledeki rolünü araştırıyor. Küresel ısınmaya katkıda bulunan sera gazı konsantrasyonlarının artması ve bunun sonucunda ortaya çıkan olumsuz etkiler nedeniyle, iyi tasarlanmış iklim değişikliği azaltım politikalarına acil bir ihtiyaç vardır. Kyoto Protokolü sonrası küresel uygulamaların sistematik bir incelemesinden yararlanan bu araştırma, ETS'ler ve karbon vergilerine ilişkin hem teorik hem de ampirik perspektifleri incelemektedir. Çalışma, karbon fiyatlandırma araçlarının etkinliğini, politik dayanıklılığını, politika tutarlılığını, esnekliğini, uyarlanabilirliğini, öngörülebilirliğini ve çevresel hedefler bakımından düzenlemenin güvenilirliğini değerlendirmek için çok katmanlı bir değerlendirme çerçevesi önererek literatüre katkıda bulunmaktadır. Bulgular, karbon vergilerinin sera gazı emisyonlarını azaltmadaki maliyet etkinliğinin ön plana çıkmasına rağmen, bunların uygulanmasının siyasi direniş ve kamuoyu muhalefeti nedeniyle engellenebileceğini gösteriyor. Bunun tersine, ETS'ler karmaşıklıklarına rağmen piyasa esnekliği ve uygun maliyetli emisyon azaltım potansiyeli sunuyor. Ancak bunların etkinliği sıkı emisyon üst sınırı ayarlarına ve sağlam piyasa mekanizmalarına bağlıdır. Çalışma, her iki aracın da tek başına üstün olmadığını, ancak daha geniş bir politika çerçevesinde tamamlayıcı araçlar olarak en iyi şekilde işlev gördüğünü yinelemektedir.

Anahtar Kelimeler: Uluslararası Çevre Politikası, Siyasa Tasarımı, İklim Değişikliği, Emisyon Ticaret Sistemleri, Karbon Vergisi

1. Introduction

Climate change, attributable to human activities, has emerged as a paramount challenge confronting the world. It now occupies a central position in the study of international environmental politics. The escalating concentration of greenhouse gases (GHGs), such as carbon dioxide (CO_2) and methane (CH_4), has precipitated a notable increase in global temperatures, entailing far-reaching consequences. These consequences encompass elevated sea levels, an increased frequency and intensity of extreme weather events, loss of biodiversity, and the degradation of ecosystems and agricultural productivity (IPCC, 2022). The magnitude and global scale of these impacts underscore the imperative need for concerted efforts to both mitigate climate change and adapt to its repercussions. Consequently, the international struggle against climate change has become a foremost agenda in the field of international environmental politics, necessitating robust international environmental cooperation and the development of effective policy designs.

Various policy tools are being employed to combat climate change caused by human activities, and one such tool is carbon pricing. Carbon pricing seeks to rationalize emission reduction among market participants. It is an economic mechanism that assigns costs to GHG emissions by considering their adverse effects on society and the environment, thereby incentivizing emission reduction. Carbon pricing is implemented through two primary methods: Emissions Trading Systems (ETSs), also known as cap-and-trade, where the carbon price is determined in the market, and carbon tax, where the carbon price is predetermined (Morris, 2022).

Despite extensive research on carbon pricing, there remains a lack of consensus on the optimal design and implementation of these mechanisms that can effectively balance various layers of policy outcomes. This study seeks to contribute to the literature by developing an evaluation framework

that encompasses all layers of these policy tools. Thus, it provides an up-to-date policy basis for climate change mitigation, focusing on optimal policy designs and offering a nuanced understanding of the relative merits and drawbacks of ETSs and carbon taxes. The study investigates the relative features of carbon pricing mechanisms in the design of context-appropriate domestic or international policies to combat climate change. Specifically, it compares ETSs and carbon taxes across several layers: Efficiency, political durability, policy consistency, flexibility and adaptability, predictability, and regulatory reliability. The study argues that since the price formation structure differs between the two instruments—with prices being assigned in carbon taxes while market player interactions determine the price in ETSs—this distinction significantly influences the mechanics of the mitigation policy. It markedly impacts the behavior of stakeholders and leads to the emergence of differentiated evaluation layers. Consequently, efficiency, durability, consistency, predictability, and regulatory reliability are the fundamental layers for evaluating these policy instruments. This differentiation highlights the relative advantages and disadvantages of both ETSs and carbon taxes in each context, which should be evaluated through a multi-layered approach, underscoring that these instruments should not be viewed as mutually exclusive but rather as complementary tools in a policy portfolio.

2. Theoretical Framework of Carbon Pricing

The tragedy of the commons illustrates how individual users, having unrestricted access to a common resource, often act in their own self-interest, leading to the depletion or degradation of that resource through collective action. In the context of GHG emissions, the atmosphere can be regarded as a common resource that is collectively utilized without any individual ownership. GHGs, generated from activities such as fossil fuel combustion, deforestation, and industrial processes, are absorbed by the atmosphere. However, those responsible for emitting GHGs do not bear the complete cost of the environmental damage caused by these emissions. This situation aligns with Pigou's concept of negative externality, where the negative impacts of individual actions are not adequately accounted for by the parties involved (Pigou, 1920; Sandmo, 2016).

Each emitter may perceive their individual emissions as a negligible contribution to the overall total, thus perceiving them as inconsequential in terms of harm caused. From an individual standpoint, they may derive benefits from GHG emission activities, while the costs, such as the impacts of climate change, are distributed among the collective. Consequently, there exists a rationale for emitters to release as much GHG as desired for their self-interested gain. However, if everyone adopts this perspective, it leads to elevated emission levels and the subsequent onset of climate change, exemplifying a classic manifestation of Hardin's concept of the tragedy of the commons (Hardin, 1968). Hardin's proposed solutions also involve addressing this problem through taxation or privatization. In other words, creating a cost and establishing a price form the foundation of these proposed solutions (Hardin, 1968, pp. 1245–1247).

Addressing the tragedy of the commons in the context of climate change necessitates mechanisms that can effectively translate shared environmental costs into individual accountability. Carbon pricing involves establishing a monetary value for GHG emissions, achievable through either a

carbon tax or an ETS (Morris, 2022). This economic valuation not only reflects the environmental impact of these emissions but also integrates these costs into the decision-making processes of businesses and individuals. A carbon tax imposes a levy on each unit of GHG emitted, while an ETS sets a cap or quota on total emissions and enables the trading of emission permits. The underlying concept is to internalize the external costs associated with emissions, compelling market participants responsible for GHG emissions to bear the environmental damages they create (Aldy & Stavins, 2012, p. 153). Such mechanisms incentivize market actors to enhance energy efficiency, transition to cleaner energy sources, and, in certain instances, modify behavior or production processes to curtail emissions. By doing so, carbon pricing attempts to shift economic behavior from an exploitative use of the common resource — the atmosphere — towards more sustainable practices and, theoretically, resolves the tragedy of the commons.

ETSs have emerged as a mechanism for pricing carbon, offering market players the opportunity to trade carbon allowances or offset certificates and thereby incentivizing emission reductions. The development of ETSs traces back to the early 1990s when the United States implemented the first cap and trade system for sulfur dioxide emissions, successfully addressing acid rain issues and serving as a model for subsequent carbon markets (van Asselt, 2016). The Kyoto Protocol, a significant milestone in international climate change negotiations accepted in 1997, played a vital role in the global expansion of carbon markets. Through mechanisms like the Clean Development Mechanism and Common Practice, the Protocol allowed developed nations to invest in emission reduction projects in developing countries and receive carbon credits in return (Chuang et al., 2019; 'Kyoto Protocol to the United Nations Framework Convention on Climate Change', 1997). Noteworthy among the carbon markets is the European Union ETS (EU ETS), launched in 2005, which stands as the largest and most prominent carbon market encompassing diverse sectors in member states. Research on the EU ETS has demonstrated its effectiveness in reducing emissions and driving the adoption of cleaner technologies within covered sectors (Martin et al., 2016, p. 16; Valdivia, 2014, p. 126). Similar positive outcomes have been observed in other carbon markets, such as the Regional GHG Initiative (RGGI) in the Northeastern United States. Furthermore, several regional and national carbon markets have emerged, including the California Cap and Trade Program in the United States and the New Zealand Emissions Trading Program. The Paris Agreement of 2015 further solidified the role of carbon markets by incorporating provisions for voluntary international cooperation, including emissions trading, to achieve emission reduction targets (Gulbrandsen & Wettestad, 2022, p. 231).

Another approach to carbon pricing is through the implementation of "Pigouvian" taxation. When a market activity generates negative externalities, it means that the total cost to society, known as social cost, exceeds the private cost borne by the individual or firm conducting the activity. Because these external costs are not factored into the market price, the allocation of resources may become inefficient, resulting in market failure. The purpose of a "Pigouvian" tax is to address this market failure by setting the tax equal to the per-unit external costs associated with the activity. This adjustment aligns the private cost with the social cost, thereby incentivizing individuals or firms to reduce their activity to a socially optimal level. In the context of climate change, a carbon tax serves as a type of "Pigouvian" tax (Metcalf & Weisbach, 2013, p. 9). By levying taxes on the carbon content

of fossil fuels, the carbon tax internalizes the external costs linked to climate change, presenting a market-based solution for reducing GHG emissions.

The introduction of carbon taxes has seen considerable progress in various countries around the world. Finland took the lead in 1990 by implementing a carbon tax, initially targeting fossil fuels used for heat and electricity generation. Following suit, Sweden introduced its own carbon tax in 1991 covering a broad range of fossil fuels. Sweden's carbon tax stands among the highest globally and has proven effective in reducing the country's carbon emissions. In the same year, Norway also introduced a carbon tax, encompassing petroleum products, coal, and natural gas. While it includes certain exemptions, the tax has predominantly driven a shift towards the utilization of hydroelectric power. In 2001, the United Kingdom introduced the Climate Change Levy (CCL), an energy tax applicable to non-domestic users (Sumner et al., 2011, p. 922). British Columbia became the first jurisdiction in North America to adopt a carbon tax in 2008. Employing a phased approach, the tax commenced at a low rate and incrementally increased over time, allowing businesses and households to adjust gradually (Bumpus, 2015, p. 481). Ireland introduced a carbon tax in 2010, encompassing most fossil fuels, with its rate steadily rising since its inception (Conefrey et al., 2013, p. 934). In 2012, Australia implemented a carbon pricing mechanism as a carbon tax. However, it was subsequently repealed in 2014 (Crowley, 2017, p. 1). Mexico became the first developing country to impose a carbon tax in 2013, focusing on fossil fuel sales and imports based on their carbon content. Chile followed suit in 2014, enacting a carbon tax law that took effect in 2017, primarily targeting large, fixed emitters, particularly within the energy sector (Flores & Mardones, 2017, p. 334). Portugal joined the ranks in 2015, implementing a carbon tax on fossil fuel combustion in the energy and industrial sectors, alongside reforms to the energy tax system (Pereira et al., 2016, p. 110). These diverse examples highlight the global momentum surrounding the implementation of carbon taxes to address climate change and mitigate GHG emissions.

The implementation of carbon pricing mechanisms, however, presents its own set of challenges and opportunities. It requires careful balancing of economic impacts, social equity, and environmental effectiveness. The success of these mechanisms is contingent on their design, the political and economic context in which they are implemented, and their ability to adapt to evolving environmental and technological realities.

3. Methodology

This study employed a systematic review approach focusing on the global implementations of ETSs and carbon taxes. The literature included peer-reviewed academic journals, authoritative reports, and case studies published focusing on the period after the Kyoto Protocol, which promoted market-based instruments for mitigating climate change. The inclusion and exclusion criteria were applied to Google Scholar, Web of Science, and Scopus searches using terms such as "carbon pricing," "carbon taxes," "emissions trading systems," and related variants and combinations. This ensured a high-quality concentration on contemporary and relevant data and discussions in the field of carbon pricing. The scope of the literature review encompassed both empirical and theoretical analyses,

with an emphasis on studies that provided insights into the practical applications and theoretical underpinnings of carbon pricing mechanisms. The evaluation was structured to systematically assess each layer of policy evaluation, drawing on the identified literature to support or challenge the theoretical and empirical findings related to ETSs and carbon taxes. Various case studies were used to provide practical examples and insights. The multi-layered approach is inspired by similar frameworks utilized in Narassimhan (2018), Haites (2018), Aldy and Stavins (2012), Doda (2016), Green (2021) which are all review theories and experiences of carbon pricing mechanisms. Therefore, the study has identified several layers for evaluation. Each of these layers is supported by theoretical and empirical studies that justify their existence: Efficiency, political durability, policy consistency, flexibility, adaptability, predictability, and regulatory reliability are major layers of evaluation.

Efficiency layer evaluates how effectively each system allocates resources to reduce emissions cost-effectively. The efficiency of carbon pricing mechanisms is underscored by Aldy & Stavins (2012) and Metcalf & Weisbach (2013), who discuss the economic rationales for using market-based tools to address greenhouse gas emissions.

Political durability dimension assesses the resilience of ETS and carbon taxes to political changes. The concept of political durability draws from Jordan & Moore (2023), Rabe (2016) emphasizing the importance of policy resilience in fluctuating political landscapes.

The policy consistency layer examines the ability of each system to integrate with international climate change mitigation efforts. The flexibility and adaptability aspect evaluates the ability of each system to adjust to technological advancements and changing economic conditions. Policy consistency, flexibility, and adaptability are derived from the dynamic nature of climate change mitigation efforts, as articulated by Aldy et al. (2003), Rhodes (2021), and (Evans et al., 2023).

Predictability and regulatory reliability layers compare the predictability of each system for businesses and their effectiveness in ensuring environmental outcomes. Predictability and regulatory reliability resonate with the literature as a commonly mentioned themes, focusing on the importance of clear policy signals to drive market participants towards sustainable outcomes (Green, 2021, pp. 3–4; Johnstone et al., 2010, pp. 9–13). These layers of evaluation are applied to assess the strengths and limitations of each carbon pricing mechanism, supported by up-to-date examples for each.

4. Evaluation of Carbon Pricing Instruments

Efficiency

Efficiency in carbon pricing mechanisms is defined by their cost-effectiveness in achieving emissions reduction targets (Rousseau & Proost, 2009, p. 25). This entails minimizing the economic costs of reducing GHG emissions, and avoiding undue burdens on businesses and consumers (Rousseau & Proost, 2009, p. 40). Furthermore, an efficient system should be straightforward to implement and manage, characterized by clear guidelines and procedures and minimal complex rules. Such simplicity reduces bureaucratic overhead and compliance costs, facilitating streamlined processes for

both government and regulated entities, leading to reduced monitoring, enforcement, and paperwork for governments and lower compliance costs for businesses and industries (Flues & Dender, 2020, p. 45).

In ETSs efficiency revolves around the notion that market forces possess the capacity to allocate resources optimally and economically when unrestricted. Grounded in the fundamental principles of supply and demand, this concept highlights the role of price determination through the dynamic interplay between buyers and sellers within a market. By allowing these market dynamics to operate freely, efficiency can be achieved as resources are allocated in the most effective and cost-efficient manner. Market efficiency may even improve as market phases progress, as seen in the EU ETS example (Mirzaee Ghazani & Jafari, 2021, p. 61093).

The ETSs play a crucial role in facilitating cost-effective emission reduction by establishing an emissions allowances market. This framework incentivizes participants to reduce emissions where it is most cost-effective and to sell surplus allowances to those with higher abatement costs. For example, a company that reduces emissions at a low cost through enhanced energy efficiency or renewable energy adoption can trade excess allowances with companies facing more expensive reduction options. This encourages efficient resource utilization and stimulates investment in emission-reducing technologies and innovative business processes, furthering emissions reductions. The ETS model also fosters innovation by enabling income generation from the sale of excess allowances for participants achieving lower-cost emissions reductions (Martin et al., 2016, p. 13). Participants facing higher abatement costs can offset their expenses by purchasing these allowances, encouraging investment in innovative emission reduction technologies (Narassimhan et al., 2018).

The case of Danish energy company Ørsted provides a compelling example of how innovation can be fostered within the framework of an ETS. Ørsted has achieved a transformation, transitioning from one of Europe's most coal-intensive enterprises to a global leader in renewable energy (Abraham-Dukuma, 2021; Madsen & Ulhøi, 2021). The EU ETS has played a pivotal role in facilitating this transition by offering Ørsted a strong financial incentive to invest in renewable energy technologies. By making substantial reductions in its carbon emissions, Ørsted has been able to capitalize on its green transition by selling excess allowances on the ETS market, leading to significant economic benefits (European Commission, 2020). It is worth noting that Ørsted's experience is not an isolated one. The ETS framework has effectively stimulated a surge in innovations related to clean technologies across diverse industries in China (Cui et al., 2018, p. 453). Within the ETS framework, companies have successfully leveraged innovation to mitigate emissions through various means, such as improving energy efficiency, adopting cleaner fuels, embracing carbon capture and storage technologies, and more.

While market-based instruments have advantages, they also have various disadvantages. ETS are subject to market dynamics and can experience price volatility (Feng et al., 2011, p. 591). Carbon taxes do not have this issue, ensuring a more stable cost for carbon emissions. Furthermore, ETSs are more complex, requiring greater bureaucratic and administrative capabilities. It requires a robust

infrastructure for tracking and trading emissions allowances, plus regular adjustments to the cap and oversight of the carbon market, while carbon taxes are simpler to implement and manage. In certain contexts, it may be more feasible and efficient to implement carbon taxes rather than ETSs as a policy instrument due to their relative simplicity. Additionally, carbon taxes can provide a clear and consistent revenue stream for governments. This revenue can be used to fund climate mitigation and adaptation projects or be redistributed to citizens to offset the increased costs of energy. Another risk associated with market-based mechanisms is that ETS can suffer from over-allocation of allowances or market manipulation, which can undermine their environmental integrity. A carbon tax avoids these issues by setting a clear price on emissions. While the tax imposes recurring costs for carbon emissions, it lacks a clear financial reward system for companies that surpass a specific threshold for emission reduction. Determining an appropriate tax rate that effectively achieves emission reduction targets without burdening specific industries or sectors can pose challenges (Haites, 2018, p. 961). Consequently, while companies are motivated to minimize their emissions to avoid taxes, they may not be equally encouraged to innovate as they would be under an ETS, where they can directly profit by selling excess allowances.

Political Durability

In the context of climate policy, political durability refers to the ability of a policy or regulatory framework to endure over time (Jordan & Moore, 2023, p. 425), regardless of shifts in political leadership, public sentiment, or economic conditions. Durable policies have the capacity to withstand political changes and maintain their core objectives and mechanisms, even when governments transition. When a policy demonstrates political resilience, it suggests that it has garnered bipartisan or extensive stakeholder support and has integrated itself into the political landscape and institutional frameworks in a manner that makes it resistant to repeal or substantial modification.

In terms of political durability, the carbon tax has encountered several challenges, primarily due to the direct impact of the tax burden on voters in democracies. In carbon tax systems, emitters bear the responsibility of paying the tax, which provides them with a more predictable and stable price signal (Compernolle et al., 2022). However, this may also result in a higher pass-through of costs for society. Consequently, the costs are immediately imposed on voters in the short term, while the benefits of the revenue generated may materialize in the longer term. As a result of this gap, there can be political pressure to abolish such taxes, as exemplified by the Australian experience with carbon tax.

From the introduction of a carbon pricing mechanism to its subsequent repeal, Australia has undergone a contentious process in formulating and implementing policies aimed at reducing carbon emissions. In 2012, under the leadership of Prime Minister Julia Gillard and the Labor Party, the Australian government enacted the Clean Energy Act, which established a carbon pricing mechanism imposing a flat price on carbon emissions (Perry et al., 2013, p. 104). However, the implementation of this mechanism has been accompanied by significant controversy. Industry groups, conservative politicians, and segments of society voiced opposition to the carbon tax, asserting that it would lead to higher energy prices, economic harm, and job losses (Grubel, 2012). The political discourse

surrounding the carbon tax became a central focus during elections. Subsequently, in 2014, the carbon pricing mechanism was repealed following the election victory of the Liberal Party. The new government contended that the carbon tax was ineffective, burdensome for businesses, and resulted in increased household costs (Taylor, 2014). The Australian carbon tax has been criticized as poorly conceived, inadequately executed, and lacking substantial public support even prior to its implementation (Robson, 2014, p. 35).

In contrast, exemplary practices in terms of political durability can be observed in various ETS examples. Notably, the EU ETS stands as the world's largest and longest-running ETS, having been successfully implemented since 2005. This system has demonstrated resistance to political pressures and has gained acceptance from stakeholders (Jordan & Moore, 2023, p. 437). Such achievements have contributed significantly to political stability and the sustained efforts for long-term emissions reduction. Moreover, the EU ETS has proven efficient in achieving a noteworthy reduction in emissions within its covered sectors, while also encouraging investments in low-carbon technologies (Calel & Dechezleprêtre, 2016; Colmer et al., 2020).

Another notable illustration is the California Cap-and-Trade Program. California, with its position as the state possessing the largest economic power in the United States and its pioneering role in the fight against climate change, successfully implemented its ETS in 2013. The California Emissions Trading System is founded on a robust legal and administrative framework that ensures political continuity. It has garnered political support, public acceptance, and has expanded over time, highlighting its political durability (Rabe, 2016, p. 118).

In terms of durability, it is important to emphasize that the decisive factor lies in the formation of a coalition seeking the repeal of a policy. The carbon tax, due to its imposition of a uniform cost on all, is more likely to create a shared interest among those seeking its abolition as seen in the Australian case. The presence or absence of such a coalition directly impacts the durability of environmental policies. An illustrative example in this regard can be found in the case of the Montreal Protocol.

One factor influencing the policies of the United States, a significant participant in the Montreal Protocol, was the dissolution of an industry coalition opposing CFC regulations. The Alliance of Responsible CFC Policy was formed to address demand-driven controls, which had the potential to harm both producers and users. However, the impact of supply-oriented controls varied based on specific details. While the top three major CFC producers accepted the Alliance's new policy, the other two smaller producers did not agree with the situation. This exemplifies that large producers recognize the potential for market consolidation and more favorable conditions resulting from CFC regulations. Conversely, for small producers, such consolidation would spell the end of their existence (Parson, 2003, p. 127). Notably, the competition between major manufacturers and European and Japanese firms necessitated international coordination of CFC regulations for significant actors. As a result, the interests of large producers within the Alliance for Responsible CFC Policy began to diverge from those of their smaller counterparts by 1986 (Falkner, 2001, p. 165). Additionally, the relatively substantial research and development budgets of large manufacturers provided them with

an advantage (Falkner, 2005, p. 110). This suggests that major manufacturers strategically shifted their anti-regulation stance and concluded that influencing the process in their own interests would be more favorable than outright opposing CFC regulations. The situation described here serves as an example of how differences in interests can hinder coalition formation or cause an existing coalition to disintegrate. On the other hand, a fixed additional tax cost imposed on all market players is more likely to generate a convergence of interests against it. Conversely, in ETSs, market actors have diverse options depending on their specific circumstances. This reduces the clustering of interests, thereby inhibiting the formation of strong coalitions against regulatory policies. The existence and status of such coalitions are crucial for the future of regulatory policy.

Policy Consistency

Policy consistency within the scope of this study refers to policy coherence and policy integration (Evans et al., 2023, pp. 9–10) which brings standardization and consistency of regulatory frameworks across different geographic regions or jurisdictions. This entails the establishment of similar rules, standards, and practices concerning carbon emissions. Policy consistency minimizes inconsistencies between regulatory jurisdictions, reduces complexity, and facilitates the operation of businesses across borders, thereby enabling multinational companies to comply easily with these regulations across the various countries in which they operate. Moreover, promoting a synchronized global effort to mitigate climate change, it enhances the effectiveness of policies that are implemented and enforced in a standardized manner worldwide. This is a subject that has been extensively discussed in literature (Haites, 2015; Müller & Slominski, 2016; Vöhringer, 2012).

