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Assessment of Operational, Environmental and Social Performance of Container Ports in Türkiye

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ABSTRACT

Purpose: This study aims to reveal the sustainability orientations of container port facilities operating in Turkey through sustainability reports and to evaluate the performance of their operational, environmental and social dimensions both separately and in an integrated manner (Environmental, Social, Operational-ESO).

Methodology: Sustainability orientations of container port facilities were subjected to qualitative assessment through examination of web pages and sustainability reports. The data obtained through document scanning regarding operational, environmental, and social performance indicators revealed by researching the relevant literature were analyzed using the MULTIMOORA method. The Rank Position Method was used in the performance ranking of port facilities.

Findings: The results show that 18% of the container service port facilities publish independent sustainability reports. There are deficiencies in the environmental and especially social performance indicators taken into account in the sustainability reports. Among the port facilities examined, Mersin International Port, which has the highest operational performance, is also ranked as the facility with the lowest integrated performance (ESO). The port facility with the highest integrated performance (ESO) was Socar.

Originality: The study contributes to filling the gap in the literature regarding the evaluation of environmental, social and operational performance of container ports in Turkey with the MULTIMOORA method. More importantly, the integrated examination of relevant performance dimensions represents the originality of this study.

Keywords: Container Ports, Sustainability Report, Environmental-Social-Operational Performance Indicators, MULTIMOORA.

JEL Codes: Q50, P47, C44.

Türkiye'deki Konteyner Limanlarının Operasyonel, Çevresel ve Sosyal Performansının Değerlendirilmesi

ÖZET

Amaç: Bu çalışmada sürdürülebilirlik raporları aracılığıyla Türkiye'de hizmet veren konteyner liman tesislerinin sürdürülebilirlik yönelimlerinin ortaya çıkarılması; operasyonel, çevresel ve sosyal boyutlarının hem ayrı ayrı hem de bütünleşik (Çevresel, Sosyal, Operasyonel-ESO) performanslarının değerlendirilmesi amaçlanmaktadır.

Yöntem: Konteyner liman tesislerinin sürdürülebilirlik yönelimleri, web sayfalarının ve sürdürülebilirlik raporlarının incelenmesi yoluyla nitel değerlendirmeye tabi tutulmuştur. İlgili literatürün taranmasıyla ortaya çıkarılan operasyonel, çevresel ve sosyal performans göstergelerine ilişkin belge tarama yoluyla elde edilen veriler MULTIMOORA yöntemi ile analiz edilmiştir. Liman tesislerinin performans sıralamasında Sıralı Pozisyon Yöntemi kullanılmıştır.

Bulgular: Sonuçlar, konteyner hizmeti veren liman tesislerinin %18'inin tesis özelinde bağımsız sürdürülebilirlik raporu yayınladığını göstermektedir. Sürdürülebilirlik raporlarında dikkate alınan çevresel ve özellikle sosyal performans göstergelerine ilişkin eksiklikler bulunmaktadır. İncelenen liman tesisleri arasında operasyonel performansı en yüksek olan Mersin Uluslararası Limanı aynı zamanda bütünleşik performansı (ESO) en düşük tesis olarak sıralanmıştır. Bütünleşik performansı (ESO) en yüksek liman tesisi Socar olmuştur.

Özgünlük: Çalışma, Türkiye'deki konteyner limanlarının çevresel, sosyal ve operasyonel performansının MULTIMOORA yöntemi ile değerlendirilmesine ilişkin literatürdeki boşluğun doldurulmasına katkıda bulunmaktadır. Daha önemlisi ilgili performans boyutlarının bütünleştirilerek incelenmesi bu çalışmanın özgünlüğünü temsil etmektedir.

Anahtar Kelimeler: Konteyner Limanları, Sürdürülebilirlik Raporu, Çevresel-Sosyal-Operasyonel Performans Göstergeleri, MULTIMOORA.

JEL Kodları: Q50, P47, C44.

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1. INTRODUCTION

The evolving consumer habits and the increasing diversification of customer demands have driven businesses to adopt strategies such as flexibility, global sourcing, and dispersed production facilities. This trend underscores the importance of maritime transport, which offers rapid and cost-effective logistics globally. According to the United Nations Conference on Trade and Development (UNCTAD, 2024), approximately 80% of international trade by volume is transported by sea. Over 60% of the global commercial value in maritime transport is handled through container ports (Humphreys, 2023). These ports have evolved into distribution centers within supply chains, acting as interfaces between production and consumption (Venus Lun et al., 2016; 50). Consequently, they are key players in international trade and global logistics, serving as critical nodes in maritime supply chains (Dong et al., 2019).

Container ports, as hubs of supply chains, significantly contribute to the socio-economic development of societies (Hossain et al., 2021). However, the expansion of resources associated with port activities has led to substantial negative environmental impacts, such as emissions and dredging waste (Lim et al., 2019). These negative impacts necessitate the adoption of a sustainability approach within the port sector. Majidi et al. (2021) argue that ports, as essential components of national economies and main channels for imports and exports, should be developed further, with more research focused on their environmental, social, and economic impacts. Sustainability in ports is defined as meeting current and future needs while conserving natural resources and the environment through proper resource utilization (Yorulmaz and Baykan, 2023). The primary objective of the sustainability approach in ports, based on the principle of sustainable development, is to adopt a safe, socially acceptable, energy-efficient, and environmentally friendly port management approach while maximizing profit (AAPA, 2007; 25).

While the sustainability approach examines the internal and external relationships provided by Environmental, Social and Governance (ESG) criteria from an organizational perspective, it requires businesses to manage environmental, social and economic risks and understand their short, medium and long-term effects in order to achieve competitive advantage (De Souza Barbosa et al., 2023). Environmental sustainability in ports aims to minimize the negative impacts of various operational and transport activities within and around the port (Lim et al., 2019). According to the European Sea Ports Organisation (ESPO) (2023; 6), the sector's top five environmental sustainability priorities are climate change, air quality, energy efficiency, noise, and water quality. These priorities encompass a wide range of issues, from emissions to biodiversity and waste management (Hossain et al., 2021). Social sustainability involves addressing socioeconomic priorities such as job creation, education for workers and the community, and improving quality of life to enhance social stability in the surrounding area (Lim et al., 2019). ESPO (2023; 19) emphasizes the dynamic interactions between ports and their regions, promoting positive port-city relationships and supporting collaborative approaches to sustainability, and social well-being. Economic sustainability in ports refers to maximizing economic performance through sustainable development initiatives without negatively impacting social and environmental development (Lim et al., 2019). Porter (2003; 2) states that businesses need to adapt to social and environmental demands alongside economic demands to gain a competitive advantage, which benefits both society and businesses. Sustainability literature suggests that businesses can enhance economic performance while reducing negative environmental impacts (Venus Lun et al., 2016; 79). Numerous findings support the view that improving environmental and social performance correlates positively with economic performance (Klassen and McLaughlin, 1996). Although there are practices aimed at reducing costs increasing productivity through energy efficiency and minimizing environmental impacts in ports, the relationship between environmental improvements and economic performance is not fully understood (Venus Lun et al., 2016; 4). Ashrafi et al. (2019) emphasize that despite the importance of the sustainability approach in most port facilities, it is not fully integrated into strategic decision-making and operations due to various challenges. One main challenge is determining sustainability performance indicators and actions needed to remain competitive and comply with the global sustainability agenda (Dong et al., 2019; Majidi et al., 2021).

