

A strategic analysis of sustainable transportation on Lake Van

Van Gölü'nde sürdürülebilir ulaşım için stratejik analiz

Türk Denizcilik ve Deniz Bilimleri Dergisi

Cilt: 9 Sayı: 1 (2023) 54-65

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ABSTRACT

The Sustainable Development Goals (SDGs) are aimed to provide a comprehensive framework for all economies /industries to work toward a more prosperous and environmentally friendly future. Maritime transport and its subsectors like Inland Waterway Transportation (IWT) are needed to attain most SDGs. Thus, it must raise awareness of how the marine industry, its sub-sectors, and scientific research contribute to SDG achievement. Accordingly, the present study is dedicated to providing a broad direction for initiatives through further strengthening Van Lake's contribution to the SDGs by accurately identifying impediments and exploring possible and present issues. In addition, as Lake Van and its surroundings were recently designated as a "naturally protected, sustainable conservation, and managed area", it should be appropriately conserved in addition to the actions taken to mitigate climate change impacts. The Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis is used in this study, which is one of the most well-known and robust approaches for strategic analysis. The study's findings highlight both the importance of improving communication among the shareholders to build cooperative connections and developing new ways to integrate the SDGs into regulatory and policy plans to innovative infrastructure planning and investment solutions. In this study, a SWOT analysis of IWT activities in Lake Van has been made, and the strengths and weaknesses, remarkable opportunities, and possible threats to sustainable maritime transportation in Lake Van are determined.

Keywords: Inland Waterway Transportation, Intermodal Logistics, Maritime Transportation, Sustainability, Sustainable Development Goals, SWOT Analysis

Article Info

Received: 21.March.2023

Revised: 17.May.2023

Accepted: 17.May.2023

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To cite this article: Karaca, İ., Söner, Ö., (2023). A strategic analysis of sustainable transportation on Lake Van, *Turkish Journal of Maritime and Marine Science* 9(1): 54-65. doi: 10.52998/trjmms.1268611

ÖZET

Sürdürülebilir Kalkınma Hedefleri'nin (SKH'ler), tüm ekonomilerin/sektörlerin daha müreffeh ve çevre dostu bir geleceğe doğru çalışması için kapsamlı bir çerçeve sunması amaçlanıyor. Çoğu SKH'ye ulaşmak için deniz taşımacılığı ve İç Su Yolu Taşımacılığı gibi alt sektörler ihtiyacı vardır. Bu nedenle, denizcilik endüstrisinin, alt sektörlerinin ve bilimsel araştırmaların SKH başarısına nasıl katkıda bulunduğu konusunda farkındalık yaratılmalıdır. Bu çalışma, engelleri doğru bir şekilde belirleyerek ve olası ve mevcut sorunları keşfederek Van Gölü'nün SKH'lere katkısını daha da güçlendirecek girişimler için geniş bir bakış açısı sağlamayı hedeflemektedir. Ayrıca, Van Gölü ve çevresi son dönemde "Doğal sit, sürdürülebilir koruma ve yönetilen alan" ilan edildiğinden, iklim değişikliği etkilerinin azaltılmasına yönelik alınan önlemlerin yanı sıra bölgenin uygun bir şekilde korunması gerekmektedir. Bu çalışmada stratejik analiz olarak en iyi bilinen ve en temel yaklaşımlardan biri olan Güçlü Yönler, Zayıf Yönler, Fırsatlar ve Tehditler (SWOT) analizi kullanılmıştır. Çalışmanın bulguları, hem işbirlikçi bağlantılar kurmak için paydaşlar arasındaki iletişimi geliştirmenin önemi hem de SKH'leri düzenleyici ve politika planlayan, yenilikçi bir altyapı planlama ve yatırım çözümlerine entegre etmenin yeni yollarını geliştirmenin önemi vurgulamaktadır. Bu çalışma ile Van Gölü'ndeki IWT faaliyetlerinin SWOT analizi yapılmış Van Gölü'nün sürdürülebilir deniz ulaşımı konusunda güçlü ve zayıf yönleri, dikkate değer fırsatları ve muhtemel tehditleri ifade edilmektedir.

