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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

LOGISTICS PERFORMANCE INDEX OF AFRICA: AN INDICATOR FOR TÜRKİYE AND AFRICA TRADE RELATIONS?

AFRİKA'NIN LOJİSTİK PERFORMANS ENDEKSİ: TÜRKİYE VE AFRİKA TİCARİ İLİŞKİLERİ İÇİN BİR GÖSTERGE Mİ?

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ABSTRACT

The logistics performance of countries is important in trade flows. As part of the supply chain process, logistics is the backbone of trade processes. In this direction, the Logistics Performance Index (LPI) put forward by the World Bank can be considered as an indicator. With the LPI, countries have the opportunity to evaluate the effectiveness of their activities in trade and logistics. The aim of the study is to rank and analyze African countries with the integrated Entropy-MOORA Reference Approach using the LPI values for 2023. In order to increase the depth of the study, an evaluation is made based on the trade data between Türkiye and African countries for 2022. The study aims to rank African countries on the basis of six criteria defined by the MOORA Reference Approach and to provide a perspective on the development of Türkiye's trade relations with African countries in line with trade figures. According to the results of the study, South Africa ranks first, Botswana second, and Libya last in the ranking of LPI countries. Türkiye's trade volume with the continent, South Africa ranks fifth, Botswana fifty-third, and Libya third. Therefore, there is no correlation between LPI and trade data in current situation.

Keywords: Logistic Performance Index, Türkiye, Africa, Trade, Entropi-MOORA.

JEL Classification Codes: N77, C60, O18.

ÖZ

Ülkelerin lojistik performansları ticari akış içerisinde önem arz etmektedir. Tedarik zinciri sürecinin bir parçası olan lojistik ticari süreçlerin bel kemiğini oluşturur. Bu doğrultuda Dünya Bankası tarafından ortaya konulan Lojistik Performans Endeksi (LPI) bir gösterge olarak kabul edilebilir. LPI ile ülkeler ticaret ve lojistik alanlarındaki faaliyetlerin etkinliğini değerlendirme imkanı elde ederler. Bu çalışmanın amacı 2023 yılı LPI değerlerini kullanarak bütünleşik Entropi-MOORA Referans Yaklaşımı ile Afrika ülkelerinin sıralamasını ve analizini yapmaktır. Çalışmanın derinliğini artırmak amacıyla Türkiye ve Afrika ülkeleri arasındaki 2022 yılına ait ticaret verileri de baz alınarak bir değerlendirme yapılmıştır. Çalışmada Afrika ülkelerinin MOORA Referans Yaklaşımı ile tanımlanan altı kriter temelinde sıralanması ve ticaret rakamları doğrultusunda Türkiye'nin Afrika ülkeleriyle ticari ilişkilerinin geliştirilmesi hususunda perspektif sunulmuştur. Çalışma sonuçlarına bakıldığında LPI ülkeler sıralamasında Güney Afrika birinci, Botswana ikinci iken Libya son sırada yer almaktadır. Türkiye'nin kıta ülkeleriyle ticaret hacminde ise Güney Afrika beşinci, Botsvana elli üçüncü iken Libya üçüncü sıradadır. Dolayısıyla mevcut durumda LPI ve ticaret verileri arasında korelasyon bulunamamıştır.

Anahtar Kelimeler: Lojistik Performans Endeksi, Türkiye, Afrika, Ticaret, Entropi-MOORA.

JEL Sınıflandırma Kodları: N77, C60, O18.

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GENİŞLETİLMİŞ ÖZET

Amaç ve Kapsam:

Bu çalışmada Türkiye ve Afrika ülkeleri ticari ilişkileri ve kıta ülkelerinin LPI verilerinin incelenmesiyle özgün bir tartışmanın oluşturulması hedeflenmiştir. Yapılan çalışmalara bakıldığında LPI ile Türkiye'nin özellikle de Afrika bağlamında karşılaştırmasının yapılmadığı görülmektedir. Bu çalışmanın amaçlarından birisi 2023 yılı için hesaplanan LPI değerlerini kullanarak bütünleşik Entropi-MOORA Referans Yaklaşımı ile, Afrika ülkelerinin bir sıralamasını ve analizini yapmaktır. Diğer amacı ise, ticari ilişkiler ve LPI arasındaki ilişkinin incelenmesi hedefi doğrultusunda Türkiye ve Afrika ülkeleri arasındaki ticaret incelenmiştir. Elde edilen sıralama ile yine 2022 yılı Türkiye-Afrika arasında gerçekleşen ticaret hacmi verilerini (TÜİK) dikkate alarak bir karşılaştırma yapmak ve Türkiye Afrika arasındaki lojistik ortamı farklı bir perspektiften değerlendirmektir. LPI endeksi, ülkelerin lojistik performanslarının iyileştirmeler ve zorluklar açısından değerlendirilmesini ve daha etkili lojistik politikaları geliştirmek için ülkeler arasında kıyaslama yapılmasını sağlamaktadır.

Yöntem:

Bu çalışmada Dünya Bankası'nın yayınlamış olduğu LPI'de yer alan 6 kriter kullanılarak Afrika Ülkelerinin Entropy tabanlı MOORA-Referans Nokta yaklaşımı ile değerlendirilmesi amaçlanmaktadır. Bu doğrultuda öncelikle LPI'de yer alan kriterler ve 30 Afrika ülkesi (alternatifler) dikkate alınarak çalışmanın karar matrisi oluşturulmuştur. Oluşturulan bu matris kullanılarak Entropy yöntemi ile kriter ağırlıkları hesaplanmıştır. Hesaplanan ağırlıklar bütünleşik olarak MOORA-Referans Nokta yaklaşımı ile sıralanmıştır. Daha sonra bu sıralama ile Türkiye- Afrika ülkeleri arasında 2022 yılında gerçekleşen ticaret hacmi verileri dikkate alınarak bir değerlendirme yapılmıştır. Çalışmada kullanılan ağırlıklandırma yöntemi objektif yöntemlerden seçilmiştir. Çünkü subjektif olmayan ve kendi iç normalleştirmesine sahip olan bu yöntem öznel ağırlıkları kullanan yöntemlerden daha güçlüdür. Çalışmada kullanılan bütünleştirilmiş yöntem ikilisi daha önce bu konu ile ilgili literatürde kullanılmadığı için tercih edilmiştir. MOORA-Referans Nokta yaklaşımı ise diğer yöntemlere nazaran daha az hesaplama zamanı, basit, daha az matematiksel işlem ve bunlara karşılık sonuçlarının daha güvenilir olması sebebiyle tercih edilmiştir. Aynı zamanda bu yöntem sadece nicel veri türünde kullanılmaktadır. Çalışma verileri de niceldir.