Performance analysis is a fundamental indicator in all decisions, including investment decisions in container ports (Görçün, 2021). Evaluating sustainability performance in ports is complex due to the multidimensional nature of sustainability and its association with numerous internal and external factors, as well as the difficulty of incorporating environmentally friendly processes into decision-making and planning (Lim et al., 2019; Majidi et al., 2021). While research in operations management emphasizes that operational practices are closely related to the economic and environmental performance of businesses (Duong, 2022), it is stated that planning and managing operations are fundamental to achieving sustainability (Mangla et al., 2020). While being aware that the operational performance of ports is closely related to their economic performance (Nottebom et al., 2023) and considering that operational performance cannot fully meet the economic dimension of sustainability (since financial data is beyond the scope of this study), instead of the term sustainability performance, the term environmental, social and operational (ESO) performance was used for integrated performance in the study. Although it has been examined individually in different studies, the integrated examination of the relevant performance dimensions represents the originality of this study. The MULTIMOORA method used in this study will enrich the literature in terms of methodology in order to meet the need for practical and multidisciplinary techniques for the integrated analysis of different dimensions of sustainability (Lim et al., 2019; Stanković et al., 2021).

In Türkiye, container ports have significant potential to enhance existing container transportation due to their geographical location and port infrastructure (Utikad, 2023). This study is motivated by the inclusion of the sustainability approach among the priority issues for these ports. The study aims to determine the sustainability orientations of container port facilities in Türkiye and evaluate their environmental, social and operational performance. The subsequent sections of this study include a literature review, research design and method, findings, conclusions, and discussions.

2. LITERATURE REVIEW

Performance measurement enables organizations to assess how effectively and efficiently they achieve their goals through specific activities while guiding improvements (Woo et al., 2011). It is obtained through a set of indicators aligned with the strategic, tactical, and operational goals of the business (Bourne et al., 2003). Over the past thirty years, the increasing interest in performance measurement in ports within academia and industry has resulted in a growing number of studies (Lim et al., 2019). This section examines the literature on port performance evaluation in four parts: 1) operational performance indicators of ports, 2) environmental and social performance indicators, 3) research methodology, and 4) studies based on port performance measurement in Türkiye.

According to Bergantino et al. (2013), there is no consensus in academia and industry regarding the indicators that can be used to evaluate the performance of port facilities. The main reason for this is the complexity and diversity of operations carried out in ports. Traditionally, the operational performance of ports is determined by efficiency measures such as quay and gate productivity, maritime connectivity, and average berth access time (Karakas 2020). Ding and Chou (2011) have taken five main indicators as the basis for evaluating the service performance of container ports: container volume, port location, port charges, facilities, and service quality. With 31 sub-indicators (number of quay, quay water depth, quay length, number of equipment, storage capacity, efficiency, etc.) linked to these indicators, they have provided a comprehensive perspective on the evaluation of the operational performance of ports. Many studies have considered these performance indicators (Li et al., 2022; Kaya et al., 2023). The most commonly used performance metric, handled container (Sheikh et al. 2023; Kaya et al., 2023), has been expressed as annual throughput in some publications (Woo et al. 2011; Danladi et al., 2024; Li et al., 2022). Wang et al. (2021) argue that a port's handling capacity is a direct result of the port's level of development and is therefore an important dimension in measuring the port's economic success. They state that the capacity of port operations can be measured by the number of quay, overall efficiency, and the intensity of traffic with foreign ports. Iyer and Nanyam (2021a) and Nanyam and Jha (2022) also support the idea that the intensity of hinterland connections with other ports and the operational performance of new mainline services increase. Therefore, performance indicators such as accessibility, hinterland, and integration level with external markets have gained importance globally in terms of the supply chain (Karakas, 2020). Vrakas et al. (2021) and Wang et al. (2021) emphasize that technology use and standardization have become increasingly important performance indicators in recent years, parallel to technological advancements. However, it is still accepted that improving quay infrastructure, yard infrastructure, and overall infrastructure is important for improving operational performance (Nanyam and Jha, 2022).

Container transportation has gained importance in global trade due to its efficiency and fast service in cargo transportation (Akkan, 2022). However, this growth has worsened environmental problems such as air, and water pollution and resource depletion caused by ports and revealed the necessity of a sustainable approach. Modern port facilities must acquire new capabilities and adopt new practices (Lirn et al., 2013). Dong et al. (2019) note the growing interest in port sustainability. Venus Lun et al. (2016) and Roh et al. (2021) list essential practices for integrating sustainability into ports, including greenhouse gas emissions management, energy and water conservation, air quality, environmental quality, resource conservation, and hazardous material management. Lirn et al. (2013) evaluated the sustainability performance of three major Chinese container ports, focusing on air pollution, aesthetic and noise pollution, and waste and water pollution management. Dong et al. (2019) evaluated the environmental performance of ten major container ports in the Silk Road belt with greenhouse gas emission criteria and highlighted the significant impact of environmental performance on competitiveness and sustainable development. In addition to greenhouse gas emissions, Dovbischuk (2021) grouped climate change, resource efficiency, and biodiversity under environmental indicators. Asgari et al. (2015) included energy consumption as a critical indicator when measuring the sustainability performance of five UK ports. Laxe et al. (2017) used indicators such as education, land use efficiency, energy and water consumption, and waste recovery in their sustainability index, covering economic, institutional, environmental, and social factors.

The social dimension of sustainability is often neglected, leading to limited academic research on social sustainability in the maritime sector (Karakasnaki et al., 2023). However, Laxe et al. (2017) based their studies on commonly used social performance indicators, including employee numbers, training, gender equality, work accidents, and occupational health and safety. Majidi et al. (2021) considered social performance from the perspective of external stakeholders, evaluating it with indicators such as population, unemployment rate, and urbanization rate. Additional studies consider the port's distance from the city center (Kaya et al., 2023). Karakas et al. (2020) used the indicators of productive personnel ratio, labor turnover rate, and training hours per employee as a basis to evaluate corporate social performance. They found that the social dimension is the most important indicator after the logistics and operational dimensions.

Lim et al. (2019) note the widespread use of Multi-Criteria Decision Making (MCDM) methods in evaluating port sustainability performance, as these methods help clarify the relationships between various port characteristics like geography, legislation, size, and cargo types. The most commonly used MCDM method in the literature is AHP (Asgari et al., 2015; Wang et al., 2021). Data Envelopment Analysis (DEA) is also frequently used to evaluate port performance (Danladi et al., 2024; Li et al., 2022). Other MCDM methods used in sector studies include WASPAS (Kaya et al., 2023), ANP (Karakas et al., 2020), TOPSIS (Çelik and Yorulmaz, 2023; Acer and Yangınlar, 2017; Akandere, 2021), PROMETHEE (Stanković et al., 2021), SWARA, MARCOS, CoCoSo (Majidi et al., 2021), OCRA, and EATWOS (Görçün, 2021; Yüksekyıldız, 2021).