Anahtar sözcükler: İç Suyolu Taşımacılığı, Intermodal Lojistik, Denizyolu Taşımacılığı, Sürdürülebilirlik, Sürdürülebilir Kalkınma Hedefleri , SWOT Analiz

1. INTRODUCTION

Maritime transportation affects the entire world by consistently and effectively transporting food, commodities, raw materials, energy, and consumer items worldwide at quite a competitive price (Wakeland *et al.*, 2012). Increased cost-effectiveness and environmental friendliness of maritime transportation are major factors driving its rapid economic growth. In addition, the marine industry is crucial to the successful development and function of international trade, working in partnership with ports and sub-industry partners. Since shipping has the lowest carbon footprint per unit of transported goods any other method of transportation, it is a crucial part of sustainable economic growth (Wakeland *et al.*, 2012). On the other hand, the maritime industry and related shareholders should unquestionably be working together to strengthen ongoing efforts toward sustainable growth to secure future competitive transportation. Considering that most 2030 Agenda development of sustainability and its SDGs depend heavily on sustainable marine transportation, which is a cross-cutting problem, this issue requires urgent attention (Barros *et al.*,

2022).

The United Nations (UN) SDGs are a global initiative that seeks to eradicate poverty and achieve sustainable development by 2030 (UN, 2016). The SDGs are viewed as a chance to improve society and ensure that no one is left behind. Since many of the goals of the 2030 Agenda can only be achieved with a maritime transportation industry facilitating international trade, the International Maritime Organization (IMO), a member of the UN, actively participates in the 2030 Agenda and the associated SDGs (IMO, 2017a). More importantly, IMO invites the shareholders to provide additional suggestions on how to better integrate the SDGs with the organization's strategic plan (IMO, 2017b). At this point, data-driven scientific studies should be established as systematic, holistic, and transdisciplinary within the maritime industry and sub-industries to develop such a strategy. This type of research would be expected to define, evaluate, and solve emerging problems and opportunities to better support maritime industries or sub-sectors in performing the 2030 Agenda. Therefore, further research is required to identify the barriers and investigate the potential issues encountered to better

understand how the maritime industry and sub-industries promote sustainable development.

Inland water transportation (IWT), which is one of the sub-industries of maritime transportation, is the movement of watercraft to a lake, river, canal, or any other body of water (Solomon *et al.*, 2021). IWT, a crucial component of sustainable transportation for the future, is endorsed by numerous developed nations and is gaining popularity (Barros *et al.*, 2022). The studies have clearly shown that IWT is an economical, fuel-efficient, and affordable means of transportation (Nokelaynen, 2018; Ojile, 2006). However, IWT has been overlooked and undervalued in numerous society that associates roads and automobiles with development and progress (Kruk and Donner, 2009). On the other hand, IWT is one of the strategic sub-industries for achieving the SDG in the 2030 Agenda (Barros *et al.*, 2022). There have been barriers to IWT for sustainability: Technical, Infrastructural, Regulatory, Geo-Political, and Financial (Trivedi *et al.*, 2021). These obstacles should be looked into while developing IWT resilient infrastructure, sustainable management, and environmentally friendly regulations in light of the 2030 Agenda and SDGs. Given the fact that IWT is connected to the three pillars of sustainability, removing the group of obstacles will help the global/regional economy run smoothly and advance sustainable development (Lee *et al.*, 2019).

Lake Van, Türkiye's largest lake, is the world's largest soda lake (Akyil *et al.*, 2009). The lake with an area of 1,434 square miles (3,713 square kilometers), features coves and islets. Among the most crucial islands for transportation are Akdamar, Arpanak, Kuş, and Adr. The lake is 430 kilometers around and 451 m deep at its

deepest. The lake is 1646 meters above sea level, and its water level changes (Aslan, 2022; Aslan and Yazir, 2009). Lake Van in Türkiye is an example of bi-modal and intermodal logistics. Freight is transported via road, inland canal, and rail within the framework of bimodal transportation. Train ferry and Ro-Ro intermodal transportation systems are used to convey freight within the framework of intermodal transportation. This example contains a basic notion. IWT in Lake Van requires design by the established IWT model. IWT is both a component of bimodal and intermodal transportation. Moreover, IWT is crucial to achieving sustainable transportation (Trivedi *et al.*, 2021).