In terms of policy consistency, the possibility of trading emissions allowances between countries through the ETS should be underscored. Under the ETS framework, countries are able to engage in cross-border emissions allowance trading by establishing harmonized ETSs. This enables international climate cooperation in efforts to reduce emissions and provides a framework for linking different regional or national systems. Second, the ETS facilitates regional integration. It serves as a suitable mechanism for combining ETSs across different regions. By establishing coherent systems, emissions allowances from various regions can be interconnected. A prime example is the European Union's ETS, which enables emissions allowance trading among member states, creating a common market for emissions reduction across the EU and ensuring regional coherence. Lastly, ETSs can be better aligned with a possible global framework for emissions reduction.

The primary example of policy consistency is the linking of ETSs such as the EU ETS and the Swiss ETS or the linking of the California and Québec cap-and-trade programs, which expanded the scope of the two systems (Isser, 2016, p. 59). In 2020, the EU and Switzerland established a linkage between their respective ETSs, allowing companies operating in both regions to utilize allowances from both systems for compliance purposes. This integration created a larger and more liquid market, reduced compliance costs, and facilitated easier planning and operations for multi-jurisdictional companies (Verde & Borghesi, 2022, pp. 32–33). Prior to the integration of the EU ETS and the Swiss ETS, a Swiss-based multinational with operations across the EU had to manage two separate allocation

sets, each with its own price dynamics and eligibility rules. However, after the integration, these allocations became interchangeable, streamlining compliance procedures and planning processes. The company can now adopt a comprehensive approach to emissions reduction in its European operations, maximizing efficiency and cost-effectiveness. There was also an intention to establish a link between the EU ETS and the Australian ETS. However, following the debate over the carbon tax in Australia, the ETS legislation was also abolished (Verde & Borghesi, 2022, p. 33).

Unlike an ETS, which necessitates the creation of a complex market for trading emissions allowances, a carbon tax is a straightforward levy on the carbon content of fossil fuels. Carbon taxes are typically implemented at the national level and can vary significantly between countries. Implementing and managing a carbon tax system is generally simpler than an ETS Carbon taxes can be applied broadly across all sectors, avoiding the need for sector-specific cap-setting as in ETS. While this simplicity renders the system less complicated, it also presents challenges in achieving international coherence and coordination. For example, different countries may impose different tax rates, leading to trade and competitive imbalances, and hindering the harmonization of international efforts towards emissions reduction. For instance, Sweden has implemented a higher carbon tax per ton of CO_2, whereas neighboring Finland imposes a considerably lower tax rate on carbon (Sumner et al., 2011, p. 924). For companies operating in both countries, managing distinct tax systems introduces complexity and potential inconsistency to their emissions reduction strategies, making it challenging to achieve an international policy effort. Sharp disparities in carbon pricing can also distort competition, placing businesses in high-tax areas at a disadvantage. This could lead to the migration of companies towards regions with no or relatively lower taxation. In a sense, it might result in the creation of havens in the context of climate.

Flexibility and Adaptability

Flexibility and adaptability pertain to the ability of a policy or regulatory framework to adjust and accommodate changing conditions, including economic fluctuations, technological advancements, new scientific discoveries, or evolving societal needs. A policy framework characterized by a high degree of flexibility and adaptability can ensure the continued effectiveness and relevance of its regulations as time progresses (Aldy et al., 2003, p. 378; Doda, 2016, p. 138). It can effectively respond to unforeseen challenges or opportunities and incorporate diverse strategies to accomplish its objectives. This attribute holds particular significance in complex and rapidly evolving domains such as climate change mitigation.

While ETSs and carbon taxes are assessed based on their flexibility, the most notable differences between them arise from their distinct carbon pricing mechanisms. In ETSs, prices are determined by the market, which allows changing conditions to be dynamically reflected in the pricing. Within ETSs, modifying the overall emissions quota to reflect new targets is relatively straightforward. With access to updated information, the central authority may adjust its strategy for acquiring emissions permits, thereby ensuring significant policy flexibility and adaptability (Aldy et al., 2003, p. 387). In such cases, industries may benefit from the flexibility of the policy to adjust their emission levels

according to their unique circumstances and business requirements. For example, if a market participant invests in cleaner technologies and successfully reduces emissions below the allocated quotas, it can sell the excess allowances to other companies facing higher abatement costs. On the other hand, carbon taxes typically rely on fixed pricing mechanisms. Although tax rates can be adjusted, such modifications often require time-consuming legislative processes and political negotiations, limiting the responsiveness of the system to changing conditions or the inclusion of new sectors and gases within the tax framework.

Secondly, the ETSs facilitate cross-border trading of emissions allowances, fostering regional and international integration. RGGI serves as an example of an ETS that showcases flexibility and adaptability. The program was initially launched in the U.S. with ten states in 2009 and has since expanded to include Virginia in 2021. Furthermore, RGGI has demonstrated its ability to adjust and evolve by tightening emission caps and incorporating additional types of emissions, reflecting its resilience to changing conditions and progress in emissions reduction. Since its inception, over time, RGGI has demonstrated its flexibility through various actions, including the addition of new states, reduction of the upper emissions limit, expansion of the program's scope, and effective price management. Regarding the addition of new states, RGGI has progressively expanded its reach since its inception. Initially consisting of ten northeastern states, the program saw the official inclusion of Virginia in 2021, marking the first southern state to join the initiative (RGGI, 2020). This expansion underscores RGGI's ability to foster collaboration and engagement across diverse regions. In terms of reducing the upper emissions limit, RGGI states have collectively agreed to lower their emissions caps by 2.5% annually until 2030, resulting in an additional 30% reduction in emissions (International Carbon Action Partnership, 2021). This commitment demonstrates the program's capacity to adjust and tighten its regulations in response to evolving environmental goals and scientific data. Furthermore, the scope of the RGGI program has expanded over time. While initially focusing solely on CO_2 emissions, recent discussions among participating states have indicated the potential for the program's extension to include emissions from transportation fuels (Shemkus, 2019). This expansion reflects the adaptability of the initiative and its commitment to addressing emerging challenges and priorities. RGGI has also exhibited flexibility in managing allowance prices. The program incorporates a Cost Containment Reserve that releases additional allowances if prices surpass a certain threshold (RGGI, 2023). This mechanism ensures that compliance costs for businesses remain controlled, preventing sudden and significant price fluctuations. To sum up, RGGI's expansion, adjustments to caps, and incorporation of additional emission types demonstrate its ability to respond to evolving conditions and drive progress in emissions reduction efforts with its flexibility and adaptability.

Predictability

Policy predictability refers to the degree to which future regulatory conditions can be anticipated based on current policy frameworks. This means that over a period, businesses can expect a stable set of rules and regulations, which allows them to make strategic decisions and plan with a comprehensive understanding of the operating environment. A predictable policy environment mitigates the

business risks associated with regulatory changes and empowers companies to confidently commit to long-term sustainable practices (Doda, 2016, p. 139).

Carbon taxes may offer a predictable and stable carbon price, aiding in long-term business and investment planning. This predictability is vital for companies transitioning to low-carbon operations. However, carbon taxes may also introduce uncertainty. For instance, Canada's federal carbon pricing started at $20 per ton of CO_2 in 2019, with planned annual increases, but later revisions projected it to reach $170 per ton by 2030 (Environment and Climate Change Canada, 2021). Such policy changes can disrupt long-term planning and alter cost projections for businesses. In contrast, the EU ETS establishes a clear, decreasing cap on emissions for key sectors, reducing by 2.2% annually in the Phase IV period (2021-2030) (European Commission, 2023b). This provides businesses a clear policy trajectory, aiding in long-term investment planning. Yet, the market-driven nature of ETS pricing, while dynamic, poses predictability challenges due to potential price fluctuations, complicating long-term strategic planning.

Regulatory Reliability

Regulatory reliability is a theme often considered in carbon pricing research. It is observed that many studies discuss this topic without explicitly using this term (Andersson, 2019; Green, 2021; Metcalf, 2021). Therefore, regulatory reliability pertains to the assurance that specific environmental outcomes or targets will be achieved. It underscores the capability of a regulatory system to yield a specific environmental outcome—specifically, emission reductions—in accordance with climate change mitigation goals. This establishes it as an important layer for assessment.

In ETSs, a maximum limit is set on GHG emissions for covered sectors, enforced by a stringent and progressively decreasing cap on total emissions. This approach, ensuring emissions do not exceed the cap regardless of allocation distribution or trading, contrasts with carbon taxes, which influence the cost of emissions but do not strictly limit their volume. For instance, the EU ETS establishes a decreasing limit on emissions, with a 1.74% annual reduction for power plants and industrial facilities during Phase III (2013-2020) (European Commission, 2023a). Similarly, the Regional Greenhouse Gas Initiative (RGGI) sets a diminishing CO_2 cap for the energy sector, providing a clear trajectory for environmental target achievement.

While carbon taxes do not set a specific emissions reduction target, empirical evidence suggests they are effective in reducing emissions (Andersson, 2019, p. 27; Green, 2021, p. 9; Metcalf, 2021, p. 255). Therefore, despite the absence of a defined upper limit for emissions, it cannot be concluded that carbon taxes are ineffective in providing regulatory reliability.

5. Discussion

Carbon taxes are generally acknowledged as the most cost-effective means for reducing GHG emissions. However, these policies encounter significant opposition due to their conspicuous costs and adverse public opinion. Consequently, few regions implement carbon taxes at levels sufficient

to meet the decarbonization targets outlined in the Paris Agreement. In instances where regulatory measures are adopted, policymakers frequently favor market-oriented or flexible regulations. Diverging from traditional command-and-control regulations that specify compliance methods, these flexible regulations grant regulated bodies the discretion to meet performance standards in various ways. They also permit the trading of compliance credits, enabling entities that do not meet the standards to purchase excess credits from those exceeding them, provided the overall requirements of the regulation are met. Consequently, flexible regulations offer a dual advantage: they are both effective in curbing emissions and politically viable (Rhodes et al., 2021, p. 1).

Evidence indicates that carbon taxes and ETSs should be considered elements of a broader array of mitigation strategies rather than as mutually exclusive optimal solutions. In practice, jurisdictions implementing a carbon tax often concurrently operate an ETS, and those with either a tax or an ETS invariably employ additional measures targeting emissions from sources covered by the tax/ETS. The rationale for this multifaceted approach, grounded in both theoretical and practical considerations, is to employ a combination of price-based and non-price mechanisms to mitigate GHG emissions. However, this approach of utilizing multiple instruments not only escalates compliance costs but also gives rise to complex interactions and distributional impacts (Haites, 2018, p. 963).

It should be emphasized that the relative advantages and disadvantages highlighted in certain dimensions of assessment cannot be simply aggregated or subtracted to determine their overall impact on the balance. In other words, the prominence of an instrument in many dimensions does not necessarily imply its superiority over other. Indeed, an instrument that appears disadvantaged in numerous dimensions might operate more effectively in unique contexts due to its relative advantages in certain aspects.

6. Conclusion

The existing literature elucidates the layers of evaluation in this study, which include efficiency, political durability, policy consistency, flexibility, adaptability, predictability, and regulatory reliability. Based on these layers, the study assesses various carbon pricing instruments, with experiences illuminating the relative merits and drawbacks of ETSs and carbon taxes. This facilitates informed decision-making in the domain of carbon pricing. By providing insights into the design of effective emission reduction policies, the study contributes to informed and sustainable policy decisions on climate change. Both ETS and carbon taxes can serve as effective components within a mitigation policy portfolio, functioning as complementary tools.

ETS, offers the advantage of setting a clear limit on emissions, providing certainty about environmental outcomes if the cap is set appropriately. It allows for market flexibility, as companies can trade emissions allowances, potentially leading to cost-effective emissions reductions. ETS can be complex to design and implement, requiring a robust monitoring and enforcement framework. It can also be subject to market volatility, which might lead to unpredictable costs for businesses. Over-allocation of permits or a lack of stringent caps can undermine the system's effectiveness.

Carbon taxes are simpler to administer and provide relatively predictable prices for carbon emissions, facilitating easier long-term planning for businesses. They generate government revenue, which can be used for climate initiatives or offsetting the tax burden elsewhere. Carbon taxes are transparent and straightforward, making them potentially more palatable to the public and easier to implement. The effectiveness of a carbon tax depends heavily on the tax rate; if set too low, it may not sufficiently incentivize emissions reductions. There is also the political challenge of setting and potentially raising the tax over time. Unlike ETS, carbon taxes do not provide a hard cap on emissions, potentially leading to uncertainty about environmental outcomes.

Future research should focus on expanding the comparative analysis of ETS and carbon taxes within diverse economic and geopolitical contexts. There is a particular need for empirical studies assessing the effectiveness of these mechanisms in developing countries, where economic constraints and different policy priorities may influence outcomes. Furthermore, longitudinal studies examining the long-term impacts of ETS and carbon taxes on innovation in green technologies would provide valuable insights. This could include analyzing how different industries adapt to these mechanisms and the subsequent effects on sustainable economic growth. Another critical area of exploration is the intersection of carbon pricing mechanisms with broader socio-political dynamics, including public acceptance, political feasibility, and the role of international cooperation and agreements in shaping these policies. Research in these areas guide more nuanced and effective policy formulations in the ongoing global effort to mitigate climate change.

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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

DETERMINANTS OF SUSTAINABILITY REPORTING PRACTICE IN TÜRKİYE

TÜRKİYE'DE SÜRDÜRÜLEBİLİRLİK RAPOLAMA UYGULAMALARININ BELİRLEYİCİLERİ

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Abstract

The aim of the study is to analyze the level and determining factors of sustainability reporting practice in Türkiye. A GRI-based sustainability disclosure index was employed to evaluate the sustainability reporting practice and the company level characteristics of sustainability reporting practice of 67 companies, which are listed in BIST Sustainability Index, over a period of 2 years, using a panel data analysis were examined. It was documented that listed companies in Türkiye are soft sustainability disclosurers and prefer to disclose environmental-related information more than economic and social information. The findings suggest that profitability, company size, leverage, and company age are positively associated with the level of sustainability disclosure in Türkiye. Moreover, the cash flow capacity of the companies has a significant and negative impact on the level of sustainability disclosure. Specifically, the results of the additional analysis indicate that company size is a significant determining factor of economic, environmental, and social sustainability disclosure.
Keywords: Sustainability Reporting, Sustainability Disclosure Score, GRI, Türkiye
JEL Classification: M41, M48, Q56, Q01

Öz

Bu çalışmanın amacı, Türkiye'de sürdürülebilirlik raporlaması uygulamalarının düzeyini ve belirleyicilerini analiz etmektir. Sürdürülebilirlik raporlaması uygulamalarını değerlendirmek amacıyla, GRI tabanlı sürdürülebilirlik açıklama endeksi kullanılmıştır ve sürdürülebilirlik raporlaması uygulamasının işletmeye özgü özellikleri BIST Sürdürülebilirlik Endeksi'nde yer alan 67 adet işletmenin iki yıllık verileri dikkate alınarak, panel veri analizi ile incelenmiştir. Çalışmada, Türkiye'de borsada işlem gören şirketlerin sürdürülebilirlik konusunda genel açıklamalarda bulundukları ve çevre ile ilişkili bilgileri ekonomik ve sosyal bilgilerden daha fazla açıkladıkları tespit edilmiştir. Çalışmada, karlılık, şirket büyüklüğü, kaldıraç oranı ve şirket yaşının Türkiye'deki sürdürülebilirlik açıklama düzeyi ile pozitif yönde ilişkili olduğu ortaya konmuştur. Öte yandan, şirketlerin nakit akış kapasitelerinin sürdürülebilirlik açıklama düzeyinin üzerinde önemli düzeyde negatif bir etkisi olduğu da tespit edilmiştir. İlave analiz sonuçları da şirket büyüklüğünün ekonomik, çevresel ve sosyal sürdürülebilirlik açıklamalarında önemli bir belirleyici faktör olduğunu göstermiştir.
Anahtar Kelimeler: Sürdürülebilirlik Raporlaması, Sürdürülebilirlik Açıklama Skoru, GRI, Türkiye
JEL Sınıflandırması: M41, M48, Q56, Q01

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1. Introduction

Over the years, global attention to sustainable development has inspired companies to be more transparent and promote stakeholder accountability. The emerging interest in contributions to sustainable development forced companies to improve their disclosure practices on environmental and social matters (Stefanescu, 2022). Unlike conventional financial reporting, which largely focuses on financial performance, sustainability reporting gives stakeholders access to information on a company's environmental, social, and economic performance. (de Villiers and Sharma, 2020). The activities of companies and their positive or negative consequences on environmental and social issues increased the desire of stakeholders' information needs for diversified and detailed sustainability information (Ebaid, 2023). Sustainability reporting promotes a company's accountability and helps companies fulfill the expectations of various stakeholders (Orazalin and Mahmood, 2020). By implementing sustainability reporting, companies seek to enhance their brand value, boost employee morale, ensure competitiveness, and assist corporate information and control systems (Hahn and Kühnen, 2013).

To provide guidelines, standards, and frameworks to disclose sustainability information, several sustainability reporting frameworks have emerged. The World Business Council for Sustainability Development (WBCSD), the Climate Disclosure Standards Board (CDSB), the Task Force on Climate Related Financial Disclosure (TCDF), the Value Reporting Foundation (VRF), the Sustainability Accounting Standards Board (SASB), the International Integrated Reporting Council (IIRC) and the Global Reporting Initiative (GRI), are the enormous organizations that have developed different frameworks for sustainability disclosure (Afolabi et al., 2022). Among these organizations, SASB and IIRC were consolidated under VRF and VRF merged with CDSB under IFRS Foundation (Hummel and Jobst, 2024). Typically, companies have voluntarily reported sustainability information in response to requests for increased accountability, and GRI is the widely recognized guideline for sustainability disclosure (Ali et al., 2023). Stakeholder-oriented reporting guidelines have been developed by GRI to ensure the disclosure of information about how companies impact on social and environmental matters (de Villiers et al., 2022). Prior to mandatory requirements for sustainability disclosure, the GRI Guidelines were a driving force behind the development of voluntary sustainability reporting (Carungu et al., 2020). However, there have been concerns about the accountability gap and the incompatibility of sustainability reports. To overcome those concerns and to build a comprehensive infrastructure for sustainability reporting, new standard-setters; the European Financial Reporting Advisory Group (EFRAG, under EU) and International Sustainability Standards Board (ISSB, under the IFRS Foundation) have both played pivotal roles in advancing reporting standards for sustainability (Korca et al., 2023). EFRAG issued the first set of ESRS (European Sustainability Reporting Standards), and the European Commission adopted this first set of ESRS in July 2023. EU based large companies are mandated to use ESRSs for sustainability reporting from financial year 2024. In parallel, ISSB released general requirements for the disclosure of sustainability-related financial information (IFRS S1) and climate-related disclosures (IFRS S2) (Hummel and Jobst, 2024).

As the demand for comparable sustainability information has largely arisen from stakeholders, different studies have been carried out to evaluate the sustainable reporting practices of companies across different nations (Aksoy-Hazır, 2023; Bhatia and Tuli, 2017; Clarkson et al., 2008; Greiling et al., 2015; Jadhav et al., 2020; Mamun, 2022; Ong et al., 2016; Penney et al., 2023; Zahid and Ghazali, 2015). A substantial amount of literature exists that examines the company level attributes of sustainability disclosure (Bhatia and Tuli, 2017; Chen et al., 2015; Dissanayake et al., 2019; Jadhav et al., 2020; H. Z. Khan et al., 2021; Laskar and Gopal Maji, 2018; Nazari et al., 2015; Orazalin and Mahmood, 2020), the effect of board attributes and corporate governance (Girón et al., 2021; Ong and Djajadikerta, 2020; Tumwebaze et al., 2022), and the association of sustainability reporting and firm reputation (Bhatia and Tuli, 2017; Ul Abideen and Fuling, 2024).

Adopting sustainability reporting is currently optional in most countries. Despite the lack of enforceable legal frameworks, Türkiye is an example of those countries, whose jurisdictions give companies a choice among various sustainability reporting frameworks. Listed companies in Türkiye are only required to declare their compliance with sustainability principles (Aksoy-Hazır, 2023). Furthermore, the existence of diversity in sustainability reporting practices raises concerns about assessing the extent, quality, and company-level characteristics of sustainability reporting in Türkiye. In line with global developments in sustainability reporting, Turkish government mandated sustainability reporting in accordance with IFRS S1 and IFRS S2 for large companies, that exceed two of the following three criteria: 250 employees, total assets of 500 million TL and net revenue of 1 million TL, beginning from the financial year 2024 (https://www.kgk.gov.tr/surdurulebilirlik).

This study attempts to investigate the scope and various factors that affect sustainability reporting practices in Türkiye. Although mandatory sustainability reporting does not exist and varies among Turkish companies due to its voluntary nature, this study explores the extent and drivers of sustainability reporting utilizing sustainability information based on the GRI framework. A survey report by KPMG (2022) indicates that GRI is the most widely utilized and comprehensive framework for evaluating the sustainability reporting practices of companies. In this perspective, sustainability disclosure scores are evaluated using a GRI-based sustainability disclosure index, and hence the association between company-level characteristics and sustainability disclosure scores is explored.

The study is structured in the following manner: In the second section, the theoretical perspectives of sustainability reporting are discussed including a review of relevant literature regarding the factors influencing sustainability reporting practices. Section 3 displays an overview of the study's dataset, variables, and the methodology. The empirical results are outlined in Section 4, and the final section concludes the study with discussion, policy implications, and limitations.

2. Literature Review and Hypothesis Development

To explore the company-level characteristics of sustainability reporting, the underlying theories explaining companies' commitment to sustainability reporting should be reviewed. The theoretical

justification of voluntary sustainability reporting relies on stakeholder theory, agency theory, and legitimacy theory.

Since the stakeholders comprise the society in which companies operate, satisfying the demands of these stakeholders is essential to raising the company's profitability and value (Freeman, 1984). Consequently, from the stakeholder theory perspective, corporations have a widening role and responsibility to understand the implied contractual nature of relationships between companies, the environment and society (Dissanayake et al., 2019). Zahid and Ghazali (2015) argue that corporate sustainability establishes who the companies should answer to and what obligations they have to complete in order to meet stakeholders' expectations. Hence, companies can build strong bonds with various stakeholders, increase company reputation, and create competitive advantage through voluntary reporting on sustainability (Schmelzer, 2013). Agency theory proposes that by disclosing all relevant information available to stakeholders, information asymmetries between managers and owners can be mitigated (Jensen and Meckling, 1976). As stated in the work of De Klerk and De Villiers (2012), investors' sense of risk rises when corporations fail to disclose information appropriately, and as a result, the market either undervalues the stock or demands higher returns from those companies. The enhanced sustainability reporting practices enable managers to be completely accountable for all the resources entrusted to them, and through proper accountability with the sustainability reporting agency costs between managers and owners can decrease (Tumwebaze et al., 2022). According to Suchman (1995), within a socially constructed framework of beliefs, assumptions, ideals, and norms, legitimacy refers to the broad presumption that a company's actions are right and appropriate. In this regard, legitimacy theory posits that there exists a social agreement between the company and society, and it requires that companies operate with goals and values that are in line with societal goals and values (Zahid and Ghazali, 2015). Within this context, sustainability reporting functions as a tool for validating company operations and certifies that a reporting company is operating in accordance with societal ideals and values (Orazalin and Mahmood, 2020).

Based on the theoretical frameworks, numerous previous studies have paid attention to the scope of sustainability reporting practice (Aksoy-Hazır, 2023; Bhatia and Tuli, 2018; Chen et al., 2015; Clarkson et al., 2008; Dissanayake et al., 2016; Ehnert et al., 2016; Greiling et al., 2015; I. Khan et al., 2023; Mamun, 2022; Ong et al., 2016; Papa et al., 2022; Zahid and Ghazali, 2015). Another stream of studies has concentrated on the factors that have an impact on sustainability reporting practice (Bhatia and Tuli, 2017; Dissanayake et al., 2019; Nazari et al., 2015; Orazalin and Mahmood, 2020; Sharma et al., 2020). Several studies have explored the association between corporate performance and sustainability reporting practice (Chen et al., 2015; Ebaid, 2023; Jadhav et al., 2020; Laskar and Gopal Maji, 2018), the relation of corporate governance and sustainability reporting practice (Ong and Djajadikerta, 2020), and the impact of sustainability reporting practice on corporate reputation (Ul Abideen and Fuling, 2024).