Turkish ports play a crucial role in the country's economy (TURKLİM, 2023; 7). Surrounded by seas on three sides and strategically located, Türkiye's port performance is vital for maintaining competitiveness in foreign trade (Çelik and Yorulmaz, 2023). The literature includes various studies on Turkish ports and their performance. Görçün (2021) examined the operational performance of nine Black Sea container ports, including Trabzon and Samsun, using indicators such as the number of employees, quay length and depth, equipment number, storage area, port area, handling capacity, and container volume (OCRA and EATWOS). Yüksekyıldız (2021) evaluated the efficiency of twenty Turkish container ports using similar indicators (EATWOS and ENTROPY). Baştuğ (2023) assessed the operational efficiency of twenty-three TURKLİM member port companies (DEA-SCOR), while Acer and Yangınlar (2017) evaluated twenty container ports (TOPSIS). Çelik and Yorulmaz (2023) assessed the performance of 13 container terminals, including Mersin Port, using indicators like handling capacity, port area, quay length and depth, and crane numbers (TOPSIS). Studies on the sustainability performance of Turkish ports are less common compared to operational performance studies. Kaya et al. (2023) evaluated (WASPAS) the sustainability performance of Marmara region container ports using thirty-six indicators grouped under economic, environmental, and social dimensions, finding that Marport and Asyaport had the highest performance. Akandere (2021) assessed the sustainability performance of five green-certified ports using data on emissions, electricity, and diesel consumption, container handling volume, port area, and equipment numbers from sustainability reports (2015-2018).

Table 1 presents the key indicators for assessing the operational, environmental, and social performance of container ports, with relevant references. As this study emphasizes operational activities over monetary outputs (Wang et al., 2024), the operational dimension is adopted instead of the economic dimension of sustainability.

Lim et al. (2019) emphasize that although the relevant literature is increasing, sustainability studies in maritime logistics remain limited compared to other logistics systems. This limitation is also evident in Türkiye, a country surrounded by seas on three sides. Although Karakas et al. (2020) developed a measurement model for the sustainability performance of container port facilities in the Marmara Sea, they did not evaluate port performance. Akandere (2021) assessed the environmental and operational performance of green-certified ports based on 2015-2018 data. Kaya et al. (2023) evaluated the sustainability of container ports in the Marmara region based on expert judgments rather than primary data. Consequently, this study aims to evaluate the operational, environmental, and social performance of container port facilities in different regions of Türkiye, using primary data from 2021-2022 years published by port facilities. Additionally, the study aims to determine the current status of sustainability orientations and approaches in Turkish container ports. In this respect, this study fills the gap in the literature by using primary data on port facilities in Türkiye and simultaneously evaluating the operational, environmental, and social performance dimensions of port facilities in an integrated manner. Using the MULTIMOORA method in evaluating the performance of ports also contributes to the literature in terms of method.

The research questions are:

- What are the general sustainability approaches of container port facilities (sustainability reporting systems, data recording, etc.)? What is the status of reporting environmental and social sustainability data?
- What sustainability-related documents/certificates do the facilities possess?
- What is the operational, environmental, and social performance status of container port facilities? Which facilities have the highest integrated (Environmental, Social, Operational-ESO) performance?
- Is there a parallel between the rankings of facilities' operational performance and their environmental and social performance?

Table 1. Performance indicators of port facilities

Performance	*Indicators*	*References*	*Unit*
Operational performance	Quay water depth	(Ding and Chou,2011)	meter
	Length of quay reserved for container	(Li et al.,2022)	meter
	Total port area	(Görçün,2021)	square meters
	Annual cargo throughput	(Iyer and Nanyam,2021b)	TEU (20 feet length for container)
	Container handling capacity	(Danladi et al.,2024)	TEU (annual)
Environmental performance	Emission release	(Dovbischuk,2021)	ton Carbon dioxide equivalents (CO_2e)
	Waste quantity	(Lirn et al.,2013)	ton
	Energy consumption	(Asgari et al.,2015)	gigajoule (GJ)
	Water consumption	(Roh et al.,2021;)	megaliter (ML)
Social performance	Percentage of female employees	(Stanković et al.,2021)	% (Number of female employees/total number of employees)
	Accident frequency rate	(Laxe et al.,2017)	% (every 1000000 hours)
	Training provided to employees	(Karakas et al.,2020)	hour/person

3. METHOD and DATA

3.1. Research Design and Method

Figure 1 provides an overview of the methodology used in line with the research purpose and problem. This study is descriptive in determining the current sustainability approaches and data of container port facilities in Türkiye and exploratory in evaluating the performance of these facilities.

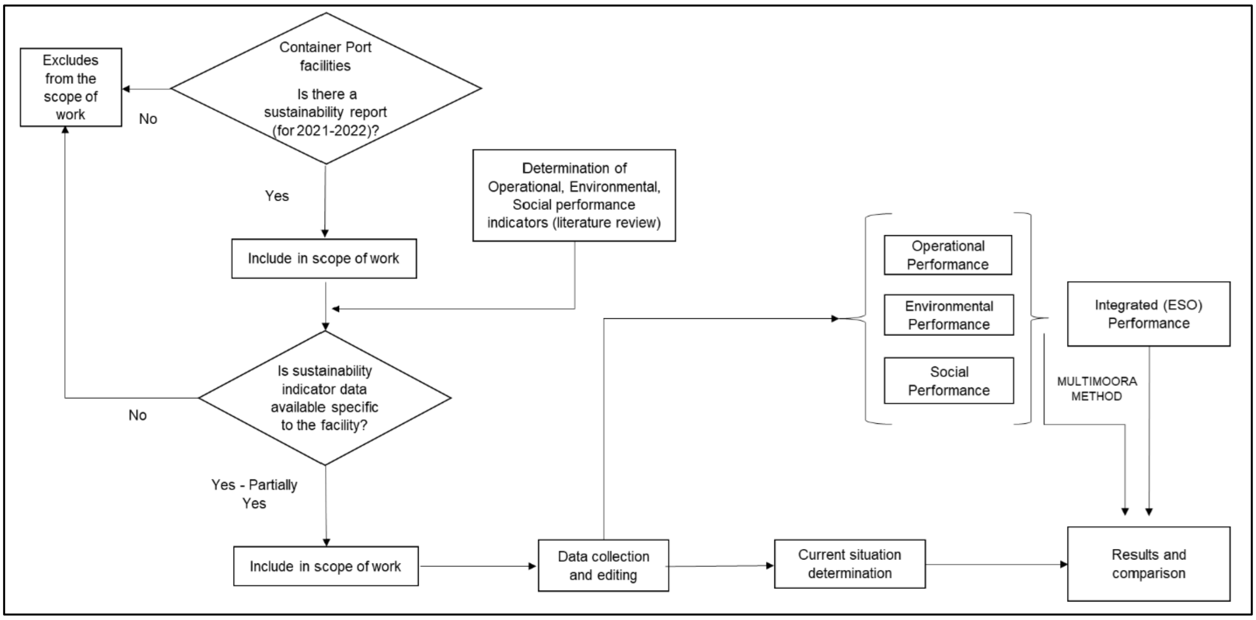

Figure 1. Design of the research

Performance indicators' literature reviews and container port facilities' sustainability reports have been conducted simultaneously. Data obtained from reports on indicators were analyzed using the MULTIMOORA method; performance rankings of port facilities were compared.