Bulgular:

Bu çalışmada LPI'yi oluşturan altı kriter objektif bir ağırlıklandırma yöntemi kullanılarak ağırlıklandırılmış ve buna bağlı olarak Afrika ülkelerin LPI sıralaması elde edilmiştir. Söz konusu kriterler; "Gümrük, Altyapı, Uluslararası Sevkiyatlar, Lojistik Kalite ve Yeterlilik, Takip ve İzleme ve Zamanındalık". Entropy yöntemi ile kriter ağırlıkları belirlenmiştir. Bu ağırlıklara göre kriterlerin önem sırası; Gümrük, Takip ve İzleme, Lojistik Kalite ve Yeterlilik, Altyapı, Zamanındalık ve Uluslararası Sevkiyatlar şeklinde belirlenmiştir. Gümrükler etkin kullanıldığında, gümrük kurumlarının hız, basitlik ve öngörülebilirlik açısından gümrük sevkiyat prosedürlerinin verimliliği ve etkinliği ortaya çıkmaktadır. Gümrük açısından düzenleyici politikalarda sağlanacak hız ve basitlik aslında dolaylı olarak zamanında teslimatı da etkilemektedir. Dolayısıyla iyi bir "Gümrük" skoru, "Zamanındalık" skoru üzerinde de büyük bir etki yapmakta ve onu problem olmaktan çıkarmaktadır. Entropy ve MOORA-Referans Nokta Yaklaşımı ile elde edilen Afrika ülkelerinin LPI endex değerlerine göre sıralaması da yapılmıştır. Bu sonuçlara göre Güney Afrika 0,000 puan ile ilk sırada ve 0,010 puan ile Botswana ikinci sırada yer alırken Libya 0,026 ağırlık puanı ile son sırada yer almaktadır

Sonuç ve Tartışma:

LPI, ülkelerin lojistik performanslarının değerlendirilmesini ve daha etkili lojistik politikaları geliştirmek için ülkeler arasında kıyaslama yapılmasını sağlamaktadır. LPI kullanılarak yapılan çalışmalar ile bu çalışma karşılaştırıldığında benzer ve farklı yönlerin olduğu görülmektedir. Yalçın ve Ayaz (2020)'nin Türkiye'ye komşu olan dört ülkenin LPI değerlerini inceledikleri çalışma sonuçlarına bakıldığında bu çalışma ile benzer sonuçlar sergilediği görülmektedir. Yapılan çalışmada 0,350 ağırlık puanı ile "Gümrük" skoru ilk sırada yer alırken 0,108 ağırlık puanı ile "Zamanındalık" skoru son sırada yer almaktadır. Yıldırım ve Mercangöz (2019), Ulutaş ve Karaköy (2019) ve Rezaei vd. (2018)'in yapmış oldukları çalışma sonuçlarına bakıldığında ise "Altyapı" skoru en önemli kriter iken bu çalışmada en önemsiz kriter olarak bulunmuştur. Mesic vd. (2022)'nin Batılı Balkan Ülkeleri üzerinde yapmış oldukları LPI sonuçlarına bakıldığında ise "Zamanındalık" skoru 0,207 ağırlık puanı ile ilk sırada yer alırken "Gümrük" skoru 0,119 ağırlık puanı ile son sırada yer almaktadır. Benzer sonuçlar da Isik vd. (2020)'nin Orta ve Doğu Avrupa Ülkeleri üzerine yapmış oldukları çalışmada görülmektedir. Çalışma sonuçlarına göre "Zamanındalık" skoru 0,200 ağırlık puanı ile ilk sırada, "Altyapı" skoru ise 0,106 ağırlık puanı ile son sırada yer almaktadır. Ozman (2019)'un OECD ülkeleriyle ilgili sıralamada kullandığı ağırlık değerlerine göre ise 0,430 ağırlık puanı ile "Lojistik Kalite ve Yeterlilik" skoru ilk sırada yer alırken "Gümrük" skoru 0,153 ağırlık puanı ile son sırada yer almaktadır. LPI endeksinde yer alan altı kriterin hesaplanan kriter ağırlıklarına bakıldığında farklı çalışmalarda farklı sonuçların ortaya çıktığı görülmektedir. Aslında bu sonuçların farklı çıkması çok doğaldır. Türkiye'nin Afrika ülkeleriyle olan ticaret hacmiyle LPI arasında, LPI verisi yüksek olan ülkelerle ticaret hacminin yüksek olduğu şeklinde orantı kurulamamıştır. LPI verisi yüksek olan ülkelerle ticari ilişkilerin daha kolay geliştirebileceği yargısı üzerinden hareket edilmektedir. Dolayısıyla Türkiye'nin Afrika ülkeleriyle ticari ilişkilerini geliştirme planı doğrultusunda LPI verisi yüksek ülkelerle ticaret hacmini artırması fırsat penceresi niteliği taşımaktadır.

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1. INTRODUCTION

The increase in global trade has led to logistics activities becoming an important tool in achieving strategic competitive advantage globally. The logistics sector, which helps facilitate activities related to the movement of goods in the supply chain, is one of the fastest growing sectors and has the capacity to influence the economic performance of countries. Measuring and assessing the logistics performance of countries can identify the strengths and weaknesses of logistics services along the supply chain, making it easier for them to achieve their economic goals of sustainable competitive advantage.

Logistics is a key element of trade and a country's logistics performance significantly affects the volume of bilateral trade. Logistics structure increases the competitiveness of countries. This has led to the need to develop a specific measurement system for logistics performance and strategies to improve country performance. Accordingly, the LPI, which expresses the logistics performance of countries, was first established in 2007. The LPI is based on interviews with stakeholders such as operators on the ground (global freight forwarders and carriers) who provide feedback on logistics. Operators' feedback is complemented by quantitative data on the performance of the key components of the logistics chain in the country. Threfore, the LPI consists of qualitative and quantitative measures and helps to create a logistics profile for these countries.

Trade, which reflects the course of relations between countries, is an influential factor on political and social relations. As a matter of fact, the development of trade relations is also considered a success in terms of international relations. In this direction, while increasing trade figures is emphasized in foreign policy goals, the development of economic relations is seen as one of the goals in high-level visits between countries and this situation is declared to the public. As government policies, orientations and preferences have short-term consequences as well as long-term effects. In terms of trade relations, studies have been conducted using quantitative data over the years. At this point, taking logistics processes into consideration reveals a different perspective and the capacity to develop commercial relations through LPI is evaluated.

Geographically, Africa ranks second after Asia among the continents with a surface area of 30 million km^2. In addition to the regional classification of the African continent as north, central, south, west and east, there is also a distinction between North and Sub-Saharan Africa. In the continent, where there are 54 independent countries in the world that have experienced the process of colonialism intensely, the decolonization process took place after the second world war, but its effects still continue. Natural resources play a major role in the economic development of African countries. In this respect, oil and natural gas are at the forefront, while exports of underground resources account for 70% of the continent's exports.

It is clear that political relations are one of the most important variables when analyzing trade relations between Türkiye and African countries. The deepening interest in the African continent in the 21st century makes it possible to open a window of economic relations. While the point from which trade relations have progressed in the period in question can be supported by statistical data, the background of the results that have emerged bears a meaning that needs to be explained. Among these, while it is an indicator of where we have come from in terms of numbers, it is also a matter of curiosity which countries have more intensive trade relations. It is obvious that Türkiye's trade relations vary by region. The figures reflect the intensity of trade relations with Egypt, Libya, Tunisia, Algeria and Morocco in the north of Africa. This can be explained by both the social ties built in the historical process and the geographical proximity factor. The development of Türkiye's relations with Sub-Saharan African countries is a result of the African opening in the last 25 years.