To ascertain the company-level characteristics of sustainability reporting practice in Türkiye, theoretical frameworks were utilized. To legitimize the operations of the companies, profitability can be a relevant influencing factor in sustainability disclosure. In the existence of higher profitability,

companies can prefer disclosing more information on sustainability for the external assurance of society (Orazalin and Mahmood, 2020). From the agency theory viewpoint, the management of a highly profitable company will have the tendency to use sustainability-related information to their personal advantage in order to uphold their positions within the company (Sharma et al., 2020). On the other hand, profitable businesses can also be motivated to report higher levels of sustainability information to have a better relationship with stakeholders and to create a good reputation (Ebaid, 2023). These theoretical explanations are supported by the research of Chen et al. (2015), Jadhav et al. (2020), Laskar and Gopal Maji (2018), Nazari et al. (2015), Orazalin and Mahmood (2020) and Sharma et al. (2020). On the contrary, in the studies of Bhatia and Tuli (2017) and Saha et al. (2023) it is found that companies with higher profitability disclose less information on sustainability matters. Other studies, such as Orazalin and Mahmood (2018), Tadros and Magnan (2019), H. Z. Khan et al. (2021) and Ebaid (2023) conclude that there is no notable correlation between sustainability reporting practice and profitability. Regarding the theoretical frameworks and prior findings, the first hypothesis is formulated below:

H1: Profitability is related with sustainability reporting practices.

Several studies of Clarkson et al. (2008), Nazari et al. (2015), Bhatia and Tuli (2017), Dissanayake et al. (2019), Tadros and Magnan (2019), Orazalin and Mahmood (2020) and H. Z. Khan et al. (2021) report that larger corporations are more motivated to reveal their sustainability activities. Aligned with legitimacy and stakeholder theory, larger companies, which are visible to stakeholders and should avoid losses of illegitimacy, are motivated to make disclosures on sustainability to demonstrate their corporate citizenship (Dissanayake et al., 2016). Further, larger companies are financially healthier than smaller companies and have the capability to put more resources into sustainability reporting. Due to economies of scale, the cost of sustainability reporting for smaller corporations is higher that of larger corporations (Bhatia and Tuli, 2017; Matuszak et al., 2019). However, Orazalin and Mahmood (2018) and Tumwebaze et al. (2022) find no evidence that the size of the company correlates with its sustainability disclosure level. Thus, the proposed hypothesis is posited:

H2: Company size is related with sustainability reporting practices.

According to Jensen and Meckling (1976), high-debt companies reveal greater information to reduce their cost of capital and agency costs. This leads to a positive relation between sustainability disclosure level and the leverage of companies. Consistent with the stakeholder theory, companies with high debt are expected to provide more sustainability-related information, because they have a higher level of responsibility to satisfy stakeholders' information needs. Clarkson et al. (2008) report a positive relationship between leverage and environmental disclosure practices. However, Bhatia and Tuli (2017), Tadros and Magnan (2019) and Orazalin and Mahmood (2020) provide evidence that companies with significant levels of debt are not involved in making sustainability-related disclosures. Studies by Nazari et al. (2015), Sharma et al. (2020) and H. Z. Khan et al. (2021) indicate no significant association between leverage and sustainability reporting practices. In the light of stakeholder and agency theories, the next hypothesis is proposed:

H3: Leverage is related with sustainability reporting practices.

Growth opportunity may be an important factor influencing sustainability reporting practice, since companies with higher growth opportunities may report sustainability information more actively to try to upgrade their sustainability disclosure level (Bhatia and Tuli, 2017). Al-Shubiri et al. (2012) support a positive relation between growth opportunity and non-financial reporting practice, whereas H. Z. Khan et al. (2021) and Saha et al. (2023) find no correlation between the two variables. The following hypothesis is formulated:

H4: Growth opportunity is related with sustainability reporting practices.

Capital expenditure investments may encourage companies to share more sustainability information with stakeholders, since they may wish to prove their competitive advantage in sustainability disclosures (Moussa and Elmarzouky, 2023). Hence, the next hypothesis is proposed as follows:

H5: Capital expenditure is related with sustainability reporting practices.

A company's capability to fulfill the expectations of its stakeholders is indicated by its level of cash flow. Cash flow capacity also allows the companies to allocate a certain amount of funds to the preparation of sustainability reports (Kuzey and Uyar, 2017). A sufficient amount of cash flow enables a higher commitment to sustainability reporting (Reverte, 2009). Given that the companies should satisfy the demands of stakeholders on sustainability information, as per stakeholder theory, higher cash resources can enable higher levels of disclosure on sustainability information. This relation is supported by the studies of Ruhnke and Gabriel (2013), who conclude that companies with significant amount of cash reserves, disclose more extensive information on sustainability matters. However, some studies indicate an insignificant relationship between cash flow level and sustainability disclosure (Orazalin and Mahmood, 2020). Accordingly, the proposed hypothesis is as follows:

H6: Cash flow is related with sustainability reporting practices.

One potential explanation for sustainability practices could be the company's age. According to legitimacy theory, it seems sense that older companies generate more information on sustainability matters since they have already established credibility with their stakeholders and have the ability to manage reporting frameworks (Orazalin and Mahmood, 2020). Considering the younger companies, older companies' more advanced accounting systems are able to generate more comprehensive information at lower costs (Al-Shammari, 2013). Bhatia and Tuli (2017) observe that older companies have a tendency to disclose more about sustainability. They conclude that older companies' economic objectives may have been met, and they have accumulated enough surpluses and resources to disclose more sustainability-related information. However, in the case of Bangladeshi banks, Orazalin and Mahmood (2020) notice no significant relationship between company age and sustainability disclosure. Therefore, the below hypothesis is posited:

H7: Company age is related with sustainability reporting practices.

3. Data and Methodology

The initial sample size for the study comprises 80 companies listed on the BIST Sustainability Index in Türkiye for the period of 2021 – 2022. In Türkiye, companies must have a combined ESG (Environmental, Social, and Governance) score of 50 or above, each pillar score of 40 or above, and at least 8 of the category scores 26 or above to be included in the BIST Sustainability Index. These sustainability scores are calculated by the contracted organization of BIST, and the assessment of ESG scores is based upon the publicly available sustainability information of companies (https://www.borsaistanbul.com/en/index/1/9/sustainability).

The companies that belong to the finance and insurance sectors and the companies that lacked data on sustainability disclosure were removed from the sample. The final sample comprises 67 companies that voluntarily disclose stand-alone sustainability reports, or integrated reports. 21 of those companies had integrated reports and 46 of those companies had stand-alone sustainability reports. The final sample comprises 134 company-year observations. The data was provided from a variety of sources, including the Thomson-Reuters database and companies' stand-alone sustainability reports and integrated reports. Since the level of sustainability reporting practice is assessed using a sustainability disclosure index based on GRI (2021) Standards, the base year of the study is 2021. Despite the limited sample size, the final sample is sufficient to perform statistical analysis and offer preliminary empirical support for future research (Orazalin & Mahmood, 2020).

In this study, the sustainability disclosure score (SustDS), which represents the level of sustainability reporting practice, serves as the dependent variable. For measuring the sustainability disclosure score, the methodology of content analysis is adopted. The most appropriate data gathering method for converting qualitative information into quantitative information is content analysis in the context of sustainability disclosure (Bhatia and Tuli, 2017; Chen et al., 2015; Clarkson et al., 2008; Dissanayake et al., 2019; Greiling et al., 2015; Guthrie and Farneti, 2008; Zahid & Ghazali, 2015). The scope of sustainability disclosure of Turkish listed companies was assessed using a newly developed sustainability disclosure index, which was first introduced as an environmental disclosure index by Clarkson et al. (2008) based on GRI G2 Guidelines, extended as a sustainability disclosure index by Ong et al. (2016) based on GRI G3 Guidelines and revised by Aksoy-Hazır (2023) based on the GRI (2021) Standards. Despite the fact that sustainability reporting is voluntary in Türkiye, the GRI-based disclosure index is appropriate for this study, since most of the sample companies have adopted the GRI Guidelines for sustainability reporting. Specifically, GRI Guideline contributed to institutionalization of sustainability reporting by forming a common framework for sustainability disclosure and is the most acclaimed sustainability reporting guideline that builds a comprehensible infrastructure to assess the sustainability disclosure level (de Villiers et al., 2022; La Torre et al., 2018). The sustainability disclosure index, which is applied in this study, is viewed as a checklist that consists of 7 categories (Appendix 1). The first 4 categories (A1, A2, A3, A4) represent hard disclosure items, and the last 3 categories (A5, A6 and A7) represent soft disclosure items. Soft disclosure items refer to information that can be provided by all companies regardless of their actual sustainability performance. Conversely, hard disclosure items focus on hard measures and

true commitment towards sustainability, that can be easily imitated by incompetent sustainability performers (Clarkson et al., 2011). For all the categories except A3, the items are given a value of 1 if the relevant information is reported and 0 otherwise. For the A3 category, the items depicting economic, environmental, and social performance indicators are assigned a maximum score of 6. When the indicator is missing, the score is 0. If the indicator is reported, the score is 1. If the indicator is presented with the industry's or competitor's data, the score is 2. When the indicator is revealed with the comparison to the previous year, the score is 3. If the indicator is reported with respect to targets, the score is 4. The score is 5, when the indicator is revealed with normalized data. Finally, if the indicator is disclosed at a categorized level (i.e. geographic segment), the score is 6 (Aksoy-Hazır, 2023; Clarkson et al., 2008; Ong et al., 2016). The sustainability disclosure index contains 144 items and has a maximum score of 569. Table 1 shows the categories of the sustainability disclosure index.

Table 1: Categories of Sustainability Disclosure Index

Category		**Items**	**Max. Score**
Hard Disclosure Items (A1-A4)			
A1	Governance Structure-Management System	12	12
A2	Credibility	4	4
A3	Economic Performance	17	102
	Environmental Performance	31	186
	Social Performance	37	222
A4	Sustainability Spending	2	2
Soft Disclosure Items			
A5	Vision and Strategy	7	7
A6	Sustainability Initiatives	3	3
A7	Disclosure on Management Approach-Economic	7	7
	Disclosure on Management Approach-Environmental	7	7
	Disclosure on Management Approach-Social	17	17
Total		144	569

The company's sustainability disclosure score is measured as a percentage of the maximum sustainability disclosure score. The dependent variables of the study are the sustainability disclosure score (SustDS), hard disclosure score (HardDS), and soft disclosure score (SoftDS) in percentages. A higher percentage of the score represents a higher level of sustainability practice.

The explanatory variables of this study are profitability, company size, leverage, growth opportunity, capital expenditure, cash flow, and company age. Profitability (ROA) is the ratio of net income to total assets. Company size (SIZE) is measured as the natural logarithm of the company's total assets. Leverage (LEV) is the ratio of total debt to total assets. Growth opportunity (GROWTH) is measured as the percentage change in revenue. Capital expenditure (CAPEX) is the ratio of total capital expenditure to total assets. Cash flow (CASH) is measured as the ratio of cash and cash equivalents

to total assets, and the years since the company was established is the company age, or AGE. All dependent and independent variables are winsorized at 1% and 99% percentiles to reduce the outlier effects.

The determinants of sustainability reporting practices are estimated using the regression models listed below.

1. $SustDS_{i,t} = \beta_0 + \beta_1 ROA_{i,t} + \beta_2 LEV_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 GROWTH_{i,t} + \beta_5 CAPEX_{i,t} + \beta_6 CASH_{i,t} + \beta_7 AGE_{i,t} + YEAR_t + \beta_{it}$;

2. $HardDS_{i,t} = \beta_0 + \beta_1 ROA_{i,t} + \beta_2 LEV_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 GROWTH_{i,t} + \beta_5 CAPEX_{i,t} + \beta_6 CASH_{i,t} + \beta_7 AGE_{i,t} + YEARt + \beta_{it}$;

3. $SoftDS_{i,t} = \beta_0 + \beta_1 ROA_{i,t} + \beta_2 LEV_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 GROWTH_{i,t} + \beta_5 CAPEX_{i,t} + \beta_6 CASH_{i,t} + \beta_7 AGE_{i,t} + YEARt + \beta_{it}$;

4. Empirical Results

Table 2 represents and compares the sustainability disclosure level in Türkiye during the period 2021-2022.

Table 2: Extent of Sustainability Reporting

Years	2021	2022
Sustainability Disclosure Mean Scores	157	203
Range of SustDS (lowest to highest)	27 to 369	18 to 457
Mean Score of HardDS	134	180
Mean Score of SoftDS	24	26
Mean Score of Economic Disclosure (EcoDS)	15	21
Mean Score of Environmental Disclosure (EnvDS)	70	94
Mean Score of Social Disclosure (SocDS)	51	67
Highest sustainability disclosure category	Environmental	Environmental
Lowest sustainability disclosure category	Economic	Economic

During the study period, the extent of sustainability reporting by Turkish companies is overall low. However, the mean of sustainability disclosure scores and the mean score for each category have shown improvement in 2022. Moreover, it can be argued that Turkish companies give priority disclosing hard disclosure items over soft disclosure items in 2022. It is evident that the disclosure of soft items is showing a minimal upward trend. During the study period, companies reported higher levels of environmental items than economic and social items. In both years, the economic sustainability category has the lowest score, compared to the environmental and social sustainability categories. It is apparent that the average sustainability scores are below the maximum available scores in every category during the study period.

Table 3 exhibits the descriptive statistics of all variables.

Table 3: Descriptive Statistics of Variables

	N	Std. Dev.	Mean	min	max	p25	p75
SustDS	134	0.178	0.316	0.032	0.803	0.179	.424
EcoDS	134	0.159	0.166	0.000	0.936	0.037	.22
EnvDS	134	0.235	0.425	0.021	1.047	0.233	.57
SocDS	134	0.162	0.245	0.008	0.678	0.113	.331
HardDS	134	0.179	0.296	0.013	0.799	0.157	.396
SoftDS	134	0.198	0.577	0.146	0.951	0.415	.756

	N	Std. Dev.	Mean	min	max	p25	p75
ROA	134	0.250	0.138	-0.193	2.372	0.049	0.169
SIZE	134	0.662	10.271	7.925	12.095	9.782	10.766
LEV	134	0.496	0.361	0.000	4.768	0.187	0.441
GROWTH	134	0.833	1.062	-0.957	5.335	0.524	1.293
CAPEX	134	0.108	0.061	-0.086	0.870	0.021	0.069
CASH	134	0.944	0.250	0.003	8.428	0.065	0.199
AGE	134	18.091	40.701	6	87	26	55

The average sustainability disclosure score is 31.60 %, with a minimum of 3.20% and a maximum of 80.30%. Concerning the sub-categories of sustainability reporting, the average score of environmental disclosure is 42.50%, which indicates that companies provided more information on environmental aspects during the study period. Moreover, the average hard disclosure score is 29.60%, whereas the average soft disclosure score is 57.70%. This result implies that Turkish companies prefer to disclose more information on corporate vision and strategy and sustainability profile, regardless of their actual sustainability performance (Aksoy-Hazır, 2023). These findings demonstrate that Turkish companies are significantly behind the alignment of the GRI framework.

In the case of explanatory variables, the findings indicate that the average ROA is 13.80%. The mean value of SIZE is 10.27 and varies between 7.92 and 12. 09. The results for leverage show that the average value of LEV is 36.10%, indicating that Turkish companies, which are on the BIST Sustainability Index, have low levels of financial debt. The average value of GROWTH is 106.20%, whereas the average value of CAPEX is 6.10%. Cash flow (CF) has an average of 25%. The findings also reveal that the average age of the sampled companies is 41.

Table 4 presents the Pearson correlation among dependent and independent variables. The correlation of company size with the sustainability disclosure score is positively significant, with a value of 0.21. Among all variables, company age is also positively correlated with sustainability disclosure score at the 1% significance level. The findings confirm that companies with a higher age and size have greater sustainability disclosure scores. To address the concern of multicollinearity, variance inflation factors (VIF) for the explanatory variables are calculated. The results of the multicollinearity test indicate that all values are under 5, confirming the absence of multicollinearity issues. (Hair JR et al., 2009).

Table 4: Pearson Correlations

Variables	SustDS	ROA	SIZE	LEV	GROWTH	CAPEX	CASH	AGE
SustDS	1.000							
ROA	0.125	1.000						
SIZE	0.213**	-0.455***	1.000					
LEV	0.061	-0.126	0.169*	1.000				
GROWTH	0.048	0.013	0.108	-0.055	1.000			
CAPEX	0.089	0.859***	-0.402***	-0.083	-0.108	1.000		
CASH	0.089	0.893***	-0.406***	-0.074	-0.045	0.903***	1.000	
AGE	0.252***	-0.134	0.358***	0.084	-0.152*	-0.167*	-0.124	1.000

**** p<0.01, ** p<0.05, * p<0.1*

The study's data were panel time-series data, and to control for potential unobservable heterogeneities among companies, various regression models were employed, including pooled ordinary least squares (OLS), fixed effects models (FE) and random effects models (RE). In this context, to ascertain the most appropriate model, the Breusch-Pagan Langrange Multiplier (LM) test was first performed. According to the results of the LM test, both FE model and RE model are more appropriate than OLS. To understand whether the fixed effect or random effect model is suitable, the study employed the Hausman test. In all models, the estimated results of the Hausman test conclude that RE model is more suitable for the analysis. To mitigate the lack of independence among observations, the standard errors of companies were clustered due to the existence of autocorrelation and heteroscedasticity issues based on diagnostic tests (Roger, 1993). Table 5 demonstrates the regression results with robust standard errors for the models.

Table 5: Regression Results

	SustDS (Model 1)	HardDS (Model 2)	SoftDS (Model 3)
ROA	0.249***	0.251***	0.235***
	(0.0841)	(0.0857)	(0.0908)
SIZE	0.0827***	0.0814***	0.0815***
	(0.0293)	(0.0297)	(0.0304)
LEV	0.0273*	0.0272*	0.0225
	(0.0141)	(0.0145)	(0.0153)
GROWTH	0.0144	0.0172	-0.0213*
	(0.0143)	(0.0149)	(0.0129)
CAPEX	0.300	0.332	-0.201
	(0.283)	(0.284)	(0.325)
CASH	-0.0436*	-0.0472*	0.00564
	(0.0243)	(0.0246)	(0.0279)
AGE	0.00198*	0.00190*	0.00319***
	(0.00108)	(0.00108)	(0.00117)
Constant	-0.681**	-0.689**	-0.398

	(0.290)	(0.294)	(0.296)
Observations	134	134	134
Number of id	67	67	67
Prob>F	0.000	0.000	0.000
Hausman	0.330	0.231	0.707
R-squared	0.143	0.136	0.239

Robust standard errors enclosed in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

The positive and significant (1% level) coefficient of the profitability reveals that a higher profitability has a positive effect on companies' sustainability disclosure scores. These findings suggest that companies with higher profitability have greater incentives to ensure more sustainability information in order to build a good and transparent bond with stakeholders (Chen et al., 2015; Jadhav et al., 2020; Laskar and Gopal Maji, 2018; Nazari et al., 2015; Orazalin and Mahmood, 2020; Sharma et al., 2020). The results in Model 2 and Model 3 show that higher profitability has a positive impact on both reporting on hard and soft disclosure items. Regarding company size, the findings confirm that in comparison to smaller companies, companies with larger sizes, which are facing greater stakeholder pressure, disclose more sustainability information. This result is supported by the results of Model 2 and Model 3. In line with the legitimacy theory, the visibility and long-term survival of companies depend on the disclosure of extensive information on both hard and soft disclosure items (Bhatia and Tuli, 2017; Clarkson et al., 2008; Dissanayake et al., 2019; Orazalin and Mahmood, 2020; Tadros and Magnan, 2019). The results imply that leverage influences sustainability disclosure ratings favorably. The regression results also reveal that the relationship between hard disclosure score and leverage is found to be significant. However, a significant association between soft disclosure score and leverage are not found. It seems that companies with higher debt place great weight on increasing their reputation and have a greater contractual obligation to reduce information asymmetry, by ensuring high levels of sustainable disclosure, especially hard disclosure items (Al-Shubiri et al., 2012). According to the findings, growth opportunity has a significant negative influence on the soft disclosure score, which reveals that companies with higher growth opportunities do not prefer to upgrade the level of soft disclosure items.

According to the stakeholder theory, companies with higher cash flow resources are expected to ensure increased transparency on sustainability. However, the results suggest that companies with higher cash flow resources provide less sustainability information to stakeholders. It can be concluded that sample companies prefer to hold cash to protect themselves from economic shocks and avoid the cost of disclosing high quality sustainability information due to economies of scale. The results in Model 2 are identical to the findings of Model 1. However, the relationship between the soft disclosure score and cash flow capacity is not significant at any level. Based on the results of all models, company age is found to be significantly related with sustainability disclosure score, as well as hard and soft disclosure scores. These findings imply that higher company age enhances both the level of hard sustainability disclosure and soft sustainability disclosure. Given that older

companies have longer reporting experience, it can be argued that they are more inclined to disclose information on sustainability matters to ensure external assurance (Bhatia and Tuli, 2017). As shown in Table 5, no significant relationship is detected between capital expenditure and sustainability reporting practices in Türkiye.

To further estimate the determinants of sustainability practice in Türkiye, the sustainability disclosure scores are decomposed into economic, environmental, and social disclosure scores as dependent variables, and the same explanatory factors were employed in the regression analysis. The findings of the regression analysis are presented in Table 6, below.

Table 6: Regression Results of Additional Analysis

	EcoDS (Model 4)	**EnvDS (Model 5)**	**SocDS (Model 6)**
ROA	0.136	0.244**	0.309***
	(0.0984)	(0.115)	(0.0837)
SIZE	0.0811***	0.103**	0.0665**
	(0.0237)	(0.0401)	(0.0273)
LEV	0.0233**	0.0191	0.0344***
	(0.0105)	(0.0246)	(0.0121)
GROWTH	0.0106	0.0279	0.0107
	(0.0124)	(0.0207)	(0.0119)
CAPEX	0.0714	0.628	0.184
	(0.271)	(0.403)	(0.273)
CASH	0.00263	-0.0708*	-0.0485*
	(0.0259)	(0.0364)	(0.0250)
AGE	0.00217***	0.00251*	0.00141
	(0.000842)	(0.00147)	(0.00103)
Constant	-0.800***	-0.828**	-0.561**
	(0.223)	(0.403)	(0.272)
Observations	134	134	134
Number of id	67	67	67
Prob>F	0.000	0.000	0.000
Hausman	0.711	0.090	0.420
R-squared	0.166	0.425	0.245

Robust standard errors enclosed in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

The findings of Model 4 in Table 6 indicate that company size at the 1% significance level, leverage at the 5% significance level, and company age at the 1% significance level have significant positive impacts on the economic disclosure score. The regression coefficients of profitability and company size are at the 5% significance level, suggesting a positive impact on the environmental disclosure score. In Model 6, results indicate that profitability, company size and leverage have significant positive

relationships with the social disclosure score, whereas cash flow has a significant negative effect at the 10% significance level. Capital expenditure and growth opportunities found to be insignificant in all models. These analyzes support the idea that larger companies have the competence to accomplish sustainability information needs of stakeholders in all aspects. Moreover, companies with high debt have the tendency to issue more information on economic and social matters, whereas older companies prefer to issue more economic and environmental information.