The multidimensional nature of sustainability in port facilities and the acquisition of data from various heterogeneous sources complicate decision-making (Stanković et al., 2021). Sustainability studies require a large number of performance indicators which are difficult to determine with different measurement units. Therefore, similar to the difficulty of measuring operational performance (Görçün, 2021), measuring environmental and social performance of sustainability is also an important challenge in the rational decision-making process (Lim et al., 2019). The maritime transport literature confirms the efficacy of multi-criteria decision-making (MCDM) methods, such as AHP, and PROMETHEE, for clearer problem formulation and informed decision-making (Majidi et al., 2021). However, no studies have evaluated the environmental, social and operational performance of container port facilities using the MULTIMOORA method, highlighting a gap this study aims to address.

The MULTIMOORA method (Multi-Objective Optimization by Ratio Analysis plus Full Multiplicative Form), developed by Brauers and Zavadskas (2013:72), is an MCDM method that integrates and evaluates multiple criteria, considering the interactions between them holistically. It has been extended by adding the Full Multiplicative Form to the Ratio System and Reference Point approaches of the MOORA (Multi-Objective Optimization Ratio Analysis) method (Hafezalkotob et al., 2019).

The MULTIMOORA Method's Ratio System, as a fully compensatory model, is useful when "independent" criteria exist in the problem. For cases with "dependent" criteria, the Full Multiplicative Form, as an incompletely compensatory model, is beneficial. The Reference Point Approach, a non-compensatory model, is a conservative method compared to the Ratio System and Full Multiplicative Form. The Ratio System and Full Multiplicative Form allow for the compensation of poor performance on one criterion by better performance on other criteria, though the degree of compensation differs between the two techniques. In contrast, the Reference Point Approach does not permit such compensation. Since "dependent" and "independent" criteria may coexist in a problem, and to achieve a conservative result, MULTIMOORA integrates these three methods to leverage their respective advantages and attain a robust outcome (Hafezalkotob et al., 2019). The steps of the MULTIMOORA method are included in the following section (Brauers and Zavadskas, 2013; Hafezalkotob et al., 2019).

Step 1. Generate and normalization of the decision matrix: The first step in an MCDM problem is constructing a decision matrix and weight vector. Thus, for MULTIMOORA, the decision matrix composed of the ratings x_{ij} of m decision alternatives of the problem concerning n criteria is first constructed, as follows (Equation 1):

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \tag{1}$$

The x_{ij} expression in the decision matrix shows the performance value of the ith alternative according to the jth criterion.

Because the ratings of alternatives on the multiple criteria of the problem may have different dimensions, the ratings should be normalized before utilization in an MCDM model. Regardless of whether the criteria in the decision problem are beneficial or non-beneficial, Equation 2 is used to normalize the decision matrix:

$$x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m}(x_{ij})^2}} \tag{2}$$

Step 2. Calculate the performance of decision alternatives using the Ratio System (RS) Approach: The performance values of non-beneficial criteria are subtracted from the sum of the performance values of the normalized beneficial-oriented criteria (Equation 3).

$$y_{ij}^* = \sum_{j=1}^{g} x_{ij}^* - \sum_{j=g+1}^{n} x_{ij}^* \tag{3}$$

Where g is the number of beneficial criteria and $(n - g)$ is the number of non-beneficial criteria. The best alternative based on the Ratio System has the maximum utility y_i and the ranking of this method is obtained in descending order (Equation 4):

$$R_{RS} = \{A_{i|max_i\ y_i} > \cdots > A_{i|min_i\ y_i}\} \tag{4}$$

Step 3. Calculate the performance of decision alternatives using the Reference Point (RPA) Approach: Based on the normalized data in Equation 1, the maximum value is determined as the reference point (r_i) if the decision alternatives are beneficial according to each criterion, and the minimum value is if they are not beneficial. The distances of the alternatives to the reference point according to each criterion are calculated with the help of Equation 5.

$$d_{ij} = \left| r_j - x_{ij}^* \right| \tag{5}$$

The score of the Reference Point Approach is obtained by maximizing the distance introduced in Equation 6.

$$z_i = max_j \, d_{ij} \tag{6}$$

The best alternative based on the Reference Point Approach has the minimum utility z_i. The ranking of the alternatives in ascending order is obtained by Equation 7.

$$R_{RPA} = \left\{ A_{i|min_i \ z_i} > \cdots > A_{i|max_i \ z_i} \right\} \tag{7}$$

Step 4. Calculate the performance of decision alternatives using the Full Multiplicative Form (FMF): To obtain the score of Full Multiplicative Form, the product of normalized alternatives ratings on beneficial criteria (A_i) is divided by the product of normalized alternatives ratings on non-beneficial criteria (B_i) (Equation 8-10).

$$U_i = \frac{A_i}{B_i} \tag{8}$$

$$\mathrm{A_i} = \prod_{\mathrm{g=1}}^{\mathrm{j}} \mathrm{x_{gj}} \,, \qquad i = 1,2, \ldots m \tag{9}$$

$$\mathrm{B_i} = \prod_{\mathrm{k=j+1}}^{\mathrm{n}} \mathrm{x_{ki}} \,, \qquad i = 1,2, \ldots m \tag{10}$$

The best alternative based on the Full Multiplicative Form has the maximum utility U_i and the ranking of this technique is generated in descending order (Equation 11).

$$R_{FMF} = \left\{ A_{i|max_i \ u_i} > \cdots > A_{i|min_i \ u_i} \right\} \tag{11}$$

Step 5. Ranking aggregation tools: Dominance Theory: In the MULTIMOORA method, Dominance Theory can be taken into account in combining the sub-rankings of the three approaches for the final ranking of the alternatives (Hafezalkotob et al., 2019). Detailed information about the dominance theory can be found in Brauers and Zavadskas (2013).

Ranking Position Method (RPM): This method is based on the $RPM\ (A_i)$ score for each alternative used to generate the final ranking. The score is calculated as follows (Equation 12) (Hafezalkotob et al., 2019):

$$RPM\ (A_i) = \frac{1}{\left(\frac{1}{r(y_i)} + \frac{1}{r(z_i)} + \frac{1}{r(u_i)}\right)} \tag{12}$$

Where $r(y_i)$, $r(z_i)$, $and\ r(u_i)$ are the rankings of Ratio System, Reference Point Approach, and Full Multiplicative Form, respectively, the best alternative based on the Rank Position Method has the minimum value of $RPM\ (A_i)$ (Hafezalkotob et al., 2019).

If the decision maker deems it necessary, the weight of the criteria (the importance coefficient) in the decision problem, that is, the importance coefficient (w_j), can be used in the MULTIMOORA method (Özbek, 2019; 198). However, in this study, which aims to determine the current situation, it is assumed that the criterion weights are equal.