This article aims to create an original discussion by analyzing the trade relations between Türkiye and African countries and the LPI data of the countries of the continent. 2023 LPI data and 2022 trade volume between Türkiye and Africa were evaluated in line with the final data (TURKSTAT). One of the objectives of this study is to make a ranking and analysis of African countries with the integrated Entropy-MOORA Reference Approach using the calculated LPI values. The other objective is to examine the relationship between trade relations and LPI, and trade between Türkiye and African countries is analyzed.

2. TRADE RELATIONS BETWEEN TÜRKİYE AND AFRICAN COUNTRIES

The basic idea in international trade fis to sell what is not needed and buy what is needed. The expected contribution of the development of trade relations to the economies of the countries is progress in terms of employment, investment, technology transfer, product and service diversification. Trade is undoubtedly a key

component of economic growth and development. Trade also promotes social and political ties between countries and geographical location is decisive in the development of trade relations. Türkiye's more intensive trade relations with North African countries can be explained by this fact. In advancing trade relations between Türkiye and Africa, the emphasis is on Sub-Saharan Africa. The aim of the policy towards Africa is to increase Türkiye's influence in global politics and to diversify its economic relations (Duzgun, 2017, p. 8). While Türkiye's trade relations with African countries are limited to import and export figures, details such as sectors and product content are not included.

In the 21st century, relations between Türkiye and Africa have started to make progress. While this can be explained by Türkiye's foreign policy preferences, it can't be separated from its economic approach. In 1998, with the launch of the Africa Action Plan, the aim was to improve Türkiye's political, economic and social relations with African countries. However, in the circumstances of the period, it was only possible to accelerate relations with the declaration of 2005 as the Year of Africa. What is meant by Türkiye and Africa relations is mostly with countries in Sub-Saharan Africa. The declaration of Türkiye as a strategic partner by the African Union in 2008 led to the Africa Initiative policy. In 2013, with the adoption of the Africa partnership policy, relations had made significant progress. The emphasis on common bonds with African countries and a win-win approach are brought to the forefront in the discourse. The organization of presidential visits and the increase in the number of embassies are indicators of progress in political relations. Increased trade and investment reflected an improvement in economic relations. On the other hand, it can be said that steps taken in areas such as culture, health, education and transportation support the development of social relations. As a matter of fact, the intensification of relations in the social sphere facilitates the development of relations in other areas. As a result, Türkiye's relations with African countries are carried out at a multidimensional level.

Turkish businesses do foreign trade mostly with North African countries due to geographical proximity and market size (Palacıoğlu, 2021, p. 207). In trade towards the continent, businesses generally work in the form of delivery on board (FOB) in Türkiye after the products reach the relevant party. Threfore, the distribution policy is determined by the recipient/intermediary African enterprises. This leads to short-term relationships, and since the buyer makes a price-based evaluation, it leads to a change of supplier as soon as it finds an alternative that offers a favorable price (Palacıoğlu, 2021, p. 212-213). Maritime transportation stands out in Türkiye's trade with African countries. The additional documents, reports, surveillance company procedures and costs required in foreign trade, and the collection of taxes based on the prices of European peer products with the reference price practice harm the price advantage of Turkish products (Palacıoğlu, 2021, p. 214). Costs, product features and reliability are also critical considerations for Turkish businesses (Duzgun, 2017, p. 123). It also shows that businesses working towards Africa are at the beginning of the internationalization process.

In 2021 and 2022, Ethiopia, Morocco, South Africa, Kenya, Libya, Libya, Egypt, Nigeria were included in the list of countries to be provided export support in foreign trade in order to find alternative markets, while in 2023, the list was expanded and included Angola, Ethiopia, Morocco, Ivory Coast, Ghana, South Africa, Kenya, Democratic Republic of Congo, Egypt, Mozambique, Nigeria, Senegal, Sudan (T.C. Ticaret Bakanlığı, 2022). In terms of investments, Turkish enterprises have chosen Egypt and Algeria in North Africa and South Africa in Sub-Saharan Africa as their bases (Palacıoğlu, 2021, p. 208). When it comes to Türkiye's product and country image in trade, historically Türkiye has a positive perception across the continent.

The level of trade between Africa and the rest of the world has increased by 200% since 2000, largely due to economic reforms in African countries (Duzgun, 2017, p. 53). Türkiye's motivation to develop its trade relations with the African continent includes the idea of diversifying its economic partners on a global scale. In 2003 strategy of developing economic relations with Africa is critical for Türkiye's relations with Africa. Algeria, Angola, Democratic Republic of Congo, Egypt, Ghana, Kenya, Mozambique, Nigeria, South Africa and Tanzania are seen as hot spots in the logistics flow to encourage investments by small and medium-sized Turkish enterprises in Africa (PWC, 2013).

Table 1 shows the export and import figures between Türkiye and African countries in 2022. Trade figures with North African countries are higher than with Sub-Saharan African countries. Among Sub-Saharan African countries, exports and imports with South Africa seem to diverge. In this study, trade relations are analyzed quantitatively. Which sector is at the forefront qualitatively can be addressed in a separate study. It should also be kept in mind that Türkiye is in competition with countries outside the region in the development of trade relations across Africa.

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Table 1. Türkiye and Africa Trade Data for 2022

Country	Export ($)	Import ($)	Total ($)
Egypt	4,052,807,746	2,331,113,283	6,383,921,029
Morocco	2,977,543,390	986,505,891	3,964,049,281
Libya	2,632,763,757	720,351,849	3,353,115,606
Algeria	1,920,020,434	1,308,350,078	3,228,370,512
South Africa	1,684,034,353	1,453,446,933	3,137,481,286
Tunisia	1,453,462,707	260,323,878	1,713,786,585
Nigeria	736,205,859	93,201,307	829,407,166
Ivory Coast	397,052,562	319,672,166	716,724,728
Senegal	629,351,914	17,377,139	646,729,053
Sudan	428,033,687	187,946,929	615,980,616
Ghana	415,707,461	112,595,278	528,302,739
Mauritania	206,128,319	285,193,528	491,321,847
Djibouti	406,888,732	811,436	407,700,168
Somalia	379,663,982	2,579,124	382,243,106
Tanzania	302,574,551	37,807,860	340,382,411
Ethiopia	316,264,261	18,263,416	334,527,677
Kenya	278,654,245	16,422,039	295,076,284
Cameroon	212,561,237	64,810,037	277,371,274
Liberia	219,858,272	15,075,918	234,934,190
Angola	215,005,154	15,465,188	230,470,342
Togo	183,501,308	11,931,340	195,432,648
Benin	162,633,858	19,965,413	182,599,271
Guinea	160,166,791	20,895,293	181,062,084
Chad	67,740,694	106,675,858	174,416,552
Mali	103,628,679	56,502,300	160,130,979
Niger	130,932,603	23,234,980	154,167,583
Burkina Faso	126,446,103	27,012,970	153,459,073
Rwanda	144,211,539	7,404,666	151,616,205
Mozambique	80,018,069	62,677,904	142,695,973
Sierra Leone	120,909,012	1,840,081	122,749,093
Congo	108,056,316	8,816,624	116,872,940
Democratic Republic of Congo	93,715,637	12,832,757	106,548,394
Mauritius	97,322,128	1,264,990	98,587,118
Madagascar	77,200,392	19,371,078	96,571,470
Gabon	69,500,415	22,005,111	91,505,526
Uganda	61,981,196	27,205,044	89,186,240
Gambia	63,811,868	5,951,678	69,763,546
Zambia	24,769,947	23,328,037	48,097,984
Eritrea	41,874,103	76,042	41,950,145
Comoros	20,951,170	17,958,060	38,909,230
Equatorial Guinea	32,960,189	3,522,259	36,482,448
Zimbabwe	19,919,997	15,863,502	35,783,499