5. Conclusion

Sustainability reporting practices help to build stakeholder trust, legitimize business operations, and protect a company's survival by demonstrating the company's dedication to environmental and social sustainability. Unlike existing studies, which generally focus on the level of sustainability reporting practice in developed countries, the present study aims to examine the factors influencing sustainability practice in an emerging market, Türkiye. Based on a sample of listed companies on the BIST Sustainability Index for the years 2021-2022, the study provides evidence that the level of sustainability reporting practices in economic, environmental, and social dimensions is overall low. Thus, there is an absence of pure accountability for sustainability. The results show that the most dominant sustainability practices are related to soft disclosure items. However, the level of sustainability disclosure has an upward trend and has increased over time.

The findings reveal that profitability, company size, leverage, cash flow, and company age are found to be influential in undertaking higher levels of sustainability reporting. The regression analysis supports the positive and significant association with respect to profitability, company size, leverage, and company age. Turkish companies concentrate on disclosing higher levels of sustainability, which results in increased profitability. The results also imply that larger and older companies have the awareness of the significance of sustainability reporting and are motivated to increase the level of sustainability disclosure. Furthermore, companies with higher debt are more engaged in sustainability reporting practices, whereas companies with high cash flow do not prefer to improve their sustainability reporting level. Certain factors, such as growth opportunity and capital expenditure, are not found to exert a significant impact on sustainability reporting practice. Overall, in accordance with the stakeholder, agency, and legitimacy theory, profitability, company size, leverage, cash flow, and company play pivotal roles in disclosing sustainability information.

The study's results contribute to existing knowledge on the extent and company-level characteristics of sustainability reporting practices in Türkiye. Firstly, the study highlights the Turkish companies' sustainability preferences and engagement level in sustainability reporting. Secondly, it suggests that companies in Türkiye should give equal consideration to disclosing hard and soft disclosure items. Thirdly, with regard to theoretical frameworks, sustainability reporting practice is heavily influenced by accounting-based factors in the context of Türkiye. The study also covers a wide spectrum of sustainability reporting practices.

The study has several contributions for many parties. Policymakers should be directed to issue legislation that obliges companies to disclose more hard disclosure items to improve the accountability of the company's sustainability practices. The decision-makers, who wish to signal a positive image and corporate citizenship to stakeholders, should concentrate on influential factors of sustainability practice, which in turn lead to improved sustainability practice. There are various limitations associated with the study. First, the study's sample size is relatively limited, with only 67 companies included. To generalize the results, larger samples over a broader time range can be used to examine the determinants of sustainability reporting practice. Secondly, it would be worthwhile to analyze the relationship between sustainability reporting practice and macro-level factors or associations with corporate governance or ownership structure across companies from different countries.

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Appendix 1

SUSTAINABILITY DISCLOSURE INDEX ITEMS	MAP TO GRI
A1 – GOVERNANCE STRUCTURE AND MANAGEMENT SYSTEMS	
Existence of the committees of the high governance body that are responsible for impacts on environment, economy and people.	**GRI 2.9**
Approach to stakeholder engagement	**GRI 2.29**
Implementation of externally developed economic, environmental and social charters/principles/ initiatives which organisation subscribes/ endorses	**GRI 2.23**
Executive compensation is linked to sustainability performance.	**GRI 2.19**
Existence of explanation for data measurement techniques and the bases of calculations, including assumptions adopted in the compilation of sustainability information in the report.	**GRI 3.1.**
Indicate whether the chair of the highest governance body is also an executive officer.	**GRI 2.11**
State the number, gender, expertise of members of the highest governance body, such as the board of directors that are independent and/or non-executive members.	**GRI 2.9c**
Processes in place for the highest governance body to ensure conflicts of interest are avoided.	**GRI 2.15**
Processes for evaluating the highest governance body's own performance, particularly with respect to economic, environmental, and social performance	**GRI 2.18**
Description of the role of highest governance body in sustainability reporting	**GRI 2.14**
Statement on sustainable development strategy	**GRI 2.22**
Reporting on the collective knowledge of the highest governance body	**GRI 2.17**
A2 – CREDIBILITY	
Adoption of GRI sustainability reporting guidelines	
Independent verifications/audits on sustainability systems/performances, including external awards/ certifications for good sustainability practices.	**GRI 2.5**
Participation in industry-specific associations/initiatives to improve sustainability practices	**GRI 2.28**
Compliance with Laws and Regulations	**GRI 2.27**
A3 – ECONOMIC PERFORMANCE INDICATORS	
Economic Performance	**GRI 201**
Direct Economic Value	
Financial Implications and Other Risks and Opportunities due to Climate Change	
Defined benefit plan obligations and other retirement plans	
Financial assistance received from government	
Market Presence	**GRI 202**
Financial assistance received from other organization	
Proportion of senior management hired from the local community	
Indirect Economic Impacts	**GRI 203**
Infrastructure investments and services supported	
Significant indirect economic impacts	
Procurement Practices	**GRI 204**
Percentage of the procurement budget and proportion of spending on local suppliers	
Anti-Corruption	**GRI 205**
Number or percentage of operations assessed for risks related to corruption	
Communication and Training about anti-corruption policies and procedures	
Confirmed incidents of corruption and actions taken	
Anti-Competetive Behavior	**GRI 206**

Number of legal actions for anti-competetive behavior, anti-trust and monopoly decisions	
Tax	**GRI 207**
Description of approach to tax	
Description of tax governance, control and risk management	
Description of stakeholder engagement and management of concerns related to tax	
Description of country by country reporting	
A3 – ENVIRONMENTAL PERFORMANCE INDICATORS	
Materials	**GRI 301**
Materials used	
Recycled Input Materials used	
Reclaimed Products and their packaging materials	
Energy	**GRI 302**
Energy consumption within the organization	
Energy consumption outside the organization	
Energy intensity	
Reduction of energy consumption	
Reduction in energy requirements of products and services	
Water and Effluents	**GRI 303**
Interactions with water as a shared resource	
Management of water discharge-related impacts	
Water Withdrawal	
Water Discharge	
Water Consump.	
Bidiversity	**GRI 304**
Operatiol sites owned, leased, managed in protected areas	
Significant impacts of activities, products and services on biodiversity	
Size and location of habitats protected or restored	
IUNC red list species and national conservation list species with habitats	
Emmisions	**GRI 305**
Scope 1 GHG emissions	
Scope 2 GHG emissions	
Scope 3 GHG emissions	
GHG emissions intensity	
Reduction of GHG emissions	
Emissions of ozone-deplating substances	
Nitrogen oxides, sulfur oxides other significant air emissions	
Effluents and Waste	**GRI 306**
Waste generation and significant waste-related impacts	
Management of significant waste-related impacts	
Waste generated	
Waste diverted from disposal	
Waste directed to disposal	
Supplier Env. Assessment	**GRI 307**
Percentage of new suppliers that were screened using environmental criteria	
Negative environmental impacts in the supply chain and actions taken	

A3 – SOCIAL PERFORMANCE INDICATORS-LABOR	
Employment	**GRI 401**
New employee hires and employee turnover	
Benefits provided to full-time employees	
Parental leave	
Labor	**GRI 402**
Minimum notice periods regarding operational change	
Occupational Health/Safety	**GRI 403**
Occupational health and safety management system	
Hazard identification, risk assessment and incident investigation	
Occupational health services	
Worker participation, consultation and communication on occupational health and safety	
Worker training on occupational health and safety	
Promotion of worker health	
Prevention and mitigation of occupational health ans safety impacts	
Workers covered by an occupational health and safety management system	
Work related injuries	
Work related III health	
A3 – SOCIAL PERFORMANCE INDICATORS-HUMAN RIGHTS	
Training Occupation	**GRI 404**
Average hours of training per year/employee	
Programs for upgrading employee skills and transition assistance programs	
Percentage of employees receiving regular performance and career development reviews	
Divesity-Equal Opporrtunity	**GRI 405**
Diversity of governance bodies and employees	
Ration of basic salary and remuneration of man/woman	
Non Discrimination	**GRI 406**
Incidents of discrimination and corrective actions	
Collective Bargaining	**GRI 407**
Operations and suppliers in which the right to freedom of association and collective bargaining	
Child Labor	**GRI 408**
Operations and suppliers at significant risks for incidents of child labor	
Forced/Compulsory Labor	**GRI 409**
Operations and suppliers at significant risks for incidents of forced or compulsory labor	
Security Practice	**GRI 410**
Security personal trained in human rights policy and procedures	
Rights of Indigenous People	**GRI 411**
Incidents of violations involving rights of indigenous people	
A3 – SOCIAL PERFORMANCE INDICATORS-SOCIETY	
Labor Commitments	**GRI 413**
Operations with local community engagement	
Operations with significant actual and potential negative impacts on local community	
Public Policy	**GRI 415**
Political contributions	
A3 – SOCIAL PERFORMANCE INDICATORS-PRODUCT/SERVICE	

Supplier Social Assessment	**GRI 414**
Supplier social assessment	
New suppliers that were screened using social criteria	
Negative social impacts in the supply chain	
Customer Health/Safety	**GRI 416**
Assessment of the health and safety impacts of product and service	
Incidents of non-compliance concerning the health and safety impacts	
Marketing/Labeling	**GRI 417**
Requirements for product and service information and labeling	
Incidents of non-compliance concerning the product and service information and labeling	
Incidents of non-compliance concerning marketing communications	
Customer/Policy	**GRI 418**
Substantiated complaints concerning breaches of customer privacy	
A4 – SPENDING ON SUSTAINABILITY	
Summary of dollar savings arising from sustainability initiatives to the company	
Amount spent on donations, community investments, technologies, R&D and/or innovations to enhance sustainability.	
A5 – VISION AND STRATEGY	
CEO statement on sustainability performance in letter to shareholders and/or stakeholders.	
A statement of corporate sustainability policy, values and principles, codes of conduct.	
A statement about formal management systems regarding risk and performance in sustainability	
A statement that the firm undertakes periodic reviews and evaluations of its sustainable performances.	
A statement of measurable goals in terms of future sustainability performance	
A statement about specific sustainability innovations and/or new technologies	
Explanation of whether and how the precautionary approach or principle on sustainability issues is addressed by the organization	
A6 – SUSTAINABLITY INITIATIVES	
Internal sustainability awards	
Internal sustainability performance audits	
Internal certification of sustainability programs	
A7 – DISCLOSURE ON MANAGEMENT APPROACH – ECONOMIC	
Economic Performance	**GRI 201**
Market Presence	**GRI 202**
Indirect Economic Impacts	**GRI203**
Procurement Practices	**GRI 204**
Anti-Corruption	**GRI 205**
Anti-Competetive Behavior	**GRI 206**
Tax	**GRI 207**
A7 – DISCLOSURE ON MANAGEMENT APPROACH – ENV	
Materials	**GRI 301**
Energy	**GRI 302**
Water and Effluents	**GRI 303**
Bidiversity	**GRI 304**
Emmisions	**GRI305**
Effluents and Waste	**GRI 306**

Supplier Env. Assessment	**GRI 308**
A7 – DISCLOSURE ON MANAGEMENT APPROACH – SOCIAL-LABOR	
Employment	**GRI 401**
Labor	**GRI 402**
Occupational Health/Safety	**GRI 403**
Training Occupation	**GRI 404**
Divesity-Equal Opporrtunity	**GRI 405**
A7 – DISCLOSURE ON MANAGEMENT APPROACH – SOCIAL-HUMAN RIGHTS	
Non Discrimination	**GRI 406**
Collective Bargaining	**GRI 407**
Child Labor	**GRI 408**
Forced/Compulsory Labor	**GRI 409**
Security Practice	**GRI 410**
Rights of Indigenous People	**GRI 411**
A7 – DISCLOSURE ON MANAGEMENT APPROACH – SOCIAL-SOCIETY	
Labor Commitments	**GRI 413**
Public Policy	**GRI 415**
A7 – DISCLOSURE ON MANAGEMENT APPROACH – SOCIAL-PRODUCT/SERVICE	
Supplier Social Assessment	**GRI 414**
Customer Health/Safety	**GRI 416**
Marketing/Labeling	**GRI 417**
Customer/Policy	**GRI 418**

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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

A BIBLIOMETRIC REVIEW ON THE SUSTAINABILITY OF AIRPORT AND AIRLINE BUSINESSES

HAVALİMANI VE HAVAYOLU İŞLETMELERİNİN SÜRDÜRÜLEBİLİRLİĞİ ÜZERİNE BİBLİYOMETRİK BİR İNCELEME

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Abstract

The importance of sustainability in research has been increasing day by day. This article aims to determine the extent to which sustainability is studied in the context of airport and airline operations in terms of economic, environmental and social dimensions, and to identify gaps in the literature to guide future research. To achieve this goal, bibliometric analysis is utilized. Using the Perish or Publish literature search program, studies obtained from the Scopus database are analyzed using the Vosviewer program to examine the dimensions of sustainability in airport and airline operations. Additionally, the most prolific authors, most cited publications, journals with the highest number of articles published, and the most studied sectors related to the topic are analyzed to contribute to the literature.
Keywords: Sustainability, Airport, Airline, Bibliometric Analysis
Jel Classification: M10, M19

Öz

Sürdürülebilirlik kavramının önemi her geçen gün artmaktadır ve aynı oranda bu alanda yapılan çalışmalar da artmaktadır. Bu makale ile havalimanı ve havayolu işletmeleri üzerine yapılan çalışmalarda sürdürülebilirliğin ekonomik, çevresel ve sosyal boyutlarının hangi oranda çalışıldığının tespit edilmesi ve yazındaki boşluklar belirlenerek gelecek çalışmalara yol gösterilmesi amaçlanmaktadır. Bu amacı gerçekleştirmek için bibliometrik analiz yönteminden yararlanılmaktadır. Perish or Publish literatür tarama programı kullanılarak Scopus veri tabanından elde edilen çalışmalar Vosviewer programı yardımıyla analiz edilerek havalimanı ve havayolu işletmelerinde sürdürülebilirliğin boyutları incelenmektedir. Yanı sıra konuyla ilgili en çok yayın yapan yazarlar, en fazla atıf alan yayınlar, en fazla makale yayınlayan dergiler, en çok incelenen sektörler analiz edilerek yazına katkı sağlanması amaçlanmaktadır.
Anahtar Kelimeler: Sürdürülebilirlik, Havalimanı, Havayolu, Bibliometrik Analiz
Jel Sınıflandırması: M10, M19

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1. Introduction

According to Tang et al. (2020), globalization has led the world to undergo various changes or transformations, which can result in a widespread range of effects on industries, sectors, organizations, etc., such as climate change, depletion of natural resources, poverty, population growth, and environmental damages caused by production processes. Essentially, these issues indicate the importance of the concept of sustainability in today's context. Simply put, sustainability entails the idea of leaving enough resources for future generations while consuming the existing ones. It is evident that this concept has increasingly gained popularity over time and is being given higher consideration in various sectors or organizations, including the aviation sector or entities within it.

However, it is noteworthy that the concept of sustainability has undergone many changes over time, with the most influential and significant development believed to be the Brundtland Report prepared by the United Nations World Commission on Environment and Development in 1987, titled "Our Common Future" (Bermejo and Bermejo, 2014). This report emphasizes the importance of sustainability and plays a significant role in increasing awareness about the concept and its explanations or approaches. Consequently, sustainability is now seen as an important principle within the framework of legal regulations, intergovernmental agreements, and national/international policies (Hörisch et al., 2017).

The phenomenon of sustainability, which is addressed in many disciplines and has been brought to an international dimension, brings up the existence of the concept of corporate sustainability when considering the increasing role and impact of businesses in the economy. Moreover, it is believed that the traditional business approach, which has traditionally focused solely on financial gains, has now been replaced by a more value-oriented approach that embraces sustainability principles. In other words, it is now necessary to consider not only financial gains but also environmental impacts, social responsibilities, and corporate governance in measuring a business's success. Therefore, businesses are not only adopting profit-driven practices but also embracing those that are compatible with the environment and society, focusing on the values they create (Frecè and Harder, 2018).

As stated by Gupta and Benson (2011), these sustainable practices have become crucial key elements that provide competitive advantages to businesses over time. This is because consumers, investors, and other stakeholders now place significant importance not only on the quality of products or services but also on the environmental and social impacts of businesses. Therefore, businesses focusing on sustainability principles can gain a significant advantage in increasing their market share by reaching a wider customer base. Hence, it is expected that businesses will make more efforts to reduce their environmental and social impacts, fulfill their social responsibilities, and embrace the principle of corporate sustainability.

On the other hand, businesses that approach corporate sustainability as a whole with its environmental, social, and economic dimensions, and integrate this approach into their management strategies, can maintain their market power continuity in addition to being at the forefront in the race of competition (Terra dos Santos et al., 2023). Corporate sustainability requires a societal perspective

and represents a steady process aimed at ensuring the careful use of a society's cultural, social, natural, scientific, and human resources and respecting their use (Jitmaneeroj, 2016). Nowadays, sustainability practices, which continue to gain importance within this framework, have been institutionalized at the organizational level (Wang and Lin, 2007) and are seen among the strategic objectives of organizations in achieving corporate sustainability. In this context, it is important that all dimensions of sustainability are equal important and carefully addressed accordingly.

Today, sustainability or coordinated activities and practices carried out within this scope in many sectors or organizations, including aviation, are important. It is advocated that organizations should take various measures to reduce their environmental and social impacts, use natural resources more efficiently, and consider the needs of future generations (Kocmanová and Dočekalová, 2011). Moreover, the changes brought about by globalization and the problems they have caused not only highlight the importance of the sustainability concept but also reveal the increasing necessity of considering sustainability both economically, socially and environmentally. Economic, social, and environmental elements are seen as important inseparable parts complementing each other in sectors or businesses (Epstein, 2018). At this point, structuring these elements and internalizing actions aimed at them in the relevant sector or organization based on the sustainability understanding in activities to be carried out is necessary. In order to emphasize this necessity, it is aimed to identify academic studies on the economic, social and environmental sustainability of organizations and to determine which dimension of sustainability (economic, social, environmental) these studies focus on more. On the other hand, determining which dimensions of sustainability remain insufficient in studies constitutes the main purpose of the current study.

2. The Concept and Importance of Sustainability

Sustainability, with its conceptual roots tracing back to ancient times, has historically been described as a subject where people contemplate how to utilize natural resources and preserve them for future generations (Basiago, 1995). However, it is observed that the modern understanding of the sustainability concept gained prominence particularly in the latter half of the 20th century and the beginning of the 21st century. As indicated in the literature, sustainability corresponds to various concepts such as continuity, perpetuity, uninterruptedness, and stability, and essentially can also imply supporting, guaranteeing, and demonstrating the preservation of something. At its simplest, sustainability is a phenomenon that entails the transfer of human actions to future generations by maintaining the balance in the ecological life system and preserving natural resources (Halme et al., 2002).

Pioneering approaches to the concept are brought to attention through the interaction of environmental sciences and economic theories. In this context, sustainability was defined in the 1987 report "Our Common Future" by the United Nations Brundtland Commission as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Bermejo and Bermejo, 2014). This definition constitutes the basis for the development of the sustainability concept and is widely accepted internationally. When approached with a modern

perspective, the sustainability concept today is expressed not only in relation to the environment but also as a broader concept encompassing economic, social, and sometimes even cultural dimensions (Frecè and Harder, 2018).

Moreover, various conceptualizations related to sustainability are discussed in many fields, and it is noted that sustainable development, sustainable environment, sustainable energy and sustainable agriculture, among others, are just a few of these sub-concepts. Viederman (1994) provides a sustainability definition developed through the joint participation of stakeholders responsible for the responsible, balanced, and measured use of all existing or potential resources in natural, human, or economic frameworks. Similarly, Gray and Milne (2002) argue that stakeholders can demonstrate sustainability through integrated mutual benefit and decision-making actions. The stakeholders in question include governments, businesses, non-governmental organizations, and individuals from different fields.

Today, it is believed that governments, businesses, non-governmental organizations, and academics have a higher level of awareness about sustainability and have widely grasped the importance of the sustainability concept (Perrini and Tencati, 2006). This is because numerous stakeholder groups in question formulate policies, develop strategies, and conduct various studies in this direction. Consequently, sustainability is now seen as a necessity rather than a voluntary action, and it becomes increasingly difficult to avoid. In this context, sustainability goals are set, and their feasibility is considered both at the local/national and global/international levels by numerous stakeholder groups (Klaas Jagersma, 2009). It is an undeniable fact that the sustainable management of these resources, whether economic, environmental, or social, is crucial for ensuring a healthy transfer to future generations (Martine and Alves, 2015).

3. Examination of Sustainability Dimensions

According to Zeng et al. (2022), sustainability consists of three sub-dimensions within a general framework: economic, environmental, and social. Sustainability, being a multidisciplinary subject, requires different approaches as it is addressed by researchers in various fields, and this greatly contributes to its development. However, ultimately, it should not be overlooked that all activities within the scope of sustainability, like stakeholder groups, are carried out with a common holistic approach for a shared future.

Economic sustainability entails the effective and efficient utilization of all current and potential financial resources of a business and is fundamentally measured through financial indicators such as profitability, earnings per share ratios, etc. (Piedra-Muñoz et al., 2016). One of the two approaches to economic sustainability is to ensure that economic activities do not impose an unreasonable burden on future generations (Foy, 1990), while the other focuses on maximizing benefits and welfare (Harris, 2001). Additionally, there is a significant relationship between economic sustainability and both environmental and social sustainability, necessitating a comprehensive approach or evaluation (Boar et al., 2020).

Environmental sustainability is based on the principle of preventing overconsumption or achieving moderate consumption based on renewable/non-renewable resources. Simply put, it aims to prevent the overconsumption of renewable resources or to procure and consume alternative resources to non-renewable resources in order to create or achieve a healthy system or functioning (Sanchirico and Wilen, 2007). This ensures the sustainability of both economic-based resources, such as atmospheric stability or biodiversity, and non-economic-based resources, such as ecosystem functions (Harris, 2003). The environmental dimension of sustainability enables the attainment of human/nature harmony and ensures and preserves the ability to meet future economic, social, or environmental needs (Nilashi et al., 2019).

Social sustainability, on the other hand, is based on the first six articles of the United Nations Global Compact, which are fundamental pillars of human rights (Moldan et al., 2012). The social dimension of sustainability encompasses the fulfillment of basic human needs, ensuring security, equality, justice, cultural diversity, development of innovative approaches, tolerance, solidarity, and taking subjective needs into account when necessary (Spangerberg and Omann, 2006). In other words, socially sustainable development is a concept that focuses on the relationships with different stakeholder groups, identifies the positive and negative effects it has on individuals, and strives to manage them. At this point, the importance of social sustainability in achieving successful and effective results is evident, as any deficiency in social development inevitably affects the entire process (Ranganathan, 1998).

4. Method

Scientific progress is cumulatively built over time. Researchers often generate new studies by evaluating the results of previous ones. In heavily studied popular topics, sometimes research may become clustered in certain aspects, leaving other facets of the topic unexplored. Identifying where clustering occurs and where gaps exist in the researched topic is crucial for scientific studies. Revealing these gaps is often achieved through bibliometric analyses (Zupic and Čater, 2015). Bibliometric studies involve statistical deductions from various perspectives such as authorship, topic, keywords, and citations of previous studies, enabling conceptual, intellectual, and social evaluations of the research topic (Bozkurt and Çetin, 2016). Bibliometric networks, consisting of visual indicators, are created using complex nodes and connections to transform quantitative data into qualitative results (van Eck and Waltman, 2014).

In this research, firstly, publications were scanned in the Scopus database using the "Publish or Perish 8" literature search program, and they included the terms "airline sustainability", "airline sustainability" and "airport sustainability" in their title, abstract or keywords and were published between 1984-2023 (The focus is on studies between the entire Scopus database). This search yielded 820 results. After excluding publications that were not relevant to sustainability studies in the aviation field, 610 publications were deemed suitable for analysis. Subsequently, the data pertaining to these results were transferred to the VOSviewer program for bibliometric analysis. This program allows

for a comprehensive examination of the studies in the literature and enables researchers to visualize developments in any field.