3.2. Data Collection

This study aimed to obtain primary (qualitative and quantitative) data by examining reports and official documents, as well as the web pages of facilities, which serve as data sources in scientific research (Balaban Salı, 2012; 151). Sustainability reports are crucial tools businesses use to monitor the economic, environmental, and social impacts of their activities, providing a competitive advantage and sharing the results in a manner that meets stakeholders' demands. These reports, which reflect social responsibilities at the corporate level, are required by regulatory bodies, stock exchanges, and other financial institutions (Çalışkan, 2012). Therefore, to obtain the most reliable data on container port facilities whose performance is to be evaluated, it was essential to examine those facilities that have published sustainability reports, ensuring that their sustainability data and claims are genuine (ACCC, 2024).

The Ports Department Unit (www.tkygm.uab.gov.tr) under the Ministry of Transport and Infrastructure of the Republic of Türkiye oversees 46 coastal facilities permitted to service container ships and their cargo, including those with temporary operating permits. However, only 28 of these facilities are operational (Table 2) (TURKLİM, 2024: 103). It was investigated whether these facilities, which may be public, foreign, or public-foreign capital, published sustainability reports and the certificates and quality documents they had. The web pages of the facilities and their parent companies, if any, were scanned repeatedly. Data regarding 28 port facilities providing container services are presented in Table 2.

In the sustainability reports of the holdings to which some ports are affiliated, no specific data regarding the port facility itself were found (i.e., the port facility was not included in the holding's reporting scope) (Akçansa, Assan Port, DP World, Karasuport, Limaş, Mardaş). Therefore, these port facilities were excluded from the study. The study focused on port facilities that had a specific sustainability report (Asya Port, Evyapport, Kumport, MIP, QTerminals) and those included in the sustainability report of their parent holding (Borusan, Limak, Socar).

The most commonly used performance indicators in the literature for evaluating port facilities' performance are presented in Table 1 in the previous section. This study used six indicators for operational performance, four for environmental performance, and three for social performance. The sustainability reports of the included port facilities were re-examined, and relevant performance indicator data were collected. These data were cross-checked with information published on the websites of the Ministry of Transport and Infrastructure (www.uab.gov.tr) and TURKLİM (Turkish Port Operators Association) (www.turklim.org). The collected data were transferred to MS Excel 2016 tables and standardized into common units (Table 1). The performance indicator data of the port facilities are presented in Tables 3-5. Data collection occurred between 01.05.2024 and 10.07.2024.

4. RESULTS

4.1. Results of Sustainability Reporting

There are 28 container port facilities operating and licensed to provide services in Türkiye's Black Sea, Aegean, Marmara, and Mediterranean regions (TURKLİM, 2024). Of these, 14 port facilities (50%) have sustainability reports either within their organization or within the holding company they are affiliated with. Although the subsidiary holding companies have sustainability reports and mention sustainability on their corporate websites, six-port facilities (21%) are excluded from the holding company reports (Akçansa, Assan Port, DP World, Karasu Port, Limaş, Mardaş). Three ports (11%) included in the holding company sustainability report have facility-specific data: Borusan, Limak Port, and Socar Terminal. Additionally, five port facilities (18%) providing container services in Türkiye (Asya Port, Evyapport, Kumport, MIP, and Qterminals Akdeniz) have published facility-specific sustainability reports for either 2021 or 2022 (Asya Port and Evyapport lack a report for 2021; Qterminals lacks one for 2022).

All 28 container port facilities (100%) are within the scope of the ISPS (International Ship and Port Facility Security) code, which establishes mandatory security standards for international merchant ships and port facilities, enacted by the International Maritime Organization (IMO) in 2004 (Republic of Türkiye Ministry of Transport and Infrastructure, 2024). Two container ports in Türkiye, Asya Port and Marport, hold the Ecoport certificate issued by the European Sea Ports Organization (ESPO). Asya Port earned this with the PERS (The Port Environmental Review System) certificate, while Marport achieved it with ISO certification (www.ecoports.com). Under the "Green Port/Eco Port" project initiated by the Ministry of Transport and Infrastructure in Türkiye in 2014, 13 port facilities have green port certificates: Akçansa, Asya Port, Borusan, Evyapport, Kumport, Limaş, Limakport, Mardaş, Marport, Nemport, QTerminals, Samsunport, and Yılport (Akandere, 2021).

According to the "Green Port Report/Green Port Policy, Regulation and Applications" by TURKLIM (2013), ports with green port certificates must establish and document an integrated management system along with the ISO 9001 Quality Management System and ISO 14001 Environmental Management System. Consequently, container facilities with green port certificates, as listed in Table 2 (except Yılport data, which was inaccessible), also possess ISO 9001 and ISO 14001 certificates. Additionally, 19 port facilities have the ISO 9001 Quality Management System, 17 have the ISO 45001 Occupational Health and Safety Management System certificate, and 20 have the ISO 14001 Environmental Management System certificate. Furthermore, 36% of container port facilities in Türkiye have the ISO 50001 Energy Management System and 29% have the ISO 14064 Greenhouse Gas and Emissions Management System certificate.

The research accessed 13 sustainability reports (6 for 2021 and 7 for 2022) for eight port facilities. These reports were published in Turkish (Evyapport), English (Asya Port), and both Turkish and English (Borusan, Kumport, Limakport, MIP, Socar, QTerminals). Independent reports specific to the port facility range from 28 to 72 pages, while those within the holding range from 63 to 221 pages.