Country	Export ($)	Import ($)	Total ($)
Malawi	4,894,679	26,076,806	30,971,485
Seychelles	12,812,473	16,720,486	29,532,959
Namibia	17,187,980	426,572	17,614,552
South Sudan	15,682,173	677	15,682,850
Mayotte	13,335,674	1,773	13,337,447
Cabo Verde	9,565,616	5,461	9,571,077
Central African Republic	3,452,601	5,852,589	9,305,190
Guinea Bissau	8,436,271	376,160	8,812,431
Burundi	8,531,432	78,209	8,609,641
Sao Tome ve Principe	5,363,733	80,925	5,444,658
Botswana	3,561,012	9,304	3,570,316
Esvatini	290,033	56,923	346,956
Lesotho	143,780	29,186	172,966
TOTAL	21,960,092,094	8,793,364,335	30,753,456,429

Source: (TÜİK, 2022).

Criteria such as cost, product features, reliability, speed and security stand out in Türkiye's trade with African countries. Moreover, the development of trade relations between Türkiye and African countries depends on transportation costs and logistics infrastructure. Logistics plays an important role in the development of foreign trade. With the development of trade between Türkiye and Africa, a roadmap will be needed to address technical barriers. Good logistics performance leads to increased economic efficiency. LPI is an important factor for the development of relationships. Apart from this, trade relations of African countries with countries outside the region are also important as a factor. On the other hand, government policies, the economic situation and taxation are also important. A high LPI can be seen as a window of opportunity. For countries wishing to develop international trade, import and export products can also be considered as a separate topic. At this point, tariff policies, regulations, customs and import controls implemented by governments also come to the fore.

3. LOGISTICS PERFORMANCE INDEX

The LPI was first published in 2007 and continues publishing by the World Bank approximately every two years in 2010, 2012 and 2014. The LPI is used by businesses to identify challenges and opportunities related to the host country's transportation infrastructure, logistics competence and the availability of efficient supply chains, enabling comparisons across 160 countries. In this context, the LPI is a useful indicator of a host country's trade logistics performance and also a benchmark when selecting locations for various types of operations. This is one of the main reasons why countries tend to focus on their rankings rather than improvements in the LPI's actual indicator values (Ojala & Çelebi 2015, p. 7). In this title, studies using LPI are presented. The LPI assesses each country in six different categories (Kim and Min 2011, p. 1170). First one is Customs. It is about efficiency of the customs clearance process, speed, simplicity and predictability of border control agencies/customs procedures. Second is Infrastructure. It reflects the quality of trade and transportation-related infrastructure such as ports, railways and information technology. Thirdly, International Shipments is ease of arranging competitively priced shipments. Fourth one is Logistics Quality and Competence. It is evaluated in terms of the adequacy and quality of logistics services provided by transport operators and customs brokers. Fifthly with Tracking and Tracing, it is possible the ability to track and monitor shipment. The last one Timeliness is about the frequency of shipments reaching recipients within planned or expected timeframes.

When LPI studies are examined, it is seen that Multi-Criteria Decision Making (MCDM) methods are frequently used. In this section, studies using LPI are included. İris & Tanyaş (2011) statistically analyzed the Turkish logistics sector in terms of each transportation mode and logistics activity. The analysis phase is based on three basic frameworks, namely flows, infrastructure and modal splits. The issues from the analysis phase were clustered according to the criteria listed in the 2010 LPI. Solutions to the problems that arise and can be reflected in each cluster are selected using the AHP method, taking into account a set of performance factors. Kim and Min (2011)

aim to examine whether some countries achieve logistics efficiency at the expense of environmental quality. In the study, the Green Logistics Performance Index (GLPI), a hybrid index of LPI and Environmental Performance Index (EPI), was created. Güner and Coşkun (2012) examined the relationship between logistics development measured by LPI and other economic and social factors, taking into account 26 OECD members. Martí et al. (2014) examined the impact of each of the LPI criteria on the trade of developing countries using a gravity model. Possible developments in the field of logistics in developing countries divided into five regions (Africa, South America, Far East, Middle East and Eastern Europe) were tried to be identified. The results suggest that improvement in any component of the LPI can lead to significant growth in a country's trade flows.

In particular, LPI components are becoming increasingly important for international trade in many countries in Africa, South America and Eastern Europe. Ojala and Çelebi (2015) provide a qualitative assessment of the trade and transportation policy environment through a case study on Türkiye. It provides an analysis of the country's logistics performance in relation to the policy components affecting trade and logistics regulations, procedures and operations. In their study Ünalan and Yapraklı (2016) examined the structure of the logistics sector in Türkiye and aimed to make an economic analysis of the sector and to reveal Türkiye's potential on a global scale. For this purpose, Türkiye's performance for the last 10 years is analyzed based on the LPI. In addition, another objective of the study is to reveal the situation of leading countries through global LPI reports and to make comparisons between countries. Uca et al. (2016) analyzed the mediating effect of LPI on the relationship between Corruption Perception Index (CPI) and Foreign Trade Volume (FTV) for the years 2007, 2010, 2012, 2014. Regression analysis method was used in the study. According to the results of the analysis, it can be said that a country's logistics capability triggers the relationship between corruption and foreign trade volume. Khan et al. (2017) examines the long-run and causal relationship between Environmental Logistics Performance Indicators (ELPI) and growth-specific factors in a panel of 15 selected global logistics countries over the period 2007-2015. Two factors play a role in country selection. The first are the top-ranked global logistics countries, which have maintained a significant share of their GDP growth over the last decade thanks to their travel and transport logistics infrastructure. The second is countries that spend their considerable profits to reduce environmental problems that could hinder their economic growth. Rezaei et al. (2018) provide an extensive literature review on LPI index studies. In addition, with the BWM method, 107 experts from different sectors were surveyed online to evaluate the criteria weights in the LPI. Looking at the weights, it is seen that the "infrastructure" criterion is the most important.

Liu et al. (2018) analyzed the link between logistics performance and environmental degradation using data from 42 Asian countries between 2007 and 2016. The system Generalized Method of Moments (GMM) regression model is used to examine data from Asian countries and four sub-regions of Asia in aggregate. The study found that logistics performance is significantly related to environmental degradation. La and Song (2019) statistically analyzed the impact of trade on the top 20 exporting Northeast Asian countries using the LPI on trade facilitation based on gravity model estimations. Ulutaş and Karaköy (2019) integrated two methods, SWARA and CRITIC, in determining the criteria weights and analyzed European Union countries. Yıldırım & Mercangöz (2019) analyzed the LPI of OECD countries with fuzzy AHP and ARAS-G methods. In this study, "infrastructure" was found to be the most important component of LPI. Acar and Benli (2021) tried to determine the effect of LPI on export and import volume with panel data models.