5. Findings

There are numerous studies by various authors in the field of sustainability in aviation. Through the analyses conducted, the ten authors and publication titles receiving the most citations have been identified. Among the studies on sustainability in aviation, it was found that the study by Hall and Page (2014) has the highest number of citations, with 3035 citations.

Tablo 1: The top ten authors and publication titles with the most citations in sustainability in aviation

Author(s)	Publication Title	Year	Citation Count
Hall & Page	The Geography of Tourism and Recreation Environment, Place and Space	2014	3035
Mbaiwa	The socio-economic and environmental impacts of tourism development on the Okavango Delta, north-western Botswana	2003	604
Foo, Chin, Tan & Phuah	The impact of COVID-19 on tourism industry in Malaysia	2021	496
Di Vaio & Varriale	Blockchain technology in supply chain management for sustainable performance: Evidence from the airport industry	2020	406
Capocchi, Vallone, Pierotti & Amaduzzi	Overtourism: A Literature Review to Assess Implications and Future Perspectives	2019	329
Amankwah-Amoah	Stepping up and stepping out of COVID-19: New challenges for environmental sustainability policies in the global airline industry	2020	296
Chuck & Donnelly	The compatibility of potential bioderived fuels with Jet A-1 aviation kerosene	2014	284
Sgouridis, Bonnefoy & Hansman	Air transportation in a carbon constrained world: Long-term dynamics of policies and strategies for mitigating the carbon footprint of commercial aviation	2011	259
Nižetić	Impact of coronavirus (COVID-19) pandemic on air transport mobility, energy, and environment: A case study	2020	251
Upham, Thomas, Gillingwater & Raper	Environmental capacity and airport operations: current issues and future prospects	2003	217

When examining cluster analysis to understand the relationships between other authors, it was observed that a total of 21 clusters were formed. When selecting data points on the visual, documents with citations of 10 or more were chosen, and out of 820 documents, 540 documents were included in the analysis. Among these documents, there are a total of 729 connections between authors receiving citations. Authors such as Graham, Cui, Button, and Zhang, among others, appear larger on the visual, indicating that they received more citations and have the most connections. On the other hand, some clusters formed by certain authors are located more centrally, while others are on the periphery. This could be explained by the fact that studies with higher relationship intensity are more centrally located, while studies with lower relationship levels are on the periphery.

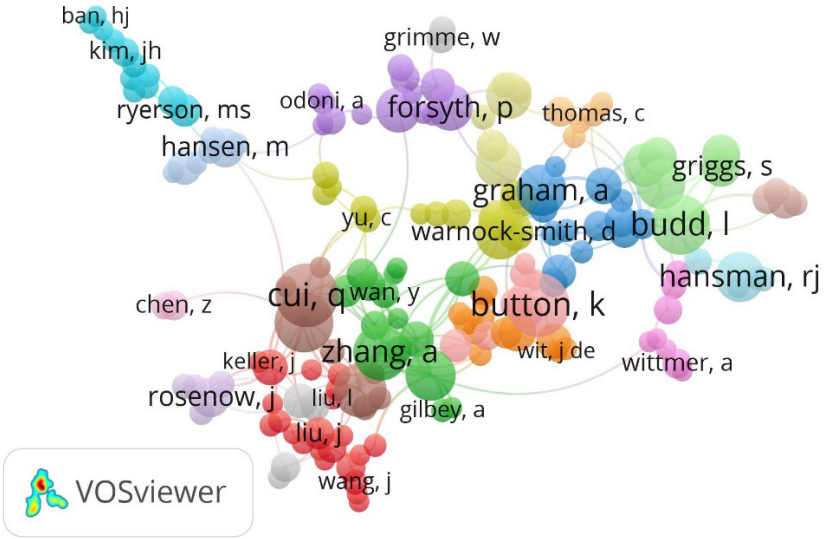

Figure 1: Text data word analysis of all authors

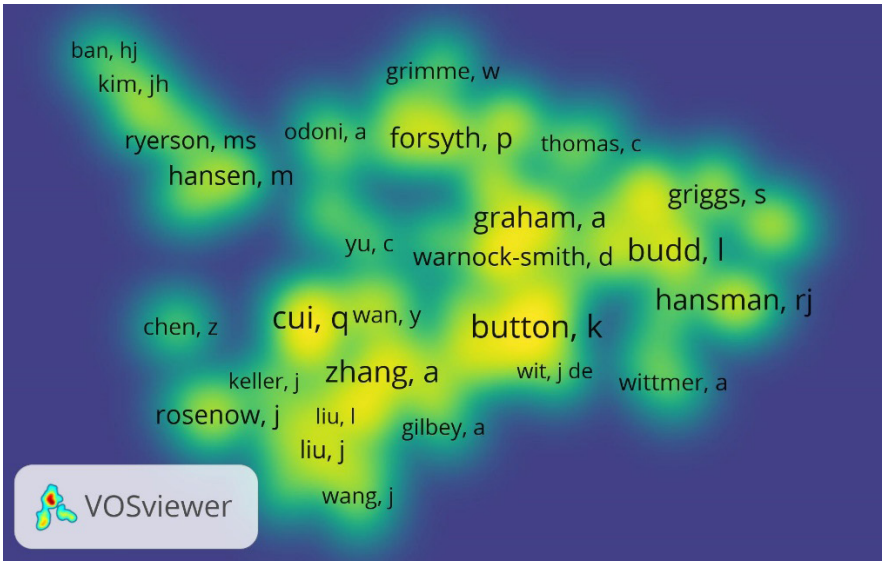

Figure 2: Density map of all authors

The studies on sustainability in aviation are observed to have started in 1984. It can be seen that the number of studies fluctuated and increased from the starting year until 2023. The rise, as depicted more clearly in the graph below, demonstrates the increasing importance given to sustainability in

the aviation sector over the years, and it underscores how authors have been increasingly interested in this topic with each passing day.

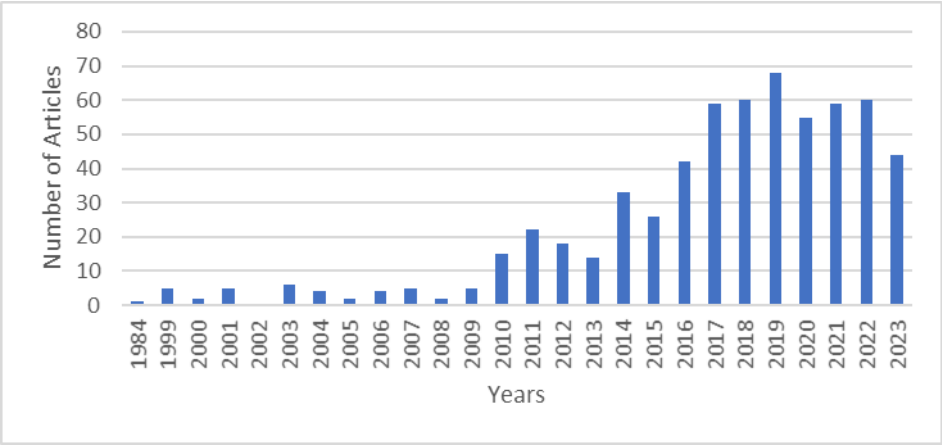

Figure 3: The distribution of studies on sustainability in aviation by year.

Some journals have been observed publishing more articles on sustainability in aviation than others. In this context, the top ten journals that have published the most articles on the subject are listed. Among these journals, "Sustainability" stands out as the journal with the highest number of articles, with 114 articles. The other journals are listed below in the table.

Table 2: The journals publishing the most articles on sustainability in aviation

Journal Name	Number of Articles
Sustainability	114
Journal of Air Transport Management	70
Journal of Cleaner Production	28
Transportation Research	24
Journal of Transport Geography	18
Transport Policy	12
Research in Transportation Economics	12
Journal of the Transportation Research	10

In these journals, while most of the publications have focused solely on aviation, some studies have also explored connections with different sectors or topics. The table below illustrates the sectors in which studies related to the three dimensions of sustainability have been conducted, in addition to the aviation sector. In the first table, studies concerning airports are examined, and sectors and dimensions are presented. Engineering-related studies stand out the most in the context of airports. Following that, studies in urbanization and ecology are seen to contribute to sustainability in aviation. It is observed that areas such as marketing, corporate social responsibility, and econometrics have not been studied in conjunction with airport sustainability. Details regarding other sectors are shown in the table below.

Table 3: Studies on sectors contributing to the sustainability of airports

Sector	Environmental	Economic	Social	Number of Studies (Airports)
Engineering	12	32	2	44
Urbanization	8	4	—	10
Ecology	10	2	—	8
Transportation	2	4	1	7
Tourism	—	6	—	6
Energy	—	2	—	2
Law	2	—	2	2
Management		5	—	5
Accounting	—	2	—	2
Finance	—	2	—	2
Politics	—	—	2	2
Marketing	—	—	—	—
Corporate Social Responsibility (CSR)	—	—	—	—
Econometrics	—	—	—	—

Below is a table showing studies conducted on airlines in conjunction with sectors other than aviation. The findings from these studies indicate that the sustainability of airline operations is primarily studied in conjunction with the ecology sector. Following ecology, finance is the second most studied sector, while no studies have been found on law, urbanization, and politics.

Table 4: Studies on sectors contributing to the sustainability of airline operations

Sector	Environmental	Economic	Social	Number of Studies (Airlines)
Ecology	34	4	—	38
Finance	—	34	—	34
Energy	17	14	—	24
Management	2	19	—	21
Marketing	2	20	4	20
Tourism	10	9	—	19
Engineering	12	14	2	18
CSR	—	18	—	18
Transportation	4	5	—	7
Accounting	—	6	—	6
Econometrics	—	2	—	2
Law	—	—	—	—
Urbanization	—	—	—	—
Politics	—	—	—	—

The relationships between the words frequently mentioned in publications were examined after separating the worked areas according to airports and airlines and analyzing the environmental, economic, and social dimensions. It is observed that the words "Environmental factor" and "transport" stand out. Words crucial for sustainability in aviation, such as "noise," "air pollutant," "green line," "alternative fuel," "profitability," and "sustainability development goal," appear to be

relatively marginal. When the figure is examined, it is observed that the word "socio" has very few relationships and remains outside the clusters. This situation provides a clue that there is less interest in the social dimension of sustainability.

Figure 4: Text data word analysis

The focus of studies on airports and airline companies regarding sustainability dimensions was examined. In addition to studies focusing on only one dimension of environmental, economic, or social aspects, studies that simultaneously focused on two or all three dimensions were also identified. The table below illustrates the focus on sustainability dimensions, categorized by airports and airlines, indicating where each dimension was studied. Accordingly, it is observed that both airports and airlines predominantly emphasize the economic dimension of sustainability. The least studied dimension appears to be the social aspect of sustainability.

Table 5: Distribution of sustainability dimensions by airport and airline

Dimensions	Airport	Airline
Economic	189	258
Environmental	134	129
Social	33	26
Environmental and Economic	48	34
Environmental and Social	2	6
Social and Economic	4	13
Environmental, Social, and Economic	20	2

As seen in the figure below, the most studied dimension for both airports and airlines is the economic dimension, followed by the environmental dimension in second place, and the social dimension in last place. When focusing on the difference between dimensions, it is observed that in airline operations, the economic dimension is proportionally 50% higher than the environmental dimension. Additionally, it is noted that the social dimension is worked on approximately 91% more than the environmental dimension. A similar trend is observed in airport studies as well. The most studied dimension is worked on approximately 42% more than the closest dimension, which is the environmental dimension. Studies related to the social dimension are only about 15% of those related to the economic dimension. Considering all studies, it is evident that the social dimension accounts for only about 8% of all studies.

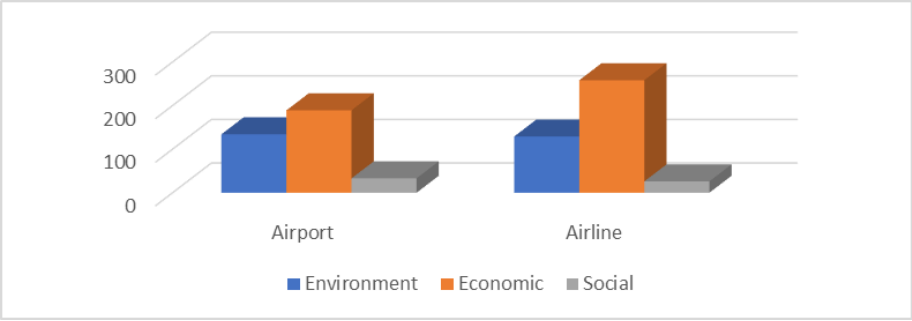

Figure 5: Distribution of sustainability dimensions by airport and airline

On the other hand, when we cluster airports and airlines including countries, we observe that the terms "air pollution" and "British Airways" stand out. The abundance of studies related to these two concepts compared to others and the formation of an intense network of relationships among them indicates that there is intensive research focused on these two concepts. The fact that the concept of "green aviation" remains distant from the clustering suggests that there are few associated studies and that it could be a relatively unexplored area for research.

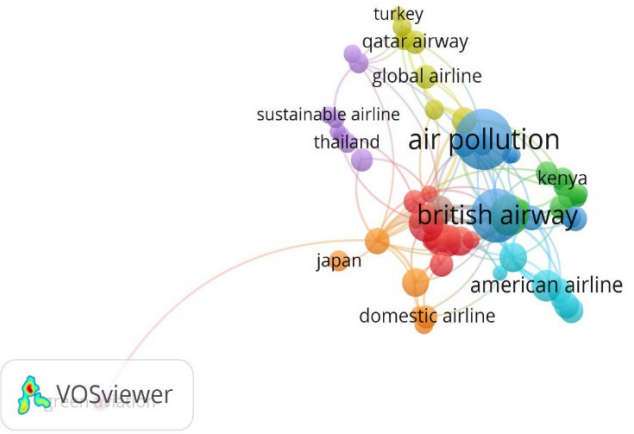

Figure 6: Sustainability topics focused on airports and countries

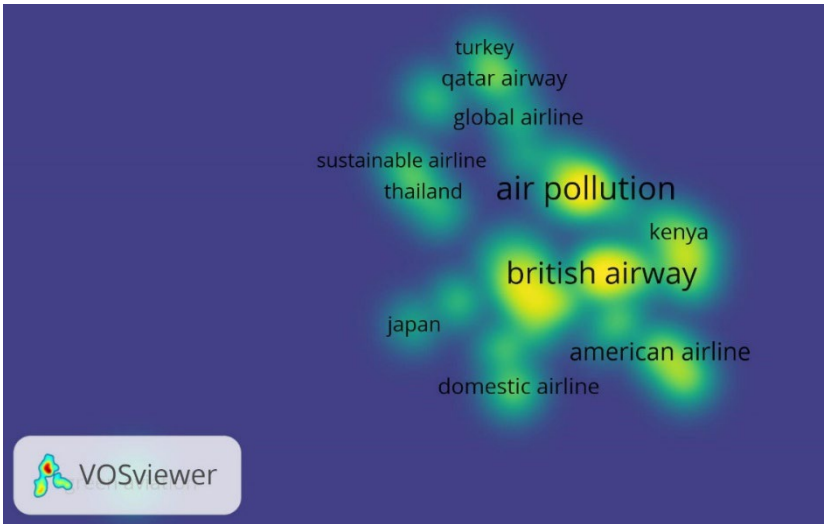

Figure 7: Density map of sustainability topics focused on airports and countries

6. Conclusion

It is believed that the success of today's businesses is shaped not only by financial gains but also by environmental impacts, social responsibilities, and corporate governance (Frecè & Harder, 2018). Therefore, businesses adopt practices that are not only profit-oriented but also environmentally and socially compatible, focusing on the long-term benefits of these values. The responsibility to create and sustain these practices lies among the ultimate goals of organizations. Organizations are implementing sustainable practices in environmental, economic, and social issues, and the importance of these three dimensions of sustainability is increasing day by day. The present study aimed to determine the extent to which these three dimensions are studied by academics in airports and airline companies and to identify possible gaps in the literature to guide future research. Despite fluctuations, research on sustainability in the aviation sector is seen to be increasing day by day. This increase particularly focuses on economic sustainability. While studies on economic sustainability are predominantly conducted in the engineering field at airports, they are predominantly conducted in the finance field at airline companies. The environmental dimension, which is nearly half as much as the economic dimension, is seen to be the most studied in the engineering field at airports, while it is studied in the field of ecology at airline companies. The social dimension of sustainability is poorly studied both at airports and airline companies. Consequently, it is observed that the prominent keywords in the network visualizations are generally related to the economic and environmental dimensions, with no prominent keywords related to the social dimension. Given that the social dimension is considered as crucial as the economic and environmental dimensions for sustainability, academics' lack of attention to this dimension may pose a danger to the future of sustainability.

When examining the studies related to corporate social responsibility (CSR) in sectors related to airports and airlines, it is observed that only the economic dimension is examined in the articles reached. However, CSR is an area that is concerned not only with the economic dimension but also with the environmental and social dimensions as much as the economic dimension. Therefore, in future studies, focusing on the environmental and social sustainability dimensions of corporate social responsibility in airports and airlines will contribute significantly to the literature. A surprising result regarding corporate social responsibility is that no studies have been conducted at airports. Similarly, studies conducted in the fields of marketing and econometrics have only been conducted on airline companies, with no studies found in these areas at airports. Therefore, in future research, it is important for academics working in the fields of marketing, corporate social responsibility, and econometrics to focus on the sustainability of airports. Similarly, while studies on law, urbanization, and politics are focused on airports, no studies related to the sustainability of airline companies have been found. Although urbanization is thought to be mainly related to airports, designing studies in the fields of law and politics including airline companies, would contribute to the literature. On the other hand, when analyzing airports and countries, it is seen that the prominent keywords are "British Airways" and "air pollution." Considering that there are numerous airline companies and airports worldwide, the concentration of studies on a single airline may hinder the sustainable development of the aviation sector. Therefore, in addition to focusing on different airline companies and airports in future studies, it is important to focus on topics other than air pollution to fill the gaps in the literature.

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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

SUSTAINABLE FOOD CONSUMPTION WITHIN THE SCOPE OF THE GREEN ECONOMY: A STUDY ON CONSUMER PERSPECTIVES

YEŞİL EKONOMİ KAPSAMINDA SÜRDÜRÜLEBİLİR GIDA TÜKETİMİ: TÜKETİCİ PERSPEKTİFLERİNE YÖNELİK BİR ÇALIŞMA

Şirin Gizem KÖSE*

Abstract

Sustainable production and consumption are one of the significant issues in the food industry, as in every field. The food industry, which is so important for the survival of humanity, is also under the spotlight in terms of its effects on the environment. In this regard, this study aims to address sustainable food consumption from the perspectives of the consumer, one of the most important actors in the food consumption system. For this purpose, data was obtained using the in-depth interview technique. Research results show that barriers to sustainable food consumption are perceived expensiveness, lack of information, perceived greenwashing, low availability, perceived effort, and living conditions, whereas drivers for sustainable food consumption are health and environmental consciousness, subjective norms, social media, and food involvement.

Keywords: Sustainable Food Consumption, Sustainable Consumption, Consumer Behavior
JEL Classification: M30, M31

Öz

Sürdürülebilir üretim ve tüketim, her alanda olduğu gibi gıda sektöründe de önemli konulardan biridir. İnsanlığın yaşama devam etmesi için elzem olan gıda sektörü, çevreye etkileri bakımından da mercek altındadır. Bu bağlamda bu çalışmanın amacı sürdürülebilir gıda tüketimini gıda tüketim sisteminin en önemli aktörlerinden biri olan tüketici perspektiflerinden ele almaktır. Bu amaçla derinlemesine görüşme tekniği kullanılarak veriler elde edilmiştir. Araştırma sonuçları, sürdürülebilir gıda tüketiminin önündeki engellerin algılanan pahalılık, bilgi eksikliği, algılanan yeşil yıkama, düşük bulunabilirlik, algılanan çaba ve yaşam koşulları olduğunu, sürdürülebilir gıda tüketiminin itici güçlerinin ise sağlık ve çevre bilinci, subjektif norm, sosyal medya ve gıda ilgilenimi olduğunu göstermektedir.

Anahtar Kelimeler: Sürdürülebilir Gıda Tüketimi, Sürdürülebilir Tüketim, Tüketici Davranışı
JEL Sınıflandırması: M30, M31

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1. Introduction

Food consumption is of great importance to humanity, but also represents an important sector that contributes significantly to environmental impact (Azzurra et al., 2019). While food is essential for humanity's survival, household food consumption can have negative effects on the environment (Chu et al., 2023; Phan, 2024). The impact of traditional agricultural production on ecosystems and the position of consumers in preserving environmental sustainability highlight the importance of investigating the consumer side of sustainable food consumption (Han & Hansen, 2012). Sustainable food refers to food that is safe, healthy, and nutritious for all consumers, provides a livable livelihood for its workers, does not harm the environment in its production and processing, reduces energy consumption, respects animal health and welfare standards, encourages local products, especially those that minimize food miles, and supports rural economies and rural cultural diversity (UK Sustainable Development Commission, 2009). Based on this definition, sustainable food consumption is a general term that covers the consumption of such foods.

Since food consumption is a basic activity for humans and is influenced by socio-cultural factors, changing food preferences is not easy and food consumption is more than a functional choice (Vermeir et al., 2020; Szalonka et al., 2021). Consumers' food preferences do not only focus on benefits sought but are also affected by psychological factors (Güneş & Karakaş, 2022). Therefore, researching sustainable food consumption from consumers' perspectives is important in terms of understanding their food preferences and determining appropriate marketing strategies.

In sustainable consumption, positive attitudes do not always result in purchase behavior, which is expressed as an attitude-behavior gap in the sustainability literature (Joshi & Rahman, 2015; Yamoah & Acquaye). This phenomenon is also evident in the context of food consumption (Vermeir & Verbeke, 2006; Vermeir et al., 2020). While consumers may have favorable attitudes toward the consumption of sustainable food products, the translation of these attitudes into actual behavior can be hindered by several factors. To investigate the reason for this gap, the qualitative research method, which is useful for revealing the thoughts in the minds of consumers, is useful. With in-depth interviews, individuals' inner worlds and thoughts, as well as previously undiscovered behaviors, can be revealed (Uslu & Demir, 2023).

Understanding food consumption is crucial for sustainability in the food field, as consumption affects both the supply chain and production systems. Exploring the demand side will help create policies for sustainable initiatives. In this regard, the objective of this study is to investigate sustainable food consumption within the scope of the green economy and to understand the perception of consumers, one of the most important actors of the system, on the subject. Drivers and barriers to sustainable food consumption are also examined. For this purpose, firstly, the green economy and sustainable food consumption were explained, and consumer attitudes were revealed through in-depth interviews.

2. Literature Review

2.1. Green Economy

The importance of green economy and green growth concepts for sustainable development is increasing day by day. One of the main goals of this economic model is to minimize damage to nature while ensuring sustainable growth.

The green economy is one of the main themes of the United Nations' Sustainable Development Conference in 2012 and has consistently remained one of the primary focal points in sustainable development (Bina, 2013; Caprotti & Bailey, 2014). The green economy is characterized by increasing human well-being, promoting social equity, and at the same time reducing environmental risks (UNEP, 2024). While ecological problems are important for environmental sustainability; economic, social, and environmental development should be considered together. In this context, a shift to a green economy is recommended as a possible alternative model (Yerlikaya, 2022). Goals in the green economy include increasing income and employment, decreasing environmental pollution and carbon emissions, improving the efficiency of resources, and protecting and enriching biodiversity (Özçağ & Hotunluoğlu, 2015).

Modern systems where economic activities are conducted in a way that creates negative effects on the environment have increased the importance of the notion of the green economy. This has led to the growth of many policies and initiatives aimed at developing the green economy. The main drivers of the green economy are the development of international commitments and initiatives aimed at minimizing and controlling waste, using resources wisely, reducing pollution, and countering the effects of climate change (Dogaru, 2021).