Severe weather conditions, rough terrain, distance from the highway and rail system, and harsh winter conditions made IWT compulsory in Lake Van (Doğan, 2020). According to the data on cabotage transportation shared by the relevant legal authority, freight, and passenger transportation on Lake Van has been increasing in recent years (Ministry of Transport and Infrastructure, 2023). Despite the proximity of the provinces of Van and Bitlis, this lake is an important inland waterway for the trade of neighboring provinces, including Iran and Iraq (Doğan, 2020). There are known to be wharves in Van, Amik, Delicay, Adilcevaz, Ahlat, Tatvan, Reşadiye, and Gevaş, where maritime transportation is conducted (Deniz and Yazıcı, 2003; Ökmen, 2021). Certain maritime stakeholders carry out the primary maritime industry-related activities on Lake Van, which include transportation, fishing, and tourism. However, it is thought that these stakeholders have a low degree of cooperative connection.

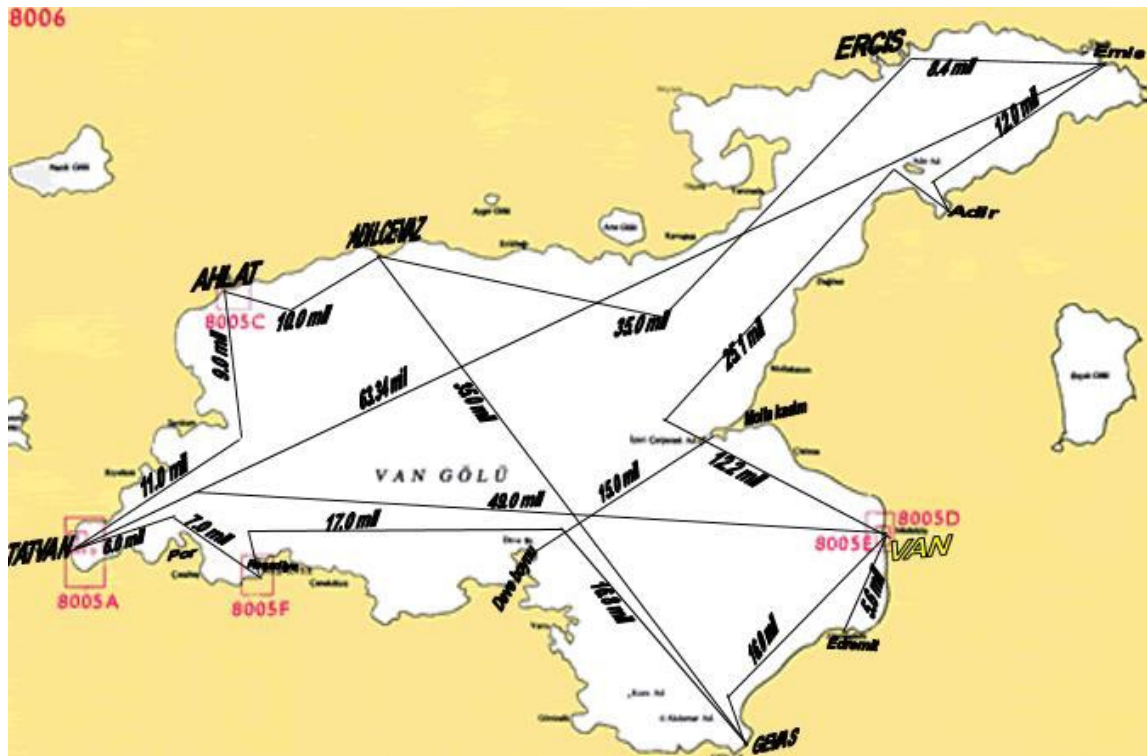


Figure 1. Lake Van transit settlements and their distances in history. (Doğan, 2020)