The empirical findings from different models strongly confirm that exports increase with an increase in logistics sector performance both in developed countries and in low and medium development countries. On the other hand, imports are not affected by LPI for both country groups. It also reveals that the relationship between the logistics sector and exports is stronger in low and middle income countries than in developed countries. Mešić et al. (2022) conducted LPI analysis and ranking of the countries in the Western Balkans with the integrated CRITIC and MARCOS methods. According to the study results, the most important criterion in weighting is "timeliness". Serbia ranks first in the country ranking. Göçer et al. (2022) developed a methodological framework to analyze the logistics strategies of specific countries and their impact on LPI scores and to recommend policies to improve the LPI scores of these countries.

4. METHODOLOGY

4.1. Entropy Method

Entropy was first developed by Rudolph in 1865 in the field of thermodynamics. It was later used as a measure of uncertainty in the Theory of Mathematical Communication by Claude E. Shannon in 1948 (Uludağ, 2021: p. 393). Criteria weights can be determined subjectively or objectively in a decision problem. The entropy method makes objective weighting based on the characteristics of the alternatives themselves. Weighting the criteria equally or by taking expert opinion is a subjective method based on the opinions of decision makers. The entropy method is an objective method that does not depend on the opinions of decision makers. The entropy method increases the reliability and objectivity of the analysis when weighting criteria. The steps of the method are as follows (Wu et al., 2011, p. 5163; Ayçin, 2018, p. 601-603; Topal, 2021, p. 537-538):

Phase 1: In this first step of the method, a decision matrix (E) is created using m options and n criteria.

$$E = |X_{ij}| = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ . & . & \dots & . \\ . & . & \dots & . \\ . & . & \dots & . \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix}, i = 1, 2, \dots, m \text{ and } j = 1, 2, \dots, n \quad (1)$$

Phase 2: At this stage, the E matrix created above is normalized. This is done using Equation 2 without distinguishing between the benefit and cost functions of the criteria. A normalized decision matrix is then created.

$$r_{ij} = \frac{a_{ij}}{\sum_{i=1}^{m} a_{ij}} \quad , i = 1, 2, 3, \dots, m \text{ and } j = 1, 2, 3, \dots, n \quad (2)$$

Phase 3: At this stage, Entropy values (e_j) for the criteria are calculated. These values should lie between $0 \leq e_j \leq 1$.

$$e_j = -k \sum_{j=1}^{n} r_{ij} \ln(r_{ij}) \ , i = 1, 2, 3, \dots, m \text{ and } j = 1, 2, 3, \dots, n$$

Phase 4: At this stage, the degree of differentiation of information (e_j) is determined. The higher the d_j values obtained, the more intense the contrast between the alternative values for the criteria.

$$dj = 1 - ej, i = 1, 2, 3, \dots, m \text{ and } j = 1, 2, 3, \dots, n$$

Phase 5: At this stage, Entropy weights (w_j) of the criteria are determined. In this case the equality $w_1 + w_2 + w_3 + \dots + w_j = 1$ must be satisfied. Therefore, the sum of the weights must be 1.

4.2. MOORA-Reference Point Approach

The MOORA method was developed in 2006 by Willem Karel M. Brauers and Edmundas Kazimieras Zavadskas. The MOORA Method is defined as the simultaneous optimization of two or more conflicting objectives subject to certain constraints in multi-objective optimization or programming (Chakraborty, 2011, p. 1156). The method starts the analysis with a matrix of different alternatives for various objectives to which ratio analysis is applied.

In the MOORA Reference Point Approach, after determining the normalized performance values, maximum and minimum reference points are determined in addition to the ratio method. Depending on these points, the result is obtained. The steps of the method are as follows (Brauers& Zavadskas, 2006, p. 447-448; Önay, 2014, p. 248):

Phase 1: In the MOORA-Reference Point Approach, firstly, a decision matrix (E) with m alternatives and n criteria is created like Equation 1 in the first step of the Entropy method.

Phase 2: At this stage, normalization of the E matrix is done with Equation 3. The matrix is normalized by dividing each value by the square root of the sum of squares of the values of the column in which it is located. Afterwards, a normalized decision matrix is created.

$$x_{ij}^{*} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^{2}}} \quad (3)$$

Phase 3: At this stage, reference values ($d_{ij} = (|r_j - x_{ij}^*|)$ are determined by considering the normalized decision matrix. The highest values for each objective of all candidate alternatives for maximization and the lowest values for minimization are selected as the reference point (r_j). At this point, if the weights of the criteria are to be used, the normalized values are multiplied by the criteria weights. In this way, a weighted normalized decision matrix is created. "Tchebycheff Min-Max Metric" process is applied to the new matrix and ranking is obtained with Equation 4.

$$mini\{maxj(|w_j r_j - w_j x_{ij}^*|)\} \quad (4)$$

4.3. Application

In this study, it is aimed to evaluate African Countries with Entropy-based MOORA-Reference Point approach by using 6 criteria in the LPI published by the World Bank. In this direction, firstly, the decision matrix of the study is created by considering the criteria in the LPI and 30 African countries. Using this matrix, criteria weights are calculated by Entropy method. The calculated weights are ranked using the integrated MOORA-Reference Point approach. Then, an evaluation is made by taking into account this ranking and the trade volume data realized between Türkiye and African countries in 2022.

The weighting method used in the study is selected from objective methods. Because this method, which is non-subjective and has its own internal normalization, is more powerful than methods that use subjective weights. The integrated method duo used in the study is preferred since it has not been used in the literature on this subject before. The point approach is preferred because it is less computation time, simpler, less mathematical, and more reliable than other methods. The use of this method only for quantitative data is another reason for preference.

4.3.1. Weighting With Entropy Method

Entropy method, one of the objective methods, is used to find the criteria weights. The decision matrix, which is the first step of the method, is taken from LPI as shown in Table 2.