The broad notion of the "green economy" encompasses risk mitigation, prosperity, growth, and efficient use of natural resources. A bibliometric study by Louseau et al (2016) found that most of the keywords related to the green economy are associated with the environmental and economic part of the green economy; this shows that less importance is given to the social aspect. These findings provide evidence of the strong relationship between the green economy and sustainability. Through its economic, social, and environmental elements, the green economy fosters sustainable development, which aims to improve human well-being, advance social justice, and lessen environmental dangers (Chaaben et al., 2022).

2.2. Sustainable Food Consumption

Sustainable consumption refers to consuming products that meet fundamental needs and enhance the quality of life, while at the same time reducing the use of natural resources, minimizing the use of harmful materials, and reducing waste (Oslo Roundtable on Sustainable Production and Consumption, 1994). Sustainable consumption is explained as follows: customers in a certain area neither use more resources than the area can sustainably create nor do they generate more trash or emissions than the area can handle. As so, the ecological footprint of consumption does not exceed

the corresponding biocapacity. As a result, environmentally conscious consumerism respects limits (Fischer et al., 2023). In light of these approaches, sustainable food consumption refers to making choices that consider the environmental, social, and economic consequences of food production and consumption (Vermeir & Verbeke, 2006).

Sustainability covers economic (profit), ecological (planet), and social (people) factors. Fair prices for both agricultural workers and customers are related to the economic dimension while protecting the natural environment and ensuring the well-being of people. The social aspect, on the other hand, refers to the alignment of production processes with societal priorities and citizen needs (Vermeir & Verbeke, 2008). Mensah et al. (2024) revealed that the definitions of sustainable food in the literature include dietary suggestions, environmental issues, and economic elements in their study focusing on sustainable food definitions.

In a sustainable food system, all people should have access to sufficient food within the constraints of scarce natural resources (Aschemann-Witzel et al., 2021). Food security and nutrition are made possible for everyone by taking into account economic, social, and environmental considerations in sustainable food systems (Kadıoğlu & Kaya, 2022). The unsustainable situation in current food systems is mainly due to the industrialization and globalization of food, the change in consumption patterns towards consuming more animal protein, and the appearance of a modern food system with more processed foods. All these factors are linked to the policies, values , and habits of consumers and the actions of companies (Reisch et al., 2013). Using less water in food production is one of the most important agenda items (Kadıoğlu & Kaya, 2022). Water management should be considered together with soil and forestry management in sustainable agriculture and food systems. Sustainable business models such as integrated resource management, smart agriculture, food villages, food centers, and clustering are important elements used in ensuring sustainability in food (Güneş & Karakaş, 2022). In this context, the food sector actively undertakes measures to ensure sustainability similar to all other sectors.

Growing organic food is seen as one of the more sustainable methods of food production (Feil et al., 2020). Food and agriculture industries are interrelated; therefore, for the food obtained to be evaluated within the scope of the green economy, agricultural systems must be compatible with green practices. In this context, organic farming systems designed according to green economy principles can be considered for sustainable food production (Güneş et al., 2014). Azzura et al.'s (2019) study also revealed that when organic food consumption intensity is high, consumers' sustainability concerns are also higher and they tend to have a more environmentally friendly lifestyle. Along with organic food, foods with certificates of origin, fair trade products, and local products are also included in the sustainable food category (Vassallo et al., 2016).

People perform many food-related tasks in daily life, such as purchasing, planning, preparing, eating, storing, or throwing away (Jaiswal & Aagja, 2023). Increasing the sustainability of these processes can enable consumers to make a significant contribution to the food chain.

Sustainable food behaviors can be categorized into two dimensions; choosing food products according to the method they are produced (organic, unconfined, fair-trade foods) and following sustainable eating styles that include reducing the food consumed (Verain et al., 2015). Reducing meat and dairy consumption, choosing organic fruits and vegetables, and avoiding eating food products that are transported via air can be effective ways to lessen the negative effects of food on the environment (Reisch et al., 2013). Research shows that sustainable food consumption includes reuse, intention to minimize waste, shopping habits, and planning habits dimensions. It also includes health-oriented sustainable food consumption and environmentally friendly sustainable food consumption (Bulut et al., 2019).

Phan (2024) classified consumers' sustainable food behaviors by focusing on three phases: the acquisition phase (purchasing ingredients), the usage phase (cooking, eating, sharing leftover food), and the disposal phase (food waste). According to another systematic analysis, most studies in the field of sustainable food have focused on dietary behavior and food waste (Aguirre Sánchez et al., 2021).

There are several studies in the literature on factors related to intention to consume sustainable food and sustainable food consumption. Korkmaz and Sertoğlu (2013) revealed that attitude, social norms, and perceived consumer effectiveness are related to behavioral intention. Consumers' health awareness and healthy lifestyles are related to their attitudes toward sustainable and healthy food consumption (Gürler & Nart, 2019). Vermeir and Verbeke (2008) researched sustainable dairy products and proved that personal attitudes, perceived social influences, consumer effectiveness availability, and intention to consume such products are interrelated. Social norm, perceived value, perceived consumer effectiveness, and attitude are revealed as predictors of intention to consume sustainable food while perceived availability, perceived consumer effectiveness, and intention are related to actual behavior (Alam et al., 2020). According to another study, in addition to behavioral attitude, subjective norms, and perceived behavioral control variables, perceived quality also affects the intention to purchase sustainable food (Chu et al., 2023).

Some studies focused on actual behavior. Research presented personal and subjective norm, and attitude as the most powerful antecedents of sustainable food purchasing (Han & Hansen, 2012). Sustainable food purchasing is explained by personal fear of missing out (FOMO) in another study (Singh & Banerjee, 2024). A study approached the concept from a moral perspective and revealed that non-moral factors significantly outweigh moral ones when it comes to the motivations behind sustainable food consumption (Panatsa & Malandrakis, 2024). Problem awareness is also related to sustainable food consumption. Furthermore, value-based, emotional, and rational factors are all predictors of sustainable food consumption (Betzler et al., 2021). The results of a study conducted in England demonstrate that sustainable food purchasing behaviors are negatively affected by price and positively affected by sustainable product availability and past purchase behavior of sustainable food products (Yamoah & Acquaye, 2019)

3. Methodology

In-depth interview, a qualitative research method, was used as the data collection method in the research. The validity of the data obtained by asking consistent questions is strengthened, and quality and strong data can be included in the research with in depth-interview (Uslu & Demir, 2023). Interviewing is defined as a process in which the interviewer and the participant take part together, focusing on questions prepared for the area being researched (deMarrais, 2004). It is a mutual and interactive communication process based on asking and answering questions (Stewart & Cash, 2003). The main objective of interviews is to understand the unobserved, such as experiences, attitudes, thoughts, intentions, interpretations, and mental perceptions and reactions (Yıldırım & Şimşek, 2011).

In-depth interviews were held with a total of 20 people, 10 women, and 10 men, throughout March 2024 to examine consumer opinions on sustainable food. Criterion sampling which refers to working with samples that met the determined criteria was used in the research (Yıldırım & Şimşek, 2011). Interviews were held with individuals who follow news about food consumption and sustainable food, about companies in the food sector, shop for food, and participate in decision-making in household food consumption.

Table 1. Characteristics of the Participants

Code	Gender	Occupation	Age
P1	Female	Research Assistant	28
P2	Female	Student	21
P3	Male	Director	40
P4	Female	Lawyer	25
P5	Male	General Manager	50
P6	Female	Private Secretary	36
P7	Male	Student	22
P8	Female	Teacher	32
P9	Male	Sales assistant	30
P10	Female	Chef	28
P11	Female	Waiter	29
P12	Male	Restaurant manager	42
P13	Male	Photographer	33
P14	Male	Chef	35
P15	Female	Dietitian	26
P16	Male	Food engineer	28
P17	Female	Housewife	38
P18	Male	Assistant Professor	36
P19	Female	Brand manager	45
P20	Male	Doctor	38

The research questions are as follows:

RQ1: How do consumers perceive sustainable food?

RQ2: What are consumers' perceived sustainable food behaviors?

RQ3: What are the barriers that consumers perceive in purchasing sustainable food?

RQ4: What are the factors that drive consumers to buy sustainable food?

To find answers to these research questions, interview questions were prepared by the researcher with the support of literature. The questions start with general questions about the perception of sustainable food and sustainable food behaviors and are then detailed to examine the obstacles and drivers of sustainable food consumption. The interviews were transferred to the Maxqda qualitative analysis program, coded, and analyzed. As a result of the analysis of the interviews, themes of sustainable food perception, sustainable food behaviors, drivers, and barriers to sustainable food consumption were determined. barriers were sub-categorized into perceived expensiveness, lack of information, perceived greenwashing, low availability, perceived effort, and living conditions whereas drivers were sub-categorized into health consciousness, subjective norm, environmental consciousness, and food involvement. These are covered in the sections that follow.

4. Findings

4.1. Sustainable Food Perception

Firstly, how the participants perceived sustainable food was examined to understand how they viewed sustainable food. Participants associated sustainable food with environmental sustainability approached sustainable food from a holistic perspective, and stated that they generally viewed sustainable foods as "harmless foods". Participants also associate sustainable food with organic food and agriculture.

"It is a concept that includes foods that take into account not only today but also the future. It does not harm nature and living things, does not disrupt the functioning of our ecosystem." (P3)

"In my opinion, sustainable or green food is food that does not harm the environment as much as possible, does not pollute natural resources, and does not harm the health of living beings, from the first stage until it reaches our table, and even afterward, when it is in the form of waste." (P13)

"I know sustainable food as organic food and this is how we integrate sustainable food into our lives. It's definitely a concept that needs to be considered." (P9)

"Foods that may cause less harm to the earth. I think it's more about agriculture." (P8)

"Foods that do not harm the nature in their production, where employees are employed ethically, and whose transportation is done ethically and without harming the environment." (P16)

4.2. Sustainable Food Behavior

To gain information about the sustainable food behaviors of the participants, it researched which behaviors they considered sustainable food and which sustainable food behaviors they performed. Participants consider consuming local, fresh products as sustainable food behavior. In addition, cooking their food, growing vegetables and fruits, shopping from nearby places, paying attention to food packaging, and reducing meat consumption are also stated as sustainable food behaviors.

"I try not to bring imported foods into the kitchen. I prepare our meals myself with healthy ingredients that I buy in healthy packages." (P6)

"I have a greengrocer whom I have known for a long time. I buy vegetables and fruits from there, and when I buy them from there, I prefer fresh, fresh and in-season fruits." (P14)

"We had our own walnut grove in our village. I have my own garden where I live and I grow vegetables and fruits both in the greenhouse and in the open field. I can my own canned tomatoes from the tomatoes I plant. We make tomato paste and roasted eggplant in advance. Everything in my closet is from my own garden. I also have chickens and roosters." (P5)

"I think I am a conscious consumer of sustainable food. I go to nearby farms to buy natural cheese. When I retire in the future, I want to grow all my own food." (P19)

"Cattle, in particular, deplete the ozone layer because they cause the release of nitrogen gas. The carbon footprint becomes larger. I mostly don't eat red meat because I don't think it's a sustainable choice for the environment." (P18)

4.3. Barriers to Consume Sustainable Food

4.3.1. Perceived Expensiveness

Price is a determining factor in consumers' ability to transform their interest in sustainable food consumption into purchasing behavior (Vermeir & Verbeke, 2008). Premium price negatively affects sustainable food purchasing behavior (Yamoah & Acquaye, 2019). Even if the participants want to consume more sustainable food, the fact that they think that sustainable food products are more expensive in the market is seen as an obstacle to this intention.

"I do not find the prices of sustainable foods sustainable. I think they appeal to a very limited income group." (P11)

"The fresh, healthy, and organic fruits that my greengrocer reserves for me taste good, but they are costly" (P14)

"I make sustainable choices as much as I can and within my financial means. Only expensive markets sell these products; especially organic agricultural products. They are really expensive." (P7)

"Unfortunately, such products are expensive." (P18)

"If I have to choose between two products, I would prefer the sustainable one, but the price should also be reasonable. However, these products are generally expensive" (P4).

4.3.2. Lack of Information

Knowledge is an important factor in understanding sustainable food preferences (Verain et al., 2015). Ran et al. (2022) found that information can be an effective instrument when it is customized to a customer's entire shopping experience. Participants state that sustainable food requires knowledge due to its complex structure and that they think there is a lack of knowledge on this subject. The difficulty of distinguishing between environmentally friendly and non-environmentally friendly products in the market has been revealed as an important barrier.

"It is a very comprehensive subject; healthy products may sometimes not be environmentally friendly and sustainable I don't think I'm good at distinguishing it." (P1)

"At some point, I think sustainability is definitely important because the environment is one of the biggest factors affecting our health, but I am not very careful about this issue because I often cannot distinguish between food purchases that are harmful to the environment or not." (P13)

"I don't know much about sustainability. But I try to buy food from places I know. Apart from that, I prefer famous food chains, I think they are at least sensitive about ensuring that the materials you buy there are not harmful to health before expiry." (P6)

"I don't feel knowledgeable, because food production has many stages." (P7)

4.3.3. Perceived Greenwashing

Green skepticism refers to customers' tendency to question a green-labeled product's environmental impact or advantages (Leonidou & Skarmeas, 2017) This skepticism is often a result of greenwashing which is a term used to describe falsely portraying products as being ecologically safe or friendly using deceptive methods (Aji & Sutikno, 2015). When participants suspect that some foods sold as sustainable are not sustainable, this has a negative impact on their attitudes.

"Not every green packaged food with happy animals on it is sustainable. I suspect that they use this situation sometimes." (P9)

"I am suspicious of where and under what conditions the products are actually made, especially those sold as home-made, natural, and sustainable in unregulated places and I sometimes see mass-produced products sold in this way." (P20)

"Sometimes they even write it wrong on the label to make it look green. Maybe they are not sustainable, but they sell them that way to raise the price." (P8)

"Frankly, I have the perception that everything is just an illusion. Maybe that's why I can't focus much." (P4)

4.3.4. Low Availability

Past research suggests that product availability affects sustainable food purchase behavior (Yamoah & 2019). Low perceived availability is one of the factors that clarifies the low level of intention to buy (Vermeir & Verbeke, 2006). Participants indicated that they find it hard to find sustainable products in the market due to low availability.

"I prefer chain markets and dairies where I can choose food by checking and touching. I would like to buy these foods by seeing them, so I can't always buy them." (P17)

"Such products are not available everywhere." (P3)

"There is no sustainable and green food in the places where I do my daily food shopping." (P11)

"There are very few places that sell food products that I can say are absolutely sustainable." (P1)

4.3.5. Perceived Effort

People may avoid making efforts to protect their resources because the effort is costly (Dreijerink et al., 2022). Most eco-friendly and green activities require a substantial amount of effort so the effort can have a negative impact on sustainable behaviors (Gathen & Praxmarer-Carus, 2020). Participants underline that obtaining sustainable food is a demanding and tiring process.

"Growing your food is nice but very tiring. I love animals and the garden, but they all require effort. I have to go at noon and feed the chickens and hoe the garden." (P5)

"Consuming seasonal vegetables requires keeping track of which product is in which season and spending time canning. It's always a struggle to figure out where to find real sustainable food." (P18)

"You live dependent on your thermos and your lunch box. I think it's nice too, but it takes effort until you get used to it. Also, I need to plan my meals in advance so there is no waste." (P2)

4.3.6. Living Conditions

Participants state that their living conditions, especially living in the city, hinder the behavior of growing their own food, which they consider sustainable. In addition to physical obstacles, air pollution is also seen as an obstacle to growing their own food. Also, where they live affects their food consumption and preparation habits.

"I wish I had the opportunity to grow more of my own food. This is a little difficult in city life." (P19)

"I find it healthier and more sustainable for people to grow their own food in a natural environment. However, I do not believe that the food grown in cities is very healthy due to reasons such as air pollution." (P16)

"I am a student and I live in a dormitory; such actions challenge me." (P7)

"For a while, I thought about going vegan and living more sustainably, but I live with my family and have to eat whatever is cooked at home." (P4)

4.4. Drivers to Consume Sustainable Food

4.4.1. Health Consciousness

The level of integration of health issues into an individual's daily activities is known as health consciousness (Akhondan et al., 2015). Health-conscious people engage in health-related behaviors in their daily lives, they are careful about their health status, they look for health-related information and they the motivation to stay healthy (Hong, 2009). This interest and motivation lead to making healthy choices. Participants stated that healthy product choices also apply to food products and that paying attention to their and their family's health is one of their main motivations for sustainable food consumption.

"I think home-cooked meals are healthy. We can say that sustainable food and home-cooked food are kind of the same thing. I think I eat healthy and maintain my routine in this regard." (P17)

"I prefer environmentally friendly and healthy products. Whenever possible, I use organic and natural ingredients at home. Refillable products and items packaged in glass are also preferred choices in my shopping. Healthiness is more important to me." (P15)

"The food I buy should be fresh and healthy. As the years pass, I pay more attention to my health. The contribution of the food I consume to my health is very important." (P12)

"Growing your own food is definitely healthier. I go and buy my own seeds; I know the fertilizer I put into the soil. I plant it myself; I water it myself. I don't use any medication, everything is natural. I don't try to make food look beautiful. We enjoy eating products that we know where they come from." (P5)

"There is a newborn baby at home, we pay more attention to what we eat for his health." (P10)

"I am really sensitive when it comes to food purchasing, because what we eat directly affects our health" (P20)

4.4.2. Subjective Norm

Subjective norm is a concept that shows the effects of the social environment on people's behavioral intention, and according to the theory of planned behavior, it is one of the factors that determine behavioral intention (Ajzen, 1991). Studies show that subjective norm is an important antecedent

of intention to purchase sustainable food (Vermeir & Verbeke, 2006; Chu et al., 2023). This study revealed that opinions of other people have a positive effect on the intention to purchase sustainable food. Furthermore, participants stated that they tend to take advice from people who belong to the same social group as they do.

"I always welcome suggestions from my friends. If the consumers around me are satisfied, I will try it. I feel like I'm missing something. When they tell me about it, I want to buy it." (P9)

"My wife is also sensitive about such issues and it is better to do it together, and she guides me. We prepare canned seasonal vegetables from summer to winter." (P3)

"There is a widespread belief in my circle that every concept with green is beautiful."(P15)

"My mother directs me to consume sustainably. We have been making yogurt at home since I was little. Now she took some seeds and started growing them. The product you grow yourself is more valuable, there is effort involved." (P2)

"If I'm going to try a new product, I research its contents, benefits, and potential drawbacks on the internet. I may be influenced by my family and friends during this process." (P6)

4.4.3. Social Media

Some of the people the participants are affected by are influencers, to whom they are constantly exposed through social media. Studies have shown in the literature that social media influencers have an impact on sustainable consumption (Vilkaite-Vaitone, 2024) and specifically, sustainable food purchase intention (Wu et al., 2023). Participants are also affected by the shared information they see on the internet.

"I follow social media accounts that examine the content of the foods we consume and their effects on nature and try to stay informed." (P1)

"Awareness about sustainability has increased a lot on social media. I am also impressed by what I see." (P8)

"Food bloggers and social media accounts that share food recipes share great information about food. I can say that I am impressed by this information." (P13)

"I am influenced by social media in my food shopping as well as in every purchase I make. I see the post and it is engraved in the back of my mind." (P4)

4.4.4. Environmental Concern

Environmental concern reflects an individual's sensitivity to environmental issues, their interest in concepts about reducing environmental problems, and their efforts to support environmental conservation (Moser, 2016). Consumers who have a high level of environmental concern often have

positive attitudes toward sustainable food products (Nguyen et al., 2021). Individuals with a high level of awareness about environmental conservation tend to make more environmentally sensitive choices (Gürler & Nart, 2019). Özkaya et al.'s (2021) study points out that the most important aspect of sustainable food is environmental aspect for the experts. Participants emphasized their sensitivity towards the environment and expressed their concern for the environment. They indicated that they want to contribute more by consuming sustainably.

"I have always been sensitive about water usage and decreasing plastic consumption. Therefore, I also want to make my food choices as sustainable as I can." (P12)

"I generally use public transportation. I take care to dispose of wastes that cause serious harm to the environment, such as batteries and oil, in their own waste bins. I am careful in environmental choices." (P10)

"I make sure to dispose of environmentally harmful waste such as batteries and oil in their designated waste bins. I am careful in my choices regarding the environment." (P20)

"Since my childhood, I have been so influenced by environmental activities that I see myself as someone who makes green choices. Even if the quality is poor, I use recycled paper. I try my best not to produce waste. I even try to make vegetable broth from onion roots. I believe we owe something to nature." (P2)

4.4.5. Food Involvement

Food involvement can be defined as the degree to which food is significant in an individual's life (Bell & Marshall, 2013) and shows the bond between consumer and food (Castellini et al., 2023). Consumers with high food involvement may be more aware of the foods they eat and how they are prepared, cooked, and acquired throughout the whole process (Bell & Marshall, 2013). It is observed that when participants' interest in food is high, they are willing to learn more about sustainable food, think more about how they will use food, and shape their preferences in this direction.

"My passion for cooking started by cooking for myself and then for my roommates. You can utilize every part of the food if you know a lot about the food. When made at home, you can make a lot of things from limited ingredients" (P2)

"*I read cookbooks both because they interest me and to learn what food can be made from which products. I can cook maybe three dishes from one carrot." (P7)*

"The food products we buy come from nearby places. I know where the products come from, what I can do with them, and I am curious and research these details" (P10)

"I cook our food. I don't consume outside unless I must. I don't buy take away food either." (P17)

5. Conclusion

The rapid increase in environmental problems in the world has led many countries to prioritize environmental protection actions. Food consumption is also under the spotlight for its impact on environmental sustainability. The fact that food consumption is one of the most basic needs increases the importance of the issue even more. However, the fact that food consumption motivations consist of rational, emotional, and social factors also shows the complex structure of food consumption. In this regard, this study focuses on sustainable food consumption by considering food consumption within the framework of green economy. There are many actors in the food industry. In this study, sustainable food consumption is investigated from the perspective of the consumer, whose demands play an important role in the sector.

To increase consumers' sustainable food choices, it is important to first understand the barriers. According to the data obtained from the participants, obstacles to sustainable food consumption were found to be perceived expensiveness, lack of information, perceived greenwashing, availability, perceived effort, and living conditions.

Research results show that consumers do not have much information to distinguish sustainable food, even if they want to buy it. Lack of information also leads to low awareness, and the importance of the issue is not adequately understood. Another important barrier is the perception that sustainable products are more expensive. This perception may also lead to the idea that sustainable product consumption is exclusive to high-income consumers. As with all sustainable products, perceived greenwashing is seen as a significant obstacle in sustainable food products. Greenwashing also reduces consumers' trust and negatively affects their purchasing decisions. The negative effect of greenwashing is also seen in other studies (Akturan, 2018; Zhang et al., 2018; Sun & Shi, 2022) and supports the result of the study. Another obstacle to sustainable food consumption is that consumers have difficulty finding sustainable food products. The scarcity of places selling and serving sustainable food directs consumers to other alternatives. Another factor that makes sustainable food consumption difficult for consumers is the perception that consuming these products requires additional effort. In today's conditions, consumers may not have the time required for this. In addition, living in a city or rural area and the type of place you live in are among the factors that limit access to such foods.

Understanding the factors that direct consumers to sustainable food consumption is also important in terms of encouraging these factors and identifying consumers who tend to consume more sustainable food. It was revealed that the factors that facilitate the participants' sustainable product consumption are health consciousness, subjective norm, environmental concern, and food involvement.