Table 2. Basic data on container port facilities with operating permits

				*Sust.Reprt**		*Documents-certificates owned*									
	Conteiner port facilities	*City*	*Ownership structure*	*2021*	*2022*	*ISO9001*	*ISO45001*	*ISO14001*	*ISO27001*	*ISO50001*	*ISO14064*	*ISPS*	*GreenPort*	*EcoPort*	*Web address*
1	Akçansa Ambarlı	İstanbul	private (Turk-Foreign)(Sabancı-Heidelberg)												www.akcansa.com.tr
2	Assan Port	Hatay	private (Turk)(Kibar)												www.assanport.com.tr
3	Asya Port	Tekirdağ	private (Turk-Foreign)(Soyuer-MSC)												www.asyaport.com
4	Beldeport	Kocaeli	private (Turk)(Med.Lojistik)												www.beldeport.com.tr
5	Borusan	Bursa	private (Turk)(Borusan Holding)												www.borusanport.com/tr
6	Çelebi Bandırma	Balıkesir	private (Turk)(Çelebi OGG)												www.portofbandirma.com.tr
7	DP World	Kocaeli	private (Foreign)(DP World)												www.dpworld.com
8	Ege Gübre	İzmir	private (Turk)(Ege Gübre)												www.egegubre.com.tr
9	Evyaport	Kocaeli	private (Turk)(Evyap)												www.evyapport.com
10	Gemport (Yılport)	Bursa	private (Turk)(Yıldırım)												www.yilport.com
11	Haydarpaşa	İstanbul	public (TCDD)												www.tcdd.gov.tr
12	Karasuport	Sakarya	private (Turk)(IC)												www.karasuport.com.tr
13	Kumport	İstanbul	private (Foreign)(Fiba-COSCO Pasific)												www.kumport.com.tr
14	Limakport İskenderun	Hatay	private (Turk-Foreign)(Limak-Infrared)												www.limakports.com.tr
15	Limaş	Kocaeli	private (Turk)(Hayat)												www.limas.com.tr
16	Mardaş	İstanbul	private (Turk)(Hayat)												www.mardas.com.tr
17	Marport	İstanbul	private (Turk-Foreign)(Arkaş-TIL)												www.marport.com.tr
18	Mersin Int.Port (MIP)	Mersin	private (Turk-Foreign)(PSA-Akfen-IFM)												www.mersinport.com.tr
19	Nemport	İzmir	private (Turk)(Nemport A.Ş)												www.nemport.com.tr
20	Qterminals Akdeniz	Antalya	private (Turk-Foreign)(Subsidiary;Global Ports)												www.qterminals.com
21	Roda Port	Bursa	private (Turk)(Roda)												www.rodaport.com
22	Safiport Derince	Kocaeli	private (Turk)(Safi)												www.safiport.com.tr
23	Samsunport	Samsun	private (Turk)(Ceynak)												www.samsunport.com.tr
24	Socar Terminal	İzmir	private (Foreign)(SOCAR-Goldman Sachs)												www.socarterminal.com
25	TCDD İzmir	İzmir	public (TCDD)												www.tcdd.gov.tr
26	Trabzonport	Trabzon	private (Turk)(Albayrak)												www.trabzonport.com.tr
27	Ulusoy Çeşme	İzmir	private (Turk)(Ulusoy)												www.ulusoysealines.com
28	Yılport Gebze	Kocaeli	private (Turk)(Yıldırım)												www.yilport.com

There is a facility-specific sustainability report.

There is no sustainability report specific to the facility.

The holding's sustainability report includes data specific to its facility.

Although the holding company has a sustainability report, facility-specific data is not included.

The facility has the relevant document.

*: Sustainable Report

Table 3. Operational performance indicator data of container port facilities

Port Facilities	Quay water depth (meter)	Length of quay reserved for container* (meter)	Total port area (square meters)	Container handling capacity (TEU)	Annual cargo throughput (TEU)		The capacity utilization rate	
					2021	2022	2021	2022
1 Asya Port	18	2010	300,000	2,500,000	1,802,517	1,796,876	0.72	0.72
2 Borusan	14.5	635	465,000	450,000	138,491	122,796	0.31	0.27
3 Evyapport	18.5	455	279,000	855,000	599,566	680,650	0.70	0.80
4 Kumport	16.5	2080	477,867	2,100,000	1,211,515	1,175,741	0.58	0.56
5 Limakport	15.5	920	1,000,000	1,000,000	476,627	496,583	0.48	0.50
6 MIP	15.8	1395	1,120,000	2,600,000	2,097,349	2,020,967	0.81	0.78
7 Socar	16	700	420,000	1,500,000	357,314	414,702	0.24	0.28
8 QTerminals	9.5	1117	203,920	350,000	116,786	93,016	0.33	0.27

(*) : Quay length is taken as the basis for container handling. This definition was not found for Asya Port and QTerminals.

Table 4. Environmental performance indicator data of container port facilities

Port Facilities	Emission release* (Ton CO_2e)		Waste quantity** (Ton)		Energy consumption*** (GJ)		Water consumption (ML)	
	2021	2022	2021	2022	2021	2022	2021	2022
1 Asya Port	-	15,089.0	-	-	72,931,163.1	80,628,934.5	-	-
2 Borusan	6,762.3	6,767.0	168.8	1,306.7	74,617.5	72,582.0	12.5	20.3
3 Evyapport	-	16,413.4	526.2	698.0	-	-	-	-
4 Kumport	13,052.8	32,969.4	268.8	244.8	1.3	1.3	22.5	25.5
5 Limakport	10,684.6	11,152.3	1,581.8	1,940.3	70,264.0	87,035.0	133.0	110.7
6 MIP	37,127.0	35,928.0	8,277.0	10,732.0	394,000.6	399,480.2	293.1	379.9
7 Socar	6,571.3	5,685.8	114.0	239.0	-	-	-	-
8 QTerminals	-	-	71.3	-	26,148.7	-	-	-

(*) : Based on Scope 1 and Scope 2 emission. Kumport included Scope 3 for 2022; Evyapport included Scope 3 and Scope 4.
(**): Total amount of hazardous and non-hazardous waste.(***): Total amount of electricity and other energy consumption.

Table 5. Social performance indicator data of port facilities

	Percentage of female employees (%)		Accident frequency rate (for 1000000 hours)		Training provided to employees (hour/person)	
Port Facilities	*2021*	*2022*	*2021*	*2022*	*2021*	*2022*
1 Asya Port	-	-	-	-	-	-
2 Borusan	-	-	2.01	11.11	-	-
3 Evyapport	-	0.073	-	-	-	48.15
4 Kumport	0.023	0.059	-	-	12.42	32.33
5 Limakport	0.088	0.089	6.17	5.17	-	-
6 MIP	0.060	0.060	7.89	6.83	-	-
7 Socar	0.098	0.101	2.10	4.67	66.50	31.53
8 QTerminals	-	-	6.60	-	-	-

The operational indicators (Table 1) for port facilities are comprehensively available in reports (Table 3). However, substantial gaps exist in the environmental indicator data (Table 4). Only four facilities—Borusan, Kumport, Limakport, and MIP—have consistently published complete environmental indicator data for both 2021 and 2022. Among the 13 sustainability reports examined, 8% lack data on emissions and waste, 17% lack data on energy consumption, and 38% lack data on water consumption. The specific missing environmental indicator data are as follows:

- *Emission Release*: QTerminals (2021)
- *Waste Quantity:* Asya Port (2022)
- *Energy Consumption:* Evyapport (2022); Socar (2021,2022)
- *Water Consumption:* Asya Port (2022); Evyapport (2022); Socar (2021,2022); QTerminals (2021)

Social performance data are also notably absent from many reports. Specifically, 31% of the accessible reports do not include data on the percentage of female employees or accident frequency rates, and 44% do not provide information on employee training. Socar is the only facility that reported all three social performance indicators (Table 5). The missing social performance data in the reports are as follows:

- *Percentage of Female Employees:* Asya Port (2022); Borusan (2021,2022); QTerminals (2021)
- *Accident Frequency Rate:* Asya Port (2022); Evyapport (2022); Kumport (2021,2022)
- *Employee Training:* Asya Port (2022); Borusan (2021, 2022); Limakport (2021,2022); MIP (2021, 2022); QTerminals (2021)

Notably, the 2021 reports for Evyapport and Asya Port and the 2022 report for QTerminals have not been published.

4.2. Performance Evaluation Results of Port Facilities

The subsequent section presents the results of the MULTIMOORA analysis (Equations 1-12), performed using MS Excel 2016, based on data collected from 13 reports about 8 port facilities included in the study.