Table 2. Decision Matrix

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
South Africa	3.8	3.8	3.8	3.3	3.6	3.6
Botswana	3.4	3.3	3.0	3	3.1	3
Egypt	2.9	3.6	2.9	2.8	3	3.2
Benin	3.0	2.7	3.2	2.7	2.5	2.9
Namibia	2.9	2.9	2.8	2.8	2.8	3
Rwanda	3.0	3.1	3.0	2.5	2.9	2.4
Djibouti	2.8	3.6	2.7	2.6	2.3	2.5
Congo, Rep.	2.9	2.9	2.7	2.3	2.1	2.6
Guinea-Bissau	2.9	2.4	2.3	2.7	2.4	2.9
Mali	2.5	3.1	2.7	2.6	2	2.6
Nigeria	2.3	3.1	2.7	2.4	2.4	2.5
Algeria	2.2	2.6	2.5	2.3	2.1	3
Central African Rep.	2.9	2.6	2.4	2.4	2.6	2.1
Congo, Dem. Rep.	2.4	2.8	2.5	2.3	2.3	2.5
Ghana	2.5	2.7	2.2	2.7	2.4	2.4
Guinea	2.7	2.5	2.7	2.4	2.4	2.2
Mauritius	2.5	3.1	2.9	2.4	2.5	1.9
Togo	2.4	2.8	2.3	2.3	2.3	3
Zimbabwe	2.3	2.8	2.7	2.2	2.4	2.5
Gabon	2.0	3.0	2.5	2	2.2	2.6

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
Liberia	2.4	2.3	2.4	2.1	2.4	2.8
Sudan	2.4	2.7	2.3	2.1	2.3	2.4
Burkina Faso	2.4	2.4	2.2	2	2.3	2.4
Gambia	2.3	2.6	2.4	1.8	2.3	2.6
Madagascar	2.2	2.6	2.0	1.8	1.8	2.9
Mauritania	2.5	2.8	2.5	2.1	2	2.2
Angola	2.3	2.1	2.3	1.7	2.1	2.4
Cameroon	2.1	2.1	1.8	2.1	2.1	2.2
Somalia	1.8	2.3	1.8	1.5	1.9	2.4
Libya	1.9	2.2	1.8	1.9	1.7	2
Total	**76.6**	**83.5**	**76.0**	**69.8**	**71.2**	**77.7**

After the creation of the decision matrix, the normalized decision matrix is calculated using Equation 2 and given in Table 3. In this method, the normalization process does not differ according to the benefit or cost characteristics of the criteria. In this step, after the column sums are calculated, each value in the decision matrix is normalized by dividing it by the column sum, for example South Africa's Logistics Competence and Quality score in the normalized decision matrix.

$$r_{ij}=\frac{a_{ij}}{\sum_{i=1}^{m} a_{ij}} = \frac{3{,}8}{76{,}6} = 0{,}050$$

Table 3. Normalized Decision Matrix

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
South Africa	0.050	0.046	0.050	0.047	0.051	0.046
Botswana	0.044	0.040	0.039	0.043	0.044	0.039
Egypt	0.038	0.043	0.038	0.040	0.042	0.041
Benin	0.039	0.032	0.042	0.039	0.035	0.037
Namibia	0.038	0.035	0.037	0.040	0.039	0.039
Rwanda	0.039	0.037	0.039	0.036	0.041	0.031
Djibouti	0.037	0.043	0.036	0.037	0.032	0.032
Congo, Rep.	0.038	0.035	0.036	0.033	0.029	0.033
Guinea-Bissau	0.038	0.029	0.030	0.039	0.034	0.037
Mali	0.033	0.037	0.036	0.037	0.028	0.033
Nigeria	0.030	0.037	0.036	0.034	0.034	0.032
Algeria	0.029	0.031	0.033	0.033	0.029	0.039
Central African Rep.	0.038	0.031	0.032	0.034	0.037	0.027
Congo, Dem. Rep.	0.031	0.034	0.033	0.033	0.032	0.032
Ghana	0.033	0.032	0.029	0.039	0.034	0.031
Guinea	0.035	0.030	0.036	0.034	0.034	0.028
Mauritius	0.033	0.037	0.038	0.034	0.035	0.024
Togo	0.031	0.034	0.030	0.033	0.032	0.039
Zimbabwe	0.030	0.034	0.036	0.032	0.034	0.032
Gabon	0.026	0.036	0.033	0.029	0.031	0.033
Liberia	0.031	0.028	0.032	0.030	0.034	0.036
Sudan	0.031	0.032	0.030	0.030	0.032	0.031

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
Burkina Faso	0.031	0.029	0.029	0.029	0.032	0.031
Gambia	0.030	0.031	0.032	0.026	0.032	0.033
Madagascar	0.029	0.031	0.026	0.026	0.025	0.037
Mauritania	0.033	0.034	0.033	0.030	0.028	0.028
Angola	0.030	0.025	0.030	0.024	0.029	0.031
Cameroon	0.027	0.025	0.024	0.030	0.029	0.028
Somalia	0.023	0.028	0.024	0.021	0.027	0.031
Libya	0.025	0.026	0.024	0.027	0.024	0.026

After the normalized decision matrix is created, the entropy value of all criteria is determined. Entropy values are calculated by multiplying each value in Table 3 by its logarithm value. Then, the entropy values (e_j) of all criteria are calculated by taking the column sums. By subtracting each calculated entropy value from 1, the "$1 - ej$" value expressing the degree of differentiation of information is found. Finally, the weights of the criteria were calculated by dividing the "$1 - e_j$" values by the row sum of the "$1 - e_j$" values. All these calculated values are given in Table 4.

Table 4. Entropy Values of the Criteria

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
South Africa	-0.149	-0.141	-0.150	-0.144	-0.151	-0.142
Botswana	-0.138	-0.128	-0.128	-0.135	-0.136	-0.126
Egypt	-0.124	-0.136	-0.125	-0.129	-0.133	-0.131
Benin	-0.127	-0.111	-0.133	-0.126	-0.118	-0.123
Namibia	-0.124	-0.117	-0.122	-0.129	-0.127	-0.126
Rwanda	-0.127	-0.122	-0.128	-0.119	-0.130	-0.107
Djibouti	-0.121	-0.136	-0.119	-0.123	-0.111	-0.111
Congo, Rep.	-0.124	-0.117	-0.119	-0.112	-0.104	-0.114
Guinea-Bissau	-0.124	-0.102	-0.106	-0.126	-0.114	-0.123
Mali	-0.112	-0.122	-0.119	-0.123	-0.100	-0.114
Nigeria	-0.105	-0.122	-0.119	-0.116	-0.114	-0.111
Algeria	-0.102	-0.108	-0.112	-0.112	-0.104	-0.126
Central African Rep.	-0.124	-0.108	-0.109	-0.116	-0.121	-0.098
Congo, Dem. Rep.	-0.109	-0.114	-0.112	-0.112	-0.111	-0.111
Ghana	-0.112	-0.111	-0.103	-0.126	-0.114	-0.107
Guinea	-0.118	-0.105	-0.119	-0.116	-0.114	-0.101
Mauritius	-0.112	-0.122	-0.125	-0.116	-0.118	-0.091
Togo	-0.109	-0.114	-0.106	-0.112	-0.111	-0.126
Zimbabwe	-0.105	-0.114	-0.119	-0.109	-0.114	-0.111
Gabon	-0.095	-0.120	-0.112	-0.102	-0.107	-0.114
Liberia	-0.109	-0.099	-0.109	-0.105	-0.114	-0.120
Sudan	-0.109	-0.111	-0.106	-0.105	-0.111	-0.107
Burkina Faso	-0.109	-0.102	-0.103	-0.102	-0.111	-0.107
Gambia	-0.105	-0.108	-0.109	-0.094	-0.111	-0.114
Madagascar	-0.102	-0.108	-0.096	-0.094	-0.093	-0.123
Mauritania	-0.112	-0.114	-0.112	-0.105	-0.100	-0.101