Findings demonstrate that participants are influenced by the views of the people around them regarding sustainable foods and sustainable food consumption. It seems that what the participants hear from others is effective in purchasing sustainable products. It is known that e-wom moderates the relationship between personal norm and green product purchase intention in purchasing green products (Jaini et al., 2020). People who are influenced by consumers can be family, friend groups, or influencers on social media. In addition, as a result of the research, it was revealed that consumers

with high environmental sensitivity and consumers with high health sensitivity are potential buyers for sustainable food consumption. Literature also suggests that the various types and quantities of food that people eat have a significant impact on both environmental sustainability and human health (Huang et al., 2022). Furthermore, findings reveal that food involvement increases the tendency to choose sustainable food products as also supported by literature (Bell & Marshall, 2013). Consumers who have high food involvement, and consumers who have a high level of interest in food can also be a crucial segment for sustainable food products.

6. Managerial Implications

These findings provide significant opportunities for brands and policymakers. First of all, understanding the barriers is the first step to creating different plans to encourage the consumption of sustainable food products. Giving consumers more information on the label and educating consumers can increase the level of knowledge of consumers on this subject. Price-related suggestions may include reviewing the production process in order to produce at lower prices, cooperating with policymakers, and increasing product diversity by marketing lower-priced versions of high-priced products. Being transparent and communicating correctly with consumers at all times is one of the most important ways to build trust and reduce the perception of greenwashing. Besides, there could be enacting laws to stop greenwashing. To increase the availability of sustainable food products, redesigning the supply chain practices could be effective, as well as utilizing more online channels would also help consumers to purchase through the internet.

Additionally, the research revealed consumer segments with a high tendency to consume sustainable food. Those consumer segments are health-conscious and environmentally-conscious consumers. Brand managers can increase sustainable food consumption by developing marketing strategies targeting these consumer segments. Experiences that will create pleasure in food purchases can be created for these consumers. Past research shows that past rewarding purchasing experience is the strongest motivation for purchasing sustainable food products (Vassallo et al., 2016). Another research also found that past purchase positively affects future purchase behavior for sustainable food products (Yamoah & Acquaye, 2019). It may also be useful to share nutritious information on the labels of sustainable food products. QR code applications can be used for this. Telling the story of the products and the recipes that can be made with the products can also attract the attention of consumers with high food interest.

7. Limitations & Suggestions for Future Research

This research examined sustainable food in general and did not focus on a specific food group. Future studies could focus on one type of food and examine how consumer reactions vary by food category. In addition, future studies may focus on specific consumer groups, such as employees, pregnant women, and consumers with a history of illness. Since this study aims to look at sustainable food consumption from the consumer perspective, the research was conducted on consumers. Future studies may focus on factors such as supply chain and retailers, which are other elements in the

sustainable food chain. Finally, this study does not aim to generalize due to the nature of qualitative research. The themes revealed in this study can also be tested with a quantitative study.

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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

THE MODERATING ROLE OF UNCERTAINTY IN THE IMPACT OF R&D EXPENDITURES ON ENVIRONMENTAL INNOVATION*

AR-GE HARCAMALARININ ÇEVRESEL İNOVASYON ÜZERİNDEKİ ETKİSİNDE BELİRSİZLİĞİN DÜZENLEYİCİ ROLÜ

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Abstract

This study examines the moderating effect of uncertainty on the relationship between firms' research and development (R&D) expenditures and environmental innovation. Firms in Germany, France, Italy, and Spain, which are the first four largest economies in the European Union, are analyzed. A panel Tobit regression model is used to evaluate data from 102 that are involved in the consumer cyclicals, industry, energy, and raw materials sectors between 2006 and 2019. The findings indicate that while uncertainty plays a negative moderating role in the relationship between R&D spending and environmental innovation, R&D expenditures itself has a positive impact on environmental innovation. The research results on the relationship between uncertainty, R&D, and environmental innovation offer valuable insights for academics and policymakers. Additionally, these findings contribute to the expanding ESG literature by highlighting how uncertainty can diminish the positive effects of firms' R&D investments on environmental innovation in the specified countries.

Keywords: R&D, Environmental Innovation, Uncertainty, Panel Tobit Regression, Moderating Role
JEL Classification: D89, M19, O39

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Öz

Bu çalışma, firmaların araştırma ve geliştirme (Ar-Ge) harcamaları ile çevresel inovasyon arasındaki ilişkide belirsizliğin düzenleyici etkisini incelemektedir. Avrupa Birliği'nin ilk dört büyük ekonomisi olan Almanya, Fransa, İtalya ve İspanya'daki firmalar analiz edilmiştir. Panel Tobit regresyon modeli, 2006-2019 yılları arasında tüketici döngüselleri, sanayi, enerji ve hammadde sektörlerinde yer alan 102 firmanın verilerini değerlendirmek için kullanılmıştır. Bulgular, belirsizliğin Ar-Ge harcamaları ile çevresel inovasyon arasındaki ilişkide negatif bir düzenleyici rol oynarken, Ar-Ge harcamalarının tek başına çevresel inovasyon üzerinde pozitif bir etkiye sahip olduğunu göstermektedir. Belirsizlik, Ar-Ge ve çevresel inovasyon arasındaki ilişkiye dair araştırma sonuçları, akademisyenler ve politika yapıcılar için değerli çıkarımlar sunmaktadır. Ayrıca bu bulgular, belirsizliğin belirtilen ülkelerde firmaların Ar-Ge yatırımlarının çevresel inovasyon üzerindeki olumlu etkilerini nasıl azaltabileceğini vurgulayarak genişleyen ÇSY literatürüne katkıda bulunmaktadır.
Anahtar Kelimeler: AR-GE, Çevresel İnovasyon, Belirslizlik, Panel Tobit Regresyon, Düzenleyici Rol
Jel Sınıflandırması: D89, M19, O39

1. Introduction

Innovation activities have become crucial at both a macro framework and a micro level in the world. It is possible to state that innovation has an effect on firms' competitiveness and growth just as it has an essential power on ensuring economic growth and welfare (Akcigit, 2022; Rennings & Rammer, 2011). Therefore, reasons such as the need for firms to survive, develop, take an active place on the market, make their customers loyal and acquire new customers have made innovation a key factor (Raymond & St-Pierre, 2010). Here, it is crucially important for companies to monitor the changing perception of all stakeholders in the realization of innovation. In parallel with this, with the increasing interest in sustainability approach, it has become inevitable for firms to take environmental issues into account in innovation. Especially in recent times, the negative effects of climate change on a global scale are very effective in environmental innovation gaining such importance (Chasiotis et al., 2023). Environmental innovation can be defined as organizational practices and changes focusing on the environment with different degrees of novelty that have an impact on firms' products, production processes and marketing (Dias Angelo et al., 2012). From this point of view, it is possible to say that environmental innovation actually overlaps with innovation activities in general.

R&D and innovation are seen by many firms as central to their survival strategies (Lawson et al., 2006). This is because these activities play a critical role in productivity growth, competitiveness of the firm, and ultimately continuity and sustainability. Firms that engage in R&D activities bring new products to the market and increase productivity with new processes, while firms that do not engage in R&D activities are more exposed to demand fluctuations (Añón-Higón et al., 2015). Considering the strong link between environmental innovation and innovation, it is possible to say that R&D investments are a driving force for environmental innovation (Liao & Liu, 2021; Zahra & George, 2002).

It is not always possible for firms to make R&D investments at the same level. Especially crises and uncertainties can directly affect firms' investment decisions. Crises and uncertainties affect innovation activities through channels such as lower R&D expenditures, loss of human capital,

lower risk taking, etc. (Chandra et al., 2009). For example, policy uncertainty increases the option value of waiting for corporate R&D investment, so that uncertainty delays R&D investment and hinders innovation (Huang et al., 2023; Julio & Yook, 2012). Many economists have also shown that increased uncertainty causes firms to reduce investment, bond issuance and spending, thus stifling innovation in the form of R&D spending and new product development (Al-Thaqeb et al., 2022; Li et al., 2021; Shankar, 2020). Similarly, uncertainty in economic policies and regulations encourages firms to postpone investments in environmental R&D or delay environmental projects that are costly to recover. One consequence of these decisions is that firms innovate less for the environment (Kyaw, 2022).

A significant number of theoretical studies have shown that investment in R&D is the main driver of productivity and economic growth in industrial and developing countries by leading to innovations and has positive effects on employment (Bayoumi et al., 1999; Becker, 2015; Di Cintio et al., 2017; Edquist & Henrekson, 2017; Esteve-Pérez & Rodríguez, 2013; Falk & de Lemos, 2019; Pessoa, 2010; Shefer & Frenkel, 2005; Tingvall & Videnord, 2020).

However, there is no specific study examining the impact of R&D investments on environmental innovation in particular. Similarly, there are not many studies that jointly test the impact of uncertainty on R&D expenditures and innovation outputs (Tajaddini & Gholipour, 2020). Considering this information, in order to contribute to the relevant gap in the literature, this study aims to investigate the moderating role of uncertainty in the impact of R&D investments on environmental innovation. Therefore, both the effect of R&D investments on environmental innovation and how this effect changes during periods of uncertainty are analyzed.

2. Literature and Hypothesis Development

Fatemi et al. (2018) investigates the effect of environmental, social, and governance (ESG) activities and their disclosure on firm value. They find that ESG strengths increase firm value and that weaknesses decrease it. They find that disclosure plays a crucial moderating role by mitigating the negative effect of weaknesses and attenuating the positive effect of strengths. They analyze 403 U.S. firms between 2006 and 2011. Xu et al. (2021) examine the impacts of R&D investment and ESG performance on green innovation performance. This paper also investigates the moderating effect of ESG performance between R&D investment and green innovation performance. The study uses the data of 223 Chinese listed companies over the period 2015–2018. The ESG indices issued by SynTao Green Finance are used to measure ESG performance. The results show that R&D investment has a positive impact on green innovation performance and ESG performance can increase the number of green invention patents. In addition, ESG performance moderates the relationship between R&D investment and green innovation performance. Vural-Yavaş (2021) investigates the effect of the economic policy uncertainty (EPU) on ESG performances, using 6,562 firm-year observations from 15 developed European countries covering the period from 2004 to 2017. The result of this paper contributes to ESG and corporate governance literature by demonstrating that EPU influences the ESG score. Their results indicate that, during periods of high uncertainty, firms are more dedicated

to the sustainability issues and attain higher level of ESG performance. This paper also contributes to literature by showing that the market competition positively moderates the relationship between uncertainty and ESG. Nirino et al. (2021) aims to explore the impact of corporate controversies on financial performance and proposes the positive moderating role of ESG practices over the aforementioned relationship. Using a database of 356 European listed companies, linear regression models confirm a negative and significant relationship between corporate controversies and financial performance. However, it was not possible to confirm the positive moderating effect of ESG practices on the relationship between controversies and financial performance. Forliano et al. (2022) analysis of 688 companies from the Refinitiv database that have won grants and had their ESG score assessed over the past eight years. This study found that R&D expenditures positively mediate between grants and ESG performance. Indeed, firms receiving grants, regardless of their nature, necessitate time to align with the requirements demanded by public bodies and develop sustainable, innovative outcomes. Moreover, despite there is still some debate if R&D intensity leads to higher ESG performance or not, we found a significant association between these two dimensions. Ilyas et al. (2022) examine 2,017 US. firms from 2002 to 2018. This study aims to examine the impact of EPU on firm investment in corporate social responsibility (CSR)'s ESG dimensions. Additionally, the study examines whether firm size moderates the EPU–CSR relationship. The findings reveal that firms increase their CSR investment in response to high EPU. The results are consistent in all the three ESG/CSR dimensions: ESG. Moreover, the positive association between EPU and CSR is driven by firm size, indicating that large-sized firms have the resources and incentives to invest more in CSR. Tang (2022) considers China's A-share listed companies as an example, the research applied linear regressions with panel data, using the ESG rating of SynTao Green Finance Agency as a proxy variable of ESG performance. The results show that ESG performance significantly promotes the quantity and quality of corporate innovation and is mediated by alleviating the financial constraints and agency cost. Internal and external governance plays different roles the higher institutional investors' attention as an external governance form does not help enterprises improve the quantity and quality of corporate innovation; however, CEO duality as an internal governance form strengthens the effect of ESG performance on corporate innovation. Based on the above rationales, the following hypothesis are proposed.

H1: *R&D expenditures have a positive effect on environmental innovation.*
H2: *Ambiguity has a moderating role in the effect of R&D expenditures on environmental innovation.*

Methodology

According to the hypotheses formulated, the model considered in the study is as follows.

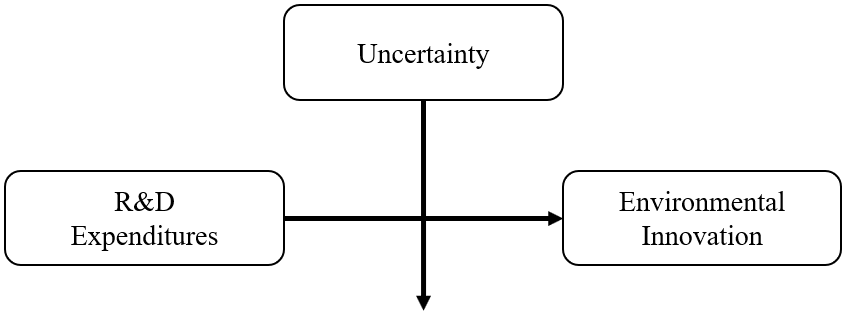

Figure 1: Research Model

The constructed mathematical models for testing the hypotheses can be shown as follows.

$$EI_t = \beta_0 + \beta_1 R\&D_{t-1} + \beta_2 lev_{t-1} + \beta_3 cash_{t-1} + \beta_4 capex_{t-1} + \beta_5 ebitda_{t-1} + \beta_6 roa_{t-1} \quad (1)$$

$$EI_t = \beta_0 + \beta_1 R\&D_{t-1} + \beta_2 R\&D \times Uncertainty_{t-1} + \beta_3 lev_{t-1} + \beta_4 cash_{t-1} + \beta_5 capex_{t-1} + \beta_6 ebitda_{t-1} + \beta_7 roa_{t-1} \quad (2)$$

In Equations (1) and (2) EI_{t-1} variable is the environmental innovation score of the firm in period t and $R\&D_t$ variable refers to the R&D expenditures of firms in period t. Leverage, cash, capex, ebitda and roa variables, which are frequently used in similar studies in the literature, are included in the models as control variables. In Equation (2) $R\&D \times Uncertainty_{t-1}$ is the moderating variable that shows the interaction between R&D expenditures and uncertainty index in period t-1. All variables except R&D expenditures and ebitda are observed to be ratio or index values. Therefore, since R&D expenditures and ebitda variables are quantified in firm balance sheets, the natural logarithm of these variables is taken for the reliability of the results. Accordingly, the mathematical models considered in the study have been updated as follows.

$$EI_t = \beta_0 + \beta_1 lnR\&D_{t-1} + \beta_2 lev_{t-1} + \beta_3 cash_{t-1} + \beta_4 capex_{t-1} + \beta_5 ebitda_{t-1} + \beta_6 roa_{t-1} \quad (1)$$

$$EI_t = \beta_0 + \beta_1 lnR\&D_{t-1} + \beta_2 R\&D \times Uncertainty_{t-1} + \beta_3 lev_{t-1} + \beta_4 cash_{t-1} + \beta_5 capex_{t-1} + \beta_6 lnebitda_{t-1} + \beta_7 roa_{t-1} \quad (2)$$

Since the lower bound of the dependent variable is zero and the upper bound is unlimited, the collected data were analyzed by panel tobit regression method.

For this study, a total of 102 enterprises from Germany (34), France (40), Spain (17) and Italy (11), which are the first four largest economies among the member countries of the European Union, were included in the study. These firms operating in raw materials, industry, energy and consumer cyclicals sectors. The Economic Uncertainty Index (EPU) (Baker et al., 2016) is used as the uncertainty variable. The firm, macro and ESG data used in the study are taken from the Thomson Reuters database, while the uncertainty index is taken from its own website where the index is calculated. Financial institutions and real estate investment trusts were not included in the study due to their

different balance sheet structures. Since the firms in the study were publicly offered at various times, unbalanced panel data was used. Firms with at least 4 years of data were included in the study. After all these criteria, the study consists of 102 firms and 1319 firm-year observations.

4. Findings

Before testing the hypotheses in line with the models, the stationarity of the variables is examined due to the panel data structure. For this purpose, firstly, for each variable, Peseran CD test is used to examine whether there is correlation between units. The purpose of this test is to determine which of the first – or second-generation tests to be used in the unit root test. If there is no inter-unit correlation in the variable of interest, first generation unit root tests are used, and if there is inter-unit correlation, second generation unit root tests are used. The results of Peseran CD test for the variables considered in the study are summarized in the table below.

Table 1: Peseran CD Test Results of Variables

Variable	CD Test	p-value	Variable	CD Test	p-value
EI	22.7	0.0000	Cash	14.438	0.0000
lnR&D	21.086	0.0000	Capex	30,04	0.0000
Uncertainty	217.903	0.0000	lnEbitda	29.785	0.0000
Lev	4.83	0.0000	ROA	27.035	0.0000

According to the results of the Peseran CD test, the p-values of all variables are less than the significance level of 0.05. Accordingly, all variables are correlated between units ($0.0000 < 0.05$). Therefore, it is appropriate to use one of the second-generation unit root tests for unit root testing. In this study, Fisher Phillips Perron panel unit root test is applied due to the unbalanced panel data. The results obtained are as follows.

Table 2: Fisher Phillips Perron Panel Unit Root Test Results

Variable		Statistics	p-value
EI	Inverse chi-squared (204)	1328.7716	0.0000
	Inverse normal	-20.8760	0.0000
	Inverse logit t (514)	-34.1492	0.0000
	Modified inv. chi-squared	55.6845	0.0000
lnR&D	Inverse chi-squared (204)	234.9319	0.0000
	Inverse normal	-3.1542	0.0000
	Inverse logit t (514)	-4.3705	0.0000
	Modified inv. chi-squared	6.6832	0.0000
Uncertainty	Inverse chi-squared (204)	211.1816	0.3504
	Inverse normal	-2.4421	0.0073
	Inverse logit t (514)	-2.4068	0.0082
	Modified inv. chi-squared	0.3555	0.3611

Lev	Inverse chi-squared (204)	328.1463	0.0000
	Inverse normal	-4.6359	0.0000
	Inverse logit t (514)	-5.0767	0.0000
	Modified inv. chi-squared	6.1462	0.0000
Cash	Inverse chi-squared (204)	585.6248	0.0000
	Inverse normal	-11.3169	0.0000
	Inverse logit t (514)	-13.6361	0.0000
	Modified inv. chi-squared	18.8932	0.0000
Capex	Inverse chi-squared (204)	505.1999	0.0000
	Inverse normal	-6.7545	0.0000
	Inverse logit t (514)	-10.2321	0.0000
	Modified inv. chi-squared	14.9116	0.0000
lnEbitda	Inverse chi-squared (204)	452.9680	0.0000
	Inverse normal	-6.1836	0.0000
	Inverse logit t (514)	-8.2656	0.0000
	Modified inv. chi-squared	12.3258	0.0000
ROA	Inverse chi-squared (204)	652.4523	0.0000
	Inverse normal	-12.9925	0.0000
	Inverse logit t (514)	-15.8304	0.0000
	Modified inv. chi-squared	22.2017	0.0000

According to the results of the Fisher Phillips Perron panel unit root test, the p-value values calculated as a result of the test statistics for all variables except the Uncertainty variable were obtained as 0.0000. Accordingly, since the p-value is less than 0.05, it is concluded that these variables do not contain unit root. However, in the Uncertainty variable, the p-value value of the two tests was greater than 0.05. For this reason, Uncertainty variable is found to contain a unit root. In order to get rid of the unit root, logarithmic transformation was applied (ln Uncertainty). According to the Peseran CD test applied to the obtained lnUncertainty variable, the result of correlation between units was obtained. In the subsequent Fisher Phillips Perron panel unit root test, since the p-value value of all tests was less than 0.05, stationarity was also achieved in the lnUncertainty variable. After the unit root tests, the multicollinearity problem was analyzed. Since the Variance Inflation Factor (VIF) values obtained are calculated below 5, it is seen that there is no multicollinearity problem.

After determining that the variables do not contain unit roots and that there is no multicollinearity problem, the hypotheses were tested. At this stage, panel tobit regression was applied to test the hypotheses since the dependent variable EI has a continuous structure and contains zero values as well as positive values. The panel tobit regression results are summarized in Table 3.

Table 3: Panel Tobit Regression Results

	A	B	C	D
Variable	**Coef.**	**Coef.**	**Coef.**	**Coef.**

lnR&D	7.241824*	7.062134*	31.29336*	26.8935*
lnUncertainty	12.87251*	13.53873*	66.16082*	58.8178*
lnR&D × lnUncertainty			-4.38265*	-3.925862*
Lev	30.82988*	24.31755*	21.14734*	28.70173*
Cash	30.56167***	27.91085**	44.15759*	47.58451*
Capex	10.8354	-29.98201	-38.61017	-116.9924*
lnEbitda	1.187642	0.4730437	0.9773927	2.604199*
ROA	-88.8028*	-93.87989*	-73.54754*	-88.95779*
Wald chi2(11)	448.92	481.13	482.91	628.60
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Sector Effect	No	Yes	No	Yes
*0.01; **0.05; ***0.1				

While sector effects are not taken into account in modules A and C of Table 3, sector effects are included in the analysis in modules B and D. The hypotheses formulated within the scope of the study are included in modules B and D. Modules A and C were carried out in order to see the changes by taking the sector effect into account. Accordingly, for the purpose of the study, it is concluded that both R&D expenditures (lnR&D) and uncertainty (lnUncertainty) positively affect environmental innovation (EI). In addition, the variable lnR&D × lnUncertainty, which shows the interaction of lnR&D and lnUncertainty variables, has a negative effect. Therefore, it is possible to say that R&D expenditures made by firms positively affect environmental innovation, while uncertainty reduces this positive effect. In other words, it can be stated that uncertainty has a moderating role in the effect of R&D expenditures on environmental innovation. The graphical representation of this moderating role is as follows.

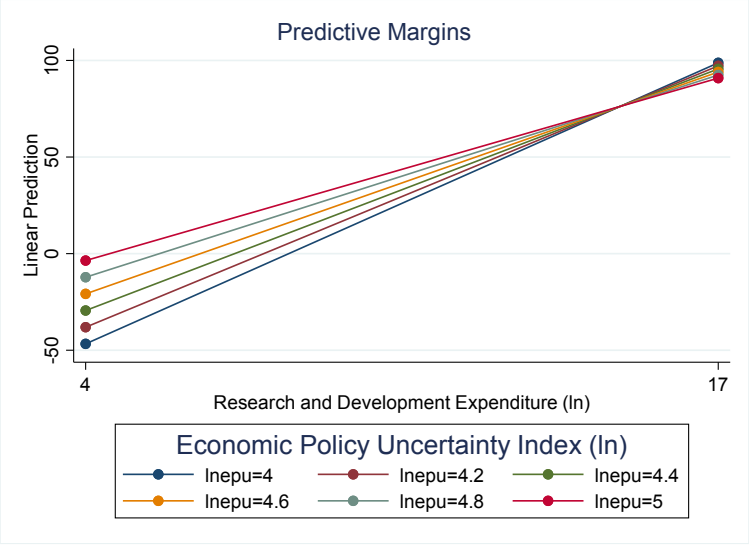

Figure 2: Graph for Regulatory Role

When the graph is analyzed, it is observed that as the uncertainty index increases, the slope showing the effect of R&D expenditures on environmental innovation decreases. For example, when the uncertainty index is 4, the slope of the effect of R&D expenditures on environmental innovation is steeper, whereas when the uncertainty index is 5, this slope becomes more horizontal. Mathematically, the calculations of the slope coefficients (average marginal effects) are as follows.