4.2.1. Operational Performance

Iyer and Nanyam (2021b) emphasize that optimal capacity utilization is crucial in the global container market, which is subject to significant changes. The capacity utilization rate is defined as the ratio of theoretical capacity to actual production (Karanki and Bilotkach, 2023). Instead of treating annual container handled and annual handling capacity as separate indicators, this study calculated the capacity utilization rate to assess port performance. This approach aims to contribute to the literature by evaluating port performance using the "capacity utilization rate" indicator.

According to the operational performance indicator data of port facilities (Table 3), Evyap Port and Asya Port have the highest quay water depths, while Kumport and Asyaport possess the longest container quay. MIP port facility boasts the largest port area and the highest annual container handling capacity, achieving a high capacity utilization rate of 81% in 2021. In 2022, Evyapport achieved the highest capacity utilization rate at 80%. Notably, Evyapport, Limakport, and Socar showed an increase in capacity utilization rates compared to the previous year. MIP handled the most cargo in Türkiye during both periods.

The operational performance of the facilities was assessed using four indicators: quay water depth, length of quay reserved for containers, total port area, and container handling capacity utilization rate. All operational performance indicators are benefical (max). Therefore, Equation 8 in the Full Multiplicative Approach becomes invalid and the MULTIMOORA method turns into the MOORA method (Hafezalkotob et al., 2019). Therefore, the results of operational performance are obtained using the Ratio Approach and Reference Point Approach of the MOORA method. The operational performance ranking of port facilities for 2021 and 2022 is provided in Table 6. The Rank Position Method (RPM) (Hafezalkotob et al., 2019) was used for the final performance ranking of port facilities, with the facility having the smallest RPM value indicating the highest performance.

Table 6. Operational performance results for 2021 and 2022

Container Port Facilities	2021 RS (y_i^*)	2021 R_{RS}	2021 RPA (z_i)	2021 R_{RPA}	2021 RPM	2022 RS (y_i^*)	2022 R_{RS}	2022 RPA (z_i)	2022 R_{RPA}	2022 RPM
MIP	714739.23	1	647.69	1	0.5	714739.20	1	647.69	1	0.5
Limakport	569594.66	2	144844.88	2	1.0	569594.67	2	144844.88	2	1.0
Kumport	131200.52	3	584186.71	3	1.5	131200.50	3	584186.71	3	1.5
Borusan	123224.11	4	591094.10	4	2.0	123224.09	4	591094.10	4	2.0
Socar	100574.01	5	613768.81	5	2.5	100574.02	5	613768.81	5	2.5
Asya Port	52349.19	6	662961.41	6	3.0	52349.19	6	662961.41	6	3.0
Evyapport	44383.78	7	669884.25	7	3.5	44383.87	7	669884.25	7	3.5
QTerminals	24017.44	8	690527.85	8	4.0	24017.42	8	690527.85	8	4.0

RS: Ratio System Approach, RPM: Reference Point Approach, RPM: Score of Ranking Position Method, y_i^*: Score of Ratio system, z_i: Score of Reference Point Approach, R_{RS}, R_{RPA}: Rank

Since all indicator data in the operational performance evaluation, except for the capacity utilization rate, about the physical characteristics of the port, the performance values of the facilities were very similar, resulting in consistent performance rankings across both periods. According to the analysis, MIP emerged as the port facility with the highest operational performance (RPM=0.5). Limakport and Kumport also ranked among the top three in operational performance. Conversely, QTerminals demonstrated the lowest operational performance (RPM=4.0).

4.2.2. Environmental Performance

According to the environmental indicator data of port facilities (Table 4), MIP recorded the highest amounts of emissions, waste, energy, and water consumption for both periods. Conversely, Socar exhibited the lowest amounts of emissions and waste for both periods. Due to incomplete data, only four port facilities (Kumport, Borusan, Limakport, MIP) with comprehensive environmental indicator data were included in the analysis. The environmental performance indicators are non-beneficial (minimum). Therefore, Equation 8 in the Full Multiplicative Approach becomes invalid and the MULTIMOORA method is transformed into the MOORA method (Hafezalkotob et al., 2019). In fact, the results were obtained using the Ratio Approach and Reference Point Approach of the MOORA method. The environmental performance ranking of container port facilities for the years 2021 and 2022 is given in Table 7.

Table 7. Environmental performance results for 2021 and 2022

Container Port Facilities	2021 RS (y_i^*)	2021 R_{RS}	2021 RPA (z_i)	2021 R_{RPA}	2021 RPM	2022 RS (y_i^*)	2022 R_{RS}	2022 RPA (z_i)	2022 R_{RPA}	2022 RPM
Kumport	-4131.8	1	3015.4	1	0,5	-21080.0	2	12686.9	1	0.7
Borusan	-14786.3	2	13676.2	3	1,2	-13750.5	1	20626.8	3	0.8
Limakport	-15240.2	3	12126.9	2	1,2	-21541.1	3	18424.5	2	1.2
MIP	-423046.9	4	381310.3	4	2,0	-420733.6	4	384314.7	4	2.0

RS: Ratio System Approach, RPM: Reference Point Approach, RPM: Score of Ranking Position Method, y_i^*: Score of Ratio system, z_i: Score of Reference Point Approach, R_{RS}, R_{RPA}: Rank

The port facility with the highest environmental performance for both periods is Kumport (RPM=0.5 for 2021 and 0.7 for 2022). It is followed by the Borusan and Limakport facilities. Notably, Borusan's environmental performance improved in 2022 (RPM=0.8) compared to Limakport (RPM=1.2). MIP ranked lowest in environmental performance for both 2021 (RPM=2.0) and 2022 (RPM=2.0).

4.2.3. Social Performance

In terms of gender equality, Socar exhibits a high female-employee ratio (0.098 for 2021; 0.101 for 2022), whereas Kumport ranks lowest for both periods (0.023 for 2021; 0.059 for 2022). According to the United Nations' Review of Maritime Transport (2023; 102), the participation rate of female employees in the port industry remains low, with minimal changes over the years. Regarding accident frequency rates, Borusan had the highest performance in 2021 (2.01), while Socar achieved the top ranking in 2022 (4.67). MIP had the highest accident frequency rate in 2021 (7.89), and Borusan in 2022 (11.11). In terms of employee training, Socar provided the most training in 2021 (66.50 hours per person), but Evyapport surpassed it in 2022 with 48.15 hours per person. Despite MIP's leading operational performance (Table 6), it significantly underperforms in social performance indicators.

As only one facility, Socar reported all social performance indicator data, so a MULTIMOORA analysis for social performance was not conducted. The subsequent section will incorporate social performance into the integrated (ESO) performance evaluation of port facilities.

4.3.3. Integrated (Environmental, Social, Operational - ESO) Performance

In this section, the results of the integrated (ESO) performance assessment are presented by bringing together operational, environmental and social performance indicators for port facilities.