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
Angola	-0.105	-0.093	-0.106	-0.090	-0.104	-0.107
Cameroon	-0.099	-0.093	-0.089	-0.105	-0.104	-0.101
Somalia	-0.088	-0.099	-0.089	-0.083	-0.097	-0.107
Libya	-0.092	-0.096	-0.089	-0.098	-0.089	-0.094
$\mathbf{e_j}$	0.996	0.997	0.996	0.996	0.996	0.997
$\mathbf{d_j = 1- e_j}$	0.004	0.003	0.004	0.004	0.004	0.003
$\mathbf{w_j}$	**0.178**	**0.148**	**0.180**	**0.190**	**0.171**	**0.133**

4.3.2. Criteria Ranking With MOORA-Reference Point Approach

In this section, the weights obtained with the Entropy method are integrated into the MOORA-Reference Point Approach to rank 30 African countries. Using the decision matrix in Table 2, the steps of the method are applied respectively. First, the decision matrix is normalized. Table 3 is not used because the normalization process is different from the normalization process in the Entropy method. The normalized decision matrix created with the help of Equation 3 is shown in Table 5.

This step calculates the sum of squares of the columns. Each value in the decision matrix is then normalized by dividing it by the square root of the sum of squares of the column values in which it is located such as South Africa's Logistics Competence and Quality score in the normalized decision matrix.

$$x_{ij}^{*} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^{2}}} = \frac{3{,}8}{\sqrt{201{,}08}} = 0{,}268$$

Table 5. Normalized Decision Matrix

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
South Africa	0.268	0.246	0.270	0.255	0.273	0.251
Botswana	0.240	0.214	0.213	0.232	0.235	0.209
Egypt	0.205	0.233	0.206	0.217	0.228	0.223
Benin	0.212	0.175	0.227	0.209	0.190	0.202
Namibia	0.205	0.188	0.199	0.217	0.213	0.209
Rwanda	0.212	0.201	0.213	0.193	0.220	0.167
Djibouti	0.197	0.233	0.192	0.201	0.175	0.174
Congo, Rep.	0.205	0.188	0.192	0.178	0.159	0.181
Guinea-Bissau	0.205	0.156	0.163	0.209	0.182	0.202
Mali	0.176	0.201	0.192	0.201	0.152	0.181
Nigeria	0.162	0.201	0.192	0.186	0.182	0.174
Algeria	0.155	0.169	0.178	0.178	0.159	0.209
Central African Rep.	0.205	0.169	0.171	0.186	0.197	0.147
Congo, Dem. Rep.	0.169	0.182	0.178	0.178	0.175	0.174
Ghana	0.176	0.175	0.156	0.209	0.182	0.167
Guinea	0.190	0.162	0.192	0.186	0.182	0.154
Mauritius	0.176	0.201	0.206	0.186	0.190	0.133
Togo	0.169	0.182	0.163	0.178	0.175	0.209
Zimbabwe	0.162	0.182	0.192	0.170	0.182	0.174
Gabon	0.141	0.195	0.178	0.155	0.167	0.181
Liberia	0.169	0.149	0.171	0.162	0.182	0.195

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
Sudan	0.169	0.175	0.163	0.162	0.175	0.167
Burkina Faso	0.169	0.156	0.156	0.155	0.175	0.167
Gambia	0.162	0.169	0.171	0.139	0.175	0.181
Madagascar	0.155	0.169	0.142	0.139	0.137	0.202
Mauritania	0.176	0.182	0.178	0.162	0.152	0.154
Angola	0.162	0.136	0.163	0.132	0.159	0.167
Cameroon	0.148	0.136	0.128	0.162	0.159	0.154
Somalia	0.127	0.149	0.128	0.116	0.144	0.167
Libya	0.134	0.143	0.128	0.147	0.129	0.140

After the normalized decision matrix is obtained, the weighted normalized decision matrix is obtained using the weights calculated in Table 4 as shown in Table 6. For example, South Africa's weighted Logistics Competence and Quality score is calculated as $0.178 * 0.268 = 0.0477$. After that the reference values of the criteria were determined.

Table 6. Weighted Normalized Matrix and Reference Values

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
South Africa	0.0477	0.0366	0.0486	0.0485	0.0467	0.0334
Botswana	0.0427	0.0318	0.0384	0.0441	0.0402	0.0279
Egypt	0.0364	0.0346	0.0371	0.0411	0.0389	0.0297
Benin	0.0376	0.0260	0.0409	0.0397	0.0324	0.0269
Namibia	0.0364	0.0279	0.0358	0.0411	0.0363	0.0279
Rwanda	0.0376	0.0298	0.0384	0.0367	0.0376	0.0223
Djibouti	0.0351	0.0346	0.0345	0.0382	0.0298	0.0232
Congo, Rep.	0.0364	0.0279	0.0345	0.0338	0.0272	0.0241
Guinea-Bissau	0.0364	0.0231	0.0294	0.0397	0.0311	0.0269
Mali	0.0314	0.0298	0.0345	0.0382	0.0259	0.0241
Nigeria	0.0289	0.0298	0.0345	0.0353	0.0311	0.0232
Algeria	0.0276	0.0250	0.0320	0.0338	0.0272	0.0279
Central African Rep.	0.0364	0.0250	0.0307	0.0353	0.0337	0.0195
Congo, Dem. Rep.	0.0301	0.0269	0.0320	0.0338	0.0298	0.0232
Ghana	0.0314	0.0260	0.0281	0.0397	0.0311	0.0223
Guinea	0.0339	0.0241	0.0345	0.0353	0.0311	0.0204
Mauritius	0.0314	0.0298	0.0371	0.0353	0.0324	0.0176
Togo	0.0301	0.0269	0.0294	0.0338	0.0298	0.0279
Zimbabwe	0.0289	0.0269	0.0345	0.0323	0.0311	0.0232
Gabon	0.0251	0.0289	0.0320	0.0294	0.0285	0.0241
Liberia	0.0301	0.0221	0.0307	0.0308	0.0311	0.0260
Sudan	0.0301	0.0260	0.0294	0.0308	0.0298	0.0223
Burkina Faso	0.0301	0.0231	0.0281	0.0294	0.0298	0.0223
Gambia	0.0289	0.0250	0.0307	0.0264	0.0298	0.0241
Madagascar	0.0276	0.0250	0.0256	0.0264	0.0233	0.0269
Mauritania	0.0314	0.0269	0.0320	0.0308	0.0259	0.0204
Angola	0.0289	0.0202	0.0294	0.0250	0.0272	0.0223

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score
Cameroon	0.0264	0.0202	0.0230	0.0308	0.0272	0.0204
Somalia	0.0226	0.0221	0.0230	0.0220	0.0246	0.0223
Libya	0.0238	0.0212	0.0230	0.0279	0.0220	0.0186
Referance	**0.0477**	**0.0366**	**0.0486**	**0.0485**	**0.0467**	**0.0334**

In this method, the best value is taken as a reference in the case of maximization and the worst value is taken as a reference in the case of minimization of the decision options according to each criterion. Since all of the criteria in the matrix have maximization objectives, the highest values of all candidate alternatives for each objective are selected as the reference point (r_j). A weighted normalized decision matrix is presented in Table 6. By applying Equation 4 to this matrix, the performance values and ranking of the countries are obtained as shown in Table 7. For example, South Africa's distance to the reference point of the Logistics Competence and Quality criterion is calculated as $|0.0477 - 0.0477| = 0$.