Tablo 4: Average Marginal Effects

lnUncertainty	**1:** 4		
	2: 4.2		
	3: 4.4		
	4: 4.6		
	5: 4.8		
	6: 5		
lnR&D	**dy/dx**	**Std. Err.**	**P>|z|**
1	11.19005	1.115616	0.000
2	10.40488	0.9609112	0.000
3	9.61971	0.8175386	0.000
4	8.834538	0.6925725	0.000
5	8.049365	0.5976719	0.000
6	7.264193	0.5486665	0.000

The slopes obtained as a result of the tobit regression of the effect of R&D expenditures on environmental innovation are calculated as 11.19005 when uncertainty is 4 and 7.264193 when uncertainty is 5. Therefore, the average effect values obtained confirm the decrease in the slopes seen in the graph.

3. Conclusion

In this study, which examines the regulatory role of uncertainty in the impact of R&D investments on environmental innovation, it is concluded that the impact of R&D investments on environmental innovation decreases during periods of uncertainty. This is because, in times of uncertainty, firms mainly stop, postpone or cancel their future activities. Therefore, R&D investments and innovation efforts tend to decrease in these periods when the level of risk-taking decreases. In line with this result in the literature, Kyaw (2022) explained that uncertainty in economic policies and regulations encourages firms to postpone environmental R&D investments and environmental projects that are costly to recover. For this reason, he stated that firms tend to reduce their environmental innovation activities during periods of uncertainty. The main reason for this result is that the return on R&D investments made during this period is much more difficult and firms tend to be much more meticulous in their investment decisions (Al-Thaqeb et al., 2022; Li et al., 2021; Shankar, 2020).

Based on the findings of the study, the fact that R&D investments and innovation activities slow down or stop the development of national economies during periods of uncertainty requires policymakers to take action. Certainly, policymakers and governments can emphasize the importance of reducing uncertainty to encourage both R&D investments and environmental innovation. Moreover, in cases where uncertainty cannot be reduced, the negative impact of uncertainty can be mitigated through grants, incentives and subsidies. On the other hand, a better transition to the post-uncertainty period can be achieved by providing support to firms in innovative sectors. In addition, relevant ministries and sub-organizations, as well as policymakers in times of uncertainty, can create a fund to support firms' activities in times of uncertainty. Like policymakers, firms can also reduce their R&D investments financially during periods of uncertainty, but they can also cooperate with start-ups. In this way, both start-ups' initiatives can find a response in the market and large firms can save money on R&D investments for innovation.

The study focuses on firms belonging to the four major economies of Europe. Therefore, this situation can be shown as the most important limitation of the study. In addition, R&D investments were evaluated as the driving force of environmental innovation. Concepts such as environmental responsibility, recycling practices, emissions, etc. among the drivers of environmental innovation are not addressed in the study. In addition, uncertainty scores are included in the scope of the analysis in the study, and crisis periods or other uncertainties are not included in the analysis. Therefore, future studies may examine the regulatory mechanism of uncertainty in the impact of R&D investments on innovation activities, especially in developing countries. In addition, the results obtained can be extended by considering other drivers of environmental innovation. Similarly, more comprehensive studies can be conducted by differentiating other periods of crisis and uncertainty.

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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

EMPOWERING SUSTAINABILITY: GREEN HUMAN RESOURCE MANAGEMENT AS A CATALYST IN THE CIRCULAR ECONOMY

SÜRDÜRÜLEBİLİRLİĞİ GÜÇLENDİRME: DÖNGÜSEL EKONOMİDE YEŞİL İNSAN KAYNAKLARININ ROLÜ

Doğan BAŞAR*

Abstract

The circular economy is emerging as a key approach to tackling environmental challenges. Organizations are using their expertise to improve their sustainability management in support of a circular economy. However, the role of green human resource management (GHRM) practices in the transition to a more circular economy remains somewhat unclear. Companies adopting green GHRM practices as part of their sustainability goals are implementing initiatives such as green recruitment and selection, green training and development, green performance appraisal, green compensation and incentives, and sustainable employee relations. This study seeks to refine and extend a more integrated approach that links green human resource management (GHRM) with the circular economy (CE).

Keywords: GHRM, Circular economy, corporate sustainability, human behavior
Jel Classification: M1, M10

Öz

Döngüsel ekonomi, çevresel sorunlara çözüm bulmak için temel bir yaklaşım haline gelmiştir. Organizasyonlar, sürdürülebilirlik faaliyetlerini geliştirmek ve döngüsel ekonomiyi desteklemek için uzmanlıklarını kullanmaya başlamışlardır. Ancak, daha döngüsel bir ekonomiye geçişte yeşil insan kaynakları yönetimi uygulamalarının önemi hala belirsizdir. Sürdürülebilirlik hedefleri kapsamında yeşil insan kaynakları uygulamalarını benimseyen şirketler, yeşil işe alım ve seçim, yeşil eğitim ve gelişim, yeşil performans değerlendirme, yeşil ücretlendirme ve teşvikler ile sürdürülebilir çalışan ilişkileri gibi önlemleri hayata geçirirler. Bu çalışmada, yeşil insan kaynakları yönetimi (GHRM) ve döngüsel ekonomi (CE) arasında daha bütünleşik bir yaklaşım geliştirilip genişletilmekte ve incelenmektedir.

Keywords: Yeşil insan kaynakları yönetimi, döngüsel ekonomi, kurumsal sürdürülebilirlik, insan davranışı
Jel Sınıflandırması: M1, M10

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1. Introduction

Sustainability has become a pressing global issue, and companies are increasingly recognizing the importance of incorporating sustainable innovation and green processes into their operations. This shift towards environmental stewardship reflects a growing corporate commitment to reducing environmental impact and promoting sustainability and innovation (Mishra, 2017). Organizations are actively engaging in practices such as investing in low carbon technologies and utilising renewable energy sources, demonstrating a strategic focus on environmental sustainability (Fachada et al., 2022).

The circular economy is rapidly emerging as a transformative economic paradigm that fundamentally rethinks the traditional linear 'take-make-dispose' model in favour of a more sustainable approach that emphasises the minimization, reuse, recycling and recovery of materials throughout the life cycle of products. This model challenges the traditional notion of the "end of life" of products by promoting the continuous use of resources, thereby reducing waste and encouraging more efficient use of materials (Kirchherr et al., 2017). The circular economy seeks to redesign the way goods and services are produced and consumed, with the reuse of products and materials as a core principle. Central to the concept of the circular economy is its potential to bridge the gap between economic growth and environmental sustainability. By advocating an economic system in which products and materials are kept in use for as long as possible, it offers a way to decouple economic development from resource consumption. This shift not only helps to reduce the environmental impacts associated with the production and disposal of goods, but also increases resource efficiency, which can lead to significant economic benefits (Ghisellini et al., 2016). Businesses are encouraged to design products with their next life in mind, which often means innovating in design and manufacturing processes to facilitate disassembly and reuse.

The circular economy also has fundamental implications for business strategies and supply chains. It encourages organizations to rethink their operations and logistics to create closed-loop systems that recycle and reuse resources. This approach is gaining traction among policymakers and business leaders who see the potential for circular strategies to contribute to economic resilience and sustainability. Governments and international organizations are increasingly promoting circular economy policies that support these transitions, recognising the importance of aligning economic activities with environmental goals to achieve sustainable development (Ormazabal et al., 2018). In this evolving economic landscape, the adoption of circular economy principles is seen not only as an environmental imperative, but also as a strategic business advantage that can drive innovation, reduce costs and open up new markets. By integrating these principles into their core operations, companies can not only improve their sustainability, but also build a competitive advantage in a world where resources are becoming increasingly scarce and consumer preferences are shifting towards more sustainable products and practices.

However, the academic discourse often overlooks the critical "human element" of sustainability and the circular economy. The "soft side" of organizations, which includes human resource management

(HRM), plays a central role in driving sustainable outcomes and innovation. Senior management increasingly views HR as a strategic pillar that is essential to achieving both economic performance and environmental stewardship (Singh et al., 2019). This perspective is supported by a body of research highlighting the profound link between HR strategies, environmental management practices and economic performance, underscoring the significant impact of human resources on organizational success (Mousa and Othman, 2020).

The concept of green human resource management (GHRM) has emerged to address this link, aiming to align HRM policies and practices with an organization's broader sustainability goals. GHRM focuses on empowering employees and fostering a culture committed to sustainability, thereby facilitating the transition to a circular economy (Renwick et al., 2013, 2016). Despite decades of interest in the 'human side' of organizations (Wilkinson, 1992; Jabbour et al., 2019), there remains a gap in research investigating how green HRM practices can promote a circular culture focused on sustainability.

2. Green Human Resource Management

Human Resource Management (HRM) plays a crucial role in steering organizational strategies towards sustainability. By implementing environmentally friendly policies and promoting regulatory compliance, HRM lays a financial and sustainable foundation for organizations. This strategic alignment with sustainability benchmarks enables organizations to not only meet but also exceed emerging environmental standards (Ahmad, 2015). Furthermore, such initiatives significantly increase the environmental awareness of employees and form a core element of an organization's identity and operational ethos (Al-Zgool, 2019).

The green behaviours adopted by employees, including practices such as duplex printing, recycling, the use of energy-efficient equipment and the reuse of old office furniture, are instrumental in achieving an organization's environmental goals (Hameed et al., 2020). This highlights the critical importance of HRM in fostering a culture that supports sustainable development, as recognised in recent literature (Mensah, 2019; Shah et al., 2021).

The development of green human resource management (GHRM) marks a significant shift in organizational values. Modern job seekers are attracted to organizations with a strong environmental ethos, making GHRM a strategic asset in attracting top talent. GHRM integrates sustainability into all facets of HR, leading to a re-evaluation of human resources as critical to an organization's environmental and strategic goals. This study focuses on the responsibility of HRM in managing and promoting the organization's environmental practices (Shahzad et al., 2023).

Jackson et al. (2014) describe GHRM as recognising the impact of organizational activities on the environment and the mutual influence of HRM systems. GHRM, as outlined by Renwick et al. (2013), includes HR strategies that support environmental sustainability efforts by emphasising the policies, strategies and actions that contribute to achieving green goals (Sabokro et al., 2021). Adhering to the principles of GHRM, organizations adopt environmentally friendly practices with

the aim of cultivating a workforce that exhibits pro-environmental behaviours. These practices increase environmental awareness and motivate employees to adopt sustainable behaviors, thereby conserving resources and improving environmental management skills (Al-Zgool, 2019).

Organizations pursue various GHRM initiatives, including green recruitment, training, performance appraisal, compensation and engagement policies. Green recruitment involves the selection and hiring of individuals who possess the knowledge, skills, attitudes and behaviours essential for effective environmental management within an organization. This recruitment strategy focuses on identifying candidates who are sensitive to environmental issues and committed to meeting environmental performance standards (Pham et al., 2020). In addition, employee training plays a vital role in the effective implementation of an environmental management system and in fostering an environmentally friendly organizational culture. This type of training equips employees with the necessary skills and knowledge to contribute positively to the environmental goals of the organization (Mishra, 2017). In the studies conducted, it is identified as the most important HRM practice in creating a culture where employees feel responsible for the environmental performance of the organization. Green performance management refers to the evaluation of employees' activities to monitor whether they add value to the organization's environmental management activities (Farooq et al., 2022). Clarifying green criteria for employees and highlighting these criteria in performance evaluations is said to guide employees to improve their environmental performance (Darvazeh et al., 2023). These initiatives are designed to foster a workplace culture that values sustainability and encourages employees to actively participate in environmental conservation efforts. In IT companies, the integration of GHRM practices such as green recruitment, training and performance appraisal has led to reduced carbon footprints and improved business sustainability. a study highlighted by Shobhana et al. (2022) shows how these practices have contributed to energy conservation, cost reduction and profitability in IT firms. Yahya and Zargar (2023) discuss how GHRM supports sustainable business practices in the banking industry, leading to reduced environmental impact and enhanced corporate sustainability.

GHRM blends traditional HR strategies with environmental goals, adding a strategic layer to the role of HR in organizations (Gholami et al., 2016). Integrating environmental considerations into HR practices is an emerging focus within environmental management, leading to a reorientation of HR strategies to support sustainability (Jabbour et al., 2015). Renwick et al. (2013) identified key development areas for GHRM, such as enhancing green skills and behaviours through various HR processes and fostering an organizational culture that supports green initiatives. These strategies have been expanded by academics to highlight the importance of recruitment, training, performance management and organizational learning in promoting environmental stewardship (Pham et al., 2019).

3. Circular Economy

The circular economy (CE) paradigm is gaining momentum as a transformative approach that challenges the traditional "take, make, use and dispose" model by advocating for a sustainable,

low-carbon and resource-efficient economy. This model aims to decouple economic growth from the consumption of finite resources by shifting towards circular production and consumption processes (García-Quevedo et al., 2020; Ghisellini et al., 2016). The European Union's endorsement of CE as a strategy highlights its potential to create new business opportunities and improve production and consumption patterns across sectors, involving a wide range of stakeholders including governments, businesses, NGOs and academic institutions (European Commission, 2015).

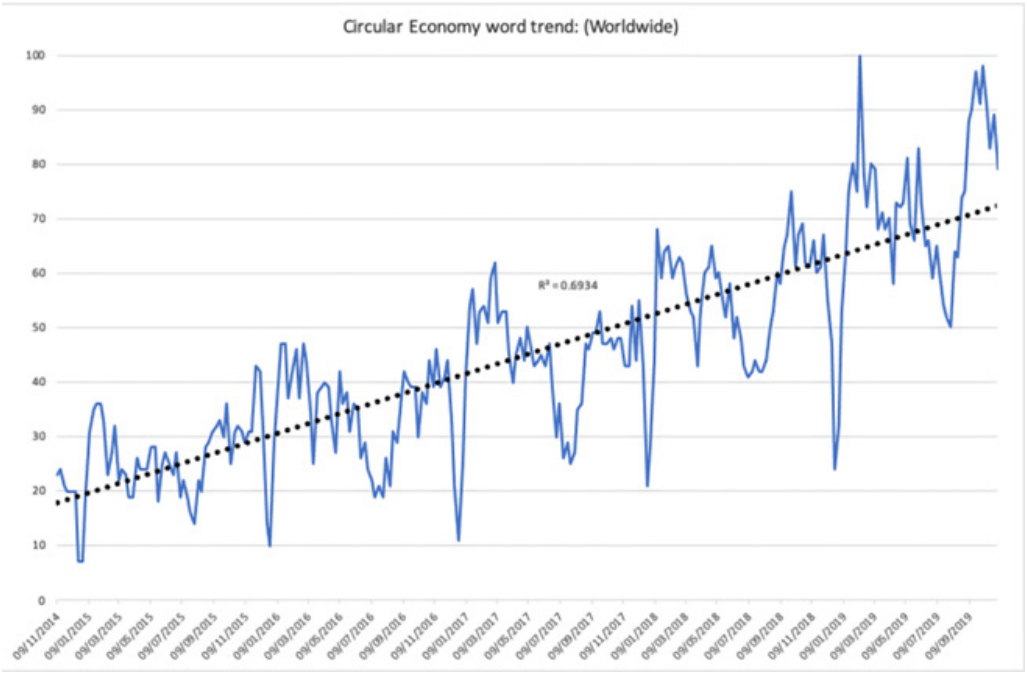

Figure 1: Circular Economy Word Trend (2014-2019)

Ref: Google Trends (2014-2019), https://trends.google.com/trends/explore?date=now%201-d&q=circular%20economy&hl=tr

At the heart of the circular economy are the principles of "reduce, reuse and recycle", which aim to minimize waste and resource use, thereby promoting economic systems that benefit both the environment and society (García-Quevedo, 2020). The Ellen MacArthur Foundation (EMF) expands on this by defining CE as an industrial system that is restorative by design, focusing on improving efficiency at all stages of production and consumption (EMF, 2013; 2014). The core elements – recycle, reduce and reuse – encapsulate the circular economy's cyclical approach to production, encompassing production, use, recovery, recycling and remanufacturing processes (Rehman Khan et al., 2022).

The circular economy's alignment with Sustainable Development Goal (SDG) 12: Responsible Consumption and Production, highlights its role in advancing global sustainability agendas. Emerging research in CE also explores the integration of human development to ensure a socially

equitable transition (Opferkuch et al., 2022). This model emphasises the importance of extending the lifecycle of products through sharing, leasing, reuse, refurbishment, repair and recycling, thereby maximizing their utility and lifespan (EU Parliament, 2023).

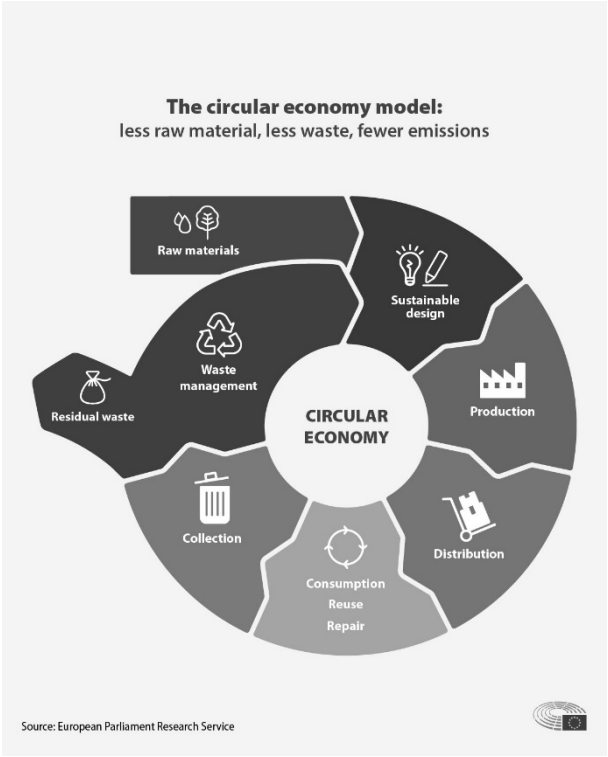

Figure 2: Circular Economy Model

Ref: European Parliement(2023), https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits#:~:text=The%20circular%20economy%20is%20a,reducing%20waste%20to%20a%20minimum.

The adoption of CE strategies has shown great promise in improving global sustainability. The literature on CE and sustainability can be categorised into three levels: micro, meso and macro. At the micro level, individual companies incorporate CE practices such as recycling, reduction and refurbishment into their operations and address sustainability challenges through innovative business models. The meso level emphasises collaborative efforts, such as green supply chain management and eco-clusters, between companies to promote sustainable development and efficient material exchange. Meanwhile, the macro level involves policy-driven strategies by governments and regional bodies to promote sustainability on a broader scale. This comprehensive framework highlights the importance of integrating CE practices across different levels of society and the economy to minimise resource consumption and improve the efficiency of material and energy cycles (Nikolaou et al., 2021; Rincón-Moreno et al., 2021).

4. Human Side of Circular Economy

The circular economy (CE) has emerged as a transformative model in the fields of business and management, promoting sustainable development by redefining production and consumption patterns (Obeidat et al., 2022). In parallel, the field of green human resource management is growing, which is increasingly seen as central to aligning HR strategies with CE principles and promoting environmental sustainability within organizations (Jabbour et al., 2019).

Green HRM strategies, ranging from training programmes to green supply chain practices, play a critical role in the implementation of CE business models and have been shown to have a significant impact on organizational performance. These HR initiatives are instrumental in driving advanced environmental management practices that contribute to improved business outcomes (Jabbour et al., 2019).

Underpinning the synergy between green HRM practices and CE are two theoretical frameworks: stakeholder theory and the resource-based view (RBV). The RBV, as posited by Barney (1991), suggests that unique resources within a firm can create a sustainable competitive advantage, especially when these resources support circular processes such as the reuse and recycling of materials (Chaudhuri et al., 2022; Jabbour et al., 2019). In the context of CE, green HRM practices serve as an invaluable resource that aligns with a company's sustainability goals and enhances organizational competitiveness by promoting green employee engagement and cultivating a culture of environmental awareness (Ramus & Steger, 2000; Marrucci et al., 2021).

Stakeholder theory complements this by framing the role of business in society, emphasising the importance of engaging with a wide range of stakeholders for sustainable value creation. This approach departs from traditional models by prioritising environmental and social benefits alongside economic ones, recognising the essential role of stakeholders in the transition to a CE (Freeman et al., 2020; Freudenreich et al., 2020; Marcon et al., 2023). Stakeholder engagement is critical to overcoming the challenges and harnessing the incentives associated with the CE, thereby driving collective efforts towards sustainable practices (Marjamaa et al., 2021; Jabbour et al., 2020).

Empirical research highlights the significant contribution of green HRM to sustainable business practices. Studies by Mishra (2017), Ren et al. (2018) and Chowdhury et al. (2022) highlight the instrumental role of HRM in embedding environmental sustainability in organizational processes, thereby advancing the goals of CE. These findings confirm the strategic importance of HRM policies aligned with environmental goals, catalysing the shift towards more sustainable business frameworks and underscoring the critical intersection between HRM practices and CE principles.

5. Discussion

The increasing integration of social dimensions into the circular economy model reflects a significant shift in the strategic responsibilities of human resources. HR departments are instrumental in cultivating an organizational culture that not only prioritises sustainability, but actively promotes

it. This involves developing specific skills and competencies, as well as promoting inclusive practices that ensure all segments of the workforce are engaged and empowered to contribute to the organization's sustainability goals. Such an approach positions HR as a critical driver in the transition to a more sustainable and circular business model. Burger et al. (2019) shed light on the diverse skill sets required in different sectors within the circular economy, highlighting the different demands for physical, technical and complex cognitive skills. This diversity highlights the critical role of targeted training programmes, tailored to sector-specific needs. HR departments are uniquely positioned to lead these initiatives and align workforce skills with the evolving demands of a circular economy. In doing so, they facilitate a smoother transition by ensuring that employees are not only aware of the importance of sustainability practices, but are also equipped with the necessary tools and knowledge to implement them effectively. In addition, HR's role goes beyond training and development to include the strategic alignment of recruitment, retention and employee engagement with the organization's sustainability goals. By embedding circular economy principles into all facets of HR management, from performance appraisal to leadership development, HR can increase its impact on the organization's overall sustainability performance. This comprehensive integration helps to build a resilient workforce that is adaptable, innovative and fully engaged in the company's environmental mission, thereby advancing the organization's transition.

The relationship between green human resource management and the circular economy is a critical aspect of advancing sustainable business practices. GHRM promotes a sustainable organizational culture by integrating CE concepts into the core values of the company. This encourages employees to adopt and apply these principles routinely, strengthening the company's commitment to sustainability.

This study aims to develop an in-depth framework that explores the link between green human resource management and the circular economy. It focuses on the critical role of incorporating GHRM strategies to enhance CE initiatives within organizations, leading to the promotion of a greener, more sustainable approach to business. GHRM encompasses a range of strategies that integrate environmental responsibility into an organization's core policies and procedures. It includes recruiting, training and motivating employees to adopt environmentally friendly practices. By embedding GHRM, companies cultivate an ethos of sustainability that inspires creative solutions to reduce waste, improve resource use and adopt green business practices. In contrast, the circular economy aims to minimise waste and optimise resource use. It prioritises the recycling, reuse, reduction and recovery of materials at all stages of the product lifecycle, from production to consumption, and seeks to extend the usability and overall life of products and infrastructure.

4.1. Recommendations for Future Studies

There's a growing emphasis on incorporating social aspects more thoroughly into the circular economy model, as highlighted by researchers such as Merli et al. (2018), Mies and Gold (2021) and Murray et al. (2017). While discussions on economic and environmental sustainability have been prevalent, there is a growing focus on the social sustainability dimensions within the circular

economy. In particular, there is a need to analyse and empirically test the human aspects of the circular economy. In order to provide support for the claim that green human resource management and the circular economy model lead to improved sustainable performance, it is essential to analyse the functions of green human resource management as green recruitment and selection, green training and development, green performance appraisal, green compensation and incentives individually within a research framework. Furthermore, exploring moderating and mediating mechanisms can significantly strengthen the link between GHRM practices and circular economy initiatives. This could include qualitative case studies or quantitative surveys that help to understand the pathways through which GHRM influences environmental performance. Conduct comparable studies across different industries to explore how industry-specific factors may act as moderators. This can provide insights into tailoring GHRM practices that are most effective for specific sectors.

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