Due to substantial gaps in published data, particularly concerning environmental and social performance indicators, the number of indicators was reduced to ensure that a sufficient number of facilities could be evaluated. While a broader range of indicators could have been included, such an expansion would increase the dimensional complexity of the study. Consequently, the study adhered to the principles of completeness and minimum indicator conditions (Tzeng and Huang, 2011; 144) in selecting the indicators. The operational performance indicators selected are the length of the quay allocated for container service and the capacity utilization rate. For environmental performance, the amount of emission release and waste were chosen, while the accident frequency rate was the sole social performance indicator included. The MULTIMOORA analysis was conducted for four port facilities with available data (Borusan, Limakport, Socar, MIP). The length of the quay allocated for container service and the capacity utilization rate are considered beneficial (max), while the amount of emission release, waste, and accident frequency rate are considered non-beneficial (min). The results of the Ratio Approach, Reference Point Approach, and Full Multiplication Approach of the MULTIMOORA method, along with the RPM rankings, are presented in Table 8 (for 2021) and Table 9 (for 2022).

Table 8. Integrated (ESO) performance results for 2021

Container	*RS*		*RPA*		*FMF*		
Port Facilities	(y_i^*)	R_{RS}	(z_i)	R_{RPA}	(U_i)	R_{FMF}	*RPM*
Socar	-832.5	1	758.4	1	0.020	1	0.3
Borusan	-943.5	2	803.6	2	0.013	2	0.7
Limakport	-2730.1	3	1784.8	3	0.000	3	1.0
MIP	-41780.6	4	33575.6	4	0.000	4	1.3

RS: Ratio System Approach, RPM: Reference Point Approach, FMF: *Full Multiplicative Form,* RPM: Score of Ranking Position Method, y_i^*: Score of Ratio system, z_i: Score of Reference Point Approach, U_i: Score of Full Multiplicative Form, R_{RS}, R_{RPA}: Rank

Table 9. Integrated (ESO) results for 2022

Container	*RS*		*RPA*		*FMF*		
Port Facilities	(y_i^*)	R_{RS}	(z_i)	R_{RPA}	(U_i)	R_{FMF}	*RPM*
Socar	-587.9	1	758.4	1	0.003038	1	0.3
Borusan	-1138.6	2	803.6	2	0.000055	2	0.7
Limakport	-3121.8	3	2381.9	3	0.000010	3	1.0
MIP	-42875.6	4	32566.8	4	0.000001	4	1.3

RS: Ratio System Approach, RPM: Reference Point Approach, FMF: *Full Multiplicative Form,* RPM: Score of Ranking Position Method, y_i^*: Score of Ratio system, z_i: Score of Reference Point Approach, U_i: Score of Full Multiplicative Form, R_{RS}, R_{RPA}: Rank

The integrated (ESO) performance ranking of port facilities remained unchanged for both 2021 and 2022 (Table 9). The facility with the highest performance is Socar (RPM=0.3), followed by Borusan (RPM=0.7) and Limakport (RPM=1.0). MIP is ranked lowest in integrated (ESO) performance for both periods with an RPM of 1.3.

5. DISCUSSION and CONCLUSION

According to the research results examining the sustainability approaches and performance of container port facilities operating in Türkiye, only 18% of the facilities have independent sustainability reports. This is an improvement from the 13% reported by Piecyk and Bjorklund (2015) for logistics service providers. However, Hossain et al. (2021) found that 67% of European and 50% of North American ports prepare such reports. Given the proximity of Turkish ports to city centers and their importance in international trade (Yorulmaz and Patruna, 2022), expanding sustainability reporting is crucial. This finding, as indicated by Ashrafi et al. (2019), suggests that although sustainability is deemed important in port facilities, it is not adequately embraced in practice. Thus, sustainability efforts in Turkish ports are still nascent. Publishing a sustainability report is generally voluntary for companies; however, since it demonstrates the company's desire to be a good corporate citizen (Piecyk and Bjorklund, 2015), it is hoped that awareness of the role of port facilities in Türkiye in improving their global image will be increased.

46% of container port facilities have the Green Port certificate from the Ministry of Transport and Infrastructure. Increasing investments and incentives for this project can enhance economic development. 71% of facilities hold ISO 14001 certification, surpassing Hossain et al. (2021)'s 53%. However, it is important to note that different environmental certification programs such as PERS (Port Environmental Review System) and EMAS (Eco-Management and Audit Scheme) are also used in Europe and North America. Additionally, there is low interest in ISO 50001-Energy Management System and ISO 14064-Greenhouse Gas and Emissions Management System certification in the facilities. However, environmental certification initiatives of ports not only reduce negative environmental impacts but also improve economic performance and increase international competitiveness (Piecyk ve Bjorklund, 2015); thus, incorporating them into a corporate strategy for more ports could facilitate the international competitiveness of Turkish ports.

Port facilities in Türkiye include all operational data in sustainability reports due to the Ministry of Transport and Infrastructure's (2022) regulations. However, the lack of standardization in environmental and social performance data, which leads to inconsistencies in reporting, is one of the most important findings of this study. Piecyk and Björklund (2015) support the uncertainty regarding which aspects of sustainability are emphasized in the reports of companies providing logistics services. This indicates a need for enhanced efforts and regulations to improve the environmental and social dimensions of sustainability. Such improvements would advance sustainability initiatives for individuals, local administrations, and governments.

Recent studies on Turkish container ports consistently find MIP to have the highest operational performance due to its large area and high capacity utilization. Conversely, QTerminals has the lowest operational performance, showing a declining trend in efficiency according to Baştuğ (2023). Environmental performance rankings vary, with MIP ranking last in 2021 and 2022. Interestingly, Kumport and Borusan, lower in operational performance, top the environmental performance rankings, indicating a greater focus on environmental factors. Socar and Borusan lead in operational, environmental, and social dimensions, with Borusan's performance supported by Kaya et al. (2023). MIP ranks lowest in integrated (ESO) performance for both periods. These variations in performance highlight the need for further research on the strategies, policies, and decision-making mechanisms of each facility.

This study emphasizes the importance of evaluating the operational, environmental and social performance dimensions of ports in a integrated manner. Using publicly available data rather than subjective expert opinions ensures more objective results. The findings provide essential feedback for port management and help identify strengths and weaknesses in operational, environmental, and social performance. This can guide facility strategies and decision-making processes. Additionally, the study raises awareness among governments about sustainability policies and incentives. By employing the MULTIMOORA method, this research offers a practical and effective tool for performance evaluation, contributing to the literature and serving as a valuable decision-making resource for managers and policymakers.

This research is limited to Turkish container port facilities with published sustainability reports or data for 2021-2022, due to the unavailability of 2023 reports. The study assumes equal importance for all evaluation indicators. Future research could explore:

- In-depth investigations into challenges in sustainability reporting for Turkish container ports.
- Evaluating the performance of Turkish container port facilities by accessing all performance data; and comparing the results globally.
- Incorporation of indicator importance levels set by policymakers into performance analyses.
- Comparison of MULTIMOORA results with other methods to assess its effectiveness.
- Examining and comparing holistic sustainability performance across different port facility categories, including financial indicators.

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Compliance with Ethical Standards
It was declared by the author that the tools and methods used in the study do not require the permission of the Ethics Committee.

Ethical Statement

It was declared by the author that scientific and ethical principles have been followed in this study and all the sources used have been properly cited.

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