Table 7. Performance Values and Ranking

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastr ucture Score	International Shipments Score	Yi Score	Ranking
South Africa	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1
Botswana	0.005	0.005	0.010	0.004	0.006	0.006	0.010	2
Egypt	0.011	0.002	0.012	0.007	0.008	0.004	0.012	3
Benin	0.010	0.011	0.008	0.009	0.014	0.006	0.014	6
Namibia	0.011	0.009	0.013	0.007	0.010	0.006	0.013	5
Rwanda	0.010	0.007	0.010	0.012	0.009	0.011	0.012	4
Djibouti	0.013	0.002	0.014	0.010	0.017	0.010	0.017	9
Congo, Rep.	0.011	0.009	0.014	0.015	0.019	0.009	0.019	10
Guinea-Bissau	0.011	0.013	0.019	0.009	0.016	0.006	0.019	15
Mali	0.016	0.007	0.014	0.010	0.021	0.009	0.021	22
Nigeria	0.019	0.007	0.014	0.013	0.016	0.010	0.019	13
Algeria	0.020	0.012	0.017	0.015	0.019	0.006	0.020	19
Central African Rep.	0.011	0.012	0.018	0.013	0.013	0.014	0.018	11
Congo, Dem. Rep.	0.018	0.010	0.017	0.015	0.017	0.010	0.018	18
Ghana	0.016	0.011	0.020	0.009	0.016	0.011	0.020	20
Guinea	0.014	0.013	0.014	0.013	0.016	0.013	0.016	7
Mauritius	0.016	0.007	0.012	0.013	0.014	0.016	0.016	8
Togo	0.018	0.010	0.019	0.015	0.017	0.006	0.019	16
Zimbabwe	0.019	0.010	0.014	0.016	0.016	0.010	0.019	14
Gabon	0.023	0.008	0.017	0.019	0.018	0.009	0.023	25
Liberia	0.018	0.014	0.018	0.018	0.016	0.007	0.018	12
Sudan	0.018	0.011	0.019	0.018	0.017	0.011	0.019	17
Burkina Faso	0.018	0.013	0.020	0.019	0.017	0.011	0.020	21
Gambia	0.019	0.012	0.018	0.022	0.017	0.009	0.022	24
Madagascar	0.020	0.012	0.023	0.022	0.023	0.006	0.023	26
Mauritania	0.016	0.010	0.017	0.018	0.021	0.013	0.021	23
Angola	0.019	0.016	0.019	0.024	0.019	0.011	0.024	27
Cameroon	0.021	0.016	0.026	0.018	0.019	0.013	0.026	28

Country	Logistics Competence and Quality Score	Timeliness Score	Tracking and Tracing Score	Customs Score	Infrastructure Score	International Shipments Score	Yi Score	Ranking
Somalia	0.025	0.014	0.026	0.026	0.022	0.011	0.026	30
Libya	0.024	0.015	0.026	0.021	0.025	0.015	0.026	29

The ranking of African countries according to LPI index values obtained by Entropy and MOORA-Reference Point Approach is presented in Table 7. In this table, the last step of the method, the Tchebycheff Min-Max Metric process, is used to calculate the highest values for all countries. The alternative with the smallest value is ranked first and the alternative with the largest value is ranked last. For example, the Yi score of Libya, which ranked last, was determined as 0.026, the largest element of the set of distances to reference points for all criteria (0.024 - 0.015 - 0.026 - 0.021 - 0.025 - 0.015). According to all results, South Africa ranks first with 0,00 points and Botswana ranks second with 0.0102 points, while Somalia ranks last with a weight score of 0.026.

5. CONCLUSION

The LPI index enables countries to assess their logistics performance and benchmark their logistics performance in order to develop more effective logistics policies. In this study, the six criteria that make up the LPI are weighted using an objective weighting method and the LPI ranking of African countries is obtained accordingly. These criteria are Customs, Infrastructure, International Shipments, Logistics Quality and Competence, Tracking and Monitoring, and Timeliness. Criteria weights are determined by Entropy method. According to these weights, the order of importance of the criteria is determined by MOORA-Reference Point Approach as Customs, Tracking and Monitoring, Logistics Quality and Competence, Infrastructure, Timeliness and International Shipments.

When customs are used effectively, the efficiency and effectiveness of customs shipping procedures in terms of speed, simplicity and predictability of customs institutions are revealed. The speed and simplicity to be achieved in regulatory policies in terms of customs actually indirectly affects on-time delivery. Therefore, a good "Customs" score has a big impact on the "Timeliness" score and makes it less of a problem. When the calculated criteria weights and importance rankings are analyzed, it is seen that partially similar results are obtained with the studies in the literature. Yalçın and Ayaz (2020) examined the LPI values of four countries neighboring Türkiye and found similar results with this study. In the study, the "Customs" score ranked first with a weight score of 0.350, while the "Timeliness" score ranked last with a weight score of 0.108. When we look at the results of the studies conducted by Yıldırım and Mercangöz (2019), Ulutaş and Karaköy (2019) and Rezaei et al. (2018), while the "Infrastructure" score was the most important criterion, it was found to be the least important criterion in this study. When we look at the LPI results of Mešić et al. (2022) on Western Balkan Countries, the "Timeliness" score ranks first with a weight score of 0.207, while the "Customs" score ranks last with a weight score of 0.119. Similar results are also observed in the study of Isik et al. (2020) on Central and Eastern European Countries. According to the results of the study, the "Timeliness" score ranks first with a weight score of 0.200 and the "Infrastructure" score ranks last with a weight score of 0.106. According to the weight values used by Ozmen (2019) in the ranking of OECD countries, the "Logistics Quality and Competence" score ranks first with a weight score of 0.430, while the "Customs" score ranks last with a weight score of 0.153. When the calculated criteria weights of the six criteria in the LPI index are examined, it is seen that different results emerge in different studies. In fact, it is natural that these results should be different. When the analyzed studies are examined, it is seen that each study is evaluated on different country groups. Factors such as the size of the countries, trade volumes, whether they are coastal or not, transit difficulties or country policies have an impact on these different results. There is no correlation between Türkiye's trade volume with African countries and LPI in the sense that Türkiye's trade volume with countries with high LPI data is high. It is based on the judgment that trade relations with countries with high LPI data can be developed more easily. Therefore, in line with Türkiye's plan to improve its trade relations with African countries, increasing trade volume with countries with high LPI data is a window of opportunity.

The period observed and the number of countries analyzed in this study limit the research. In this context, LPI values to be published in the coming years can also be included in this study, i.e. results can be produced. The study area can be expanded by including different sectors and countries in this group. The impact of individual indicators on the LPI value can be determined using different subjective and objective methods and can be compared with the results in this study. In addition, by comparing the ranking obtained here with past and future total trade volume data, the direction of our country's trade with Africa can be evaluated.

DECLARATION OF THE AUTHORS

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