Since that there is no railway connection between Tatvan and Van, railway cars are loaded onto ferries in Tatvan and taken across Lake Van to Van. From there, they are moved to Kapikoy, which is the border crossing with Iran, using the railway link in Van. 4 ships with a capacity of 12 wagons, carrying freight, wagons, passengers, and vehicles between Tatvan and Van, operate within the scope of intermodal transportation. In the Lake Van region, there is a total road network of 3.626 km, of which 1.387 km is State Highway and 2.239 km is Provincial Road. It is necessary to develop IWT connection roads for intermodal transport because IWT connection is not sufficient for the road. However, despite these inadequacies, it is expressed on the map in Figure 1 that there was activated IWT in the region in history. (Doğan, 2020). In this figure, Lake Van transit settlements and their distances in history are expressed.

IWT-based research on Lake Van is not identified in any of the databases selected for a literature review, including Web of Science, Scopus, and Science Direct. IWT has only been the subject of one research listed, there is no research on nautical and transportation themes for Lake Van. However, there are studies to

encourage the investigation of IWT by using SWOT analysis for sustainability and IWT for Van Lake.

As mentioned, IWTs are crucial not only for regional and national growth but also for international trade (Solomon *et al.*, 2021). While trying to develop inland waterway transport in Europe, IWT is trying to be developed policies and incentives in waterways with less activity (Mihic *et al.*, 2011). The effectiveness of SWOT analysis has been proven in the literature as an initial study on the sustainability of inland waterways (Bamler *et al.*, 2021; Dávid and Madudová, 2019; Hricová, 2013; Srinivas *et al.*, 2018).

Turkey's Seventh National Notification report prepared within the scope of the United Nations Framework Convention on Climate Change (UNFCCC) states that it is desired to increase maritime transport, and as a target, to increase the share of seaways in cabotage freight transport by 10% and in passenger transport by 4%, as a target, National Climate Change 2011-2023. It was included in the Action Plan (Demirtürk, 2021). National research is not sufficient to encourage IWT stakeholders, especially Lake Van. Due to its geopolitical location, Lake Van

is one of the significant inland waterways with the huge potential to not only generate economic revenue, but also offer great and diverse job and career options, as well as sport aquaculture and commercial fishing, and the leisure sector (Aslan, 2022; Aslan and Yazir, 2009; Bilgili and Şahin, 2023; Doğan, 2020; Ökmen, 2021). Lake Van is especially important for sustainable intermodal transportation. The province of Bitlis has been determined as a logistics center due to its port authority and railway connection, and it has been stated that sustainable IWT and maritime transportation should be encouraged in this region (Paçacı *et al.*, 2022). Apart from that, recently (in August 2022) Lake Van and its surrounds are formally recognized as a "naturally protected, sustainable conservation, and managed area," the basin should also be properly preserved in addition to the efforts to mitigate climate change. Despite these benefits, IWT activity on this lake falls short of expectations (Doğan, 2020). Thus, it is vital to conduct Lake Van-related research on maritime transportation. Given that a considerable number of the SDGs in the 2030 Agenda rely significantly on sustainable maritime transportation, this issue must be addressed immediately.

In this research, Lake Van transportation will be assessed and examined as an inland waterway, and awareness will be promoted about the need to conduct a formal scientific assessment of IWT on the lake. As a result, the main objective of the present research is to correctly identify obstacles and investigate the potential and existing challenges to further sustainable transportation. Accordingly, the study structure is presented as follows. In section 2, materials and methods are presented, including SWOT analysis and SWOT analysis of Lake Van IWT. After those, results and discussions are addressed in section 3. Finally, in section 4, the study conclusion is presented.

2. MATERIALS AND METHODS

In terms of the 2030 Agenda and its SDG framework, marine transportation is critical to attaining sustainable development in all three aspects (social, economic, and environmental) (Barua *et al.*, 2019). When comparing fuel

efficiency, the age of the fleet, and transportation matrix makeup, waterways emerge as the clear winner (Oliveira and Cicolin, 2016). Sustainability is defined as the sustaining of well-being over an indefinite length of time (Kuhlman and Farrington, 2010). The notion of sustainable development refers to a process of transformation in which the utilization of technology, resources, investments, and institutions is modified to satisfy both present and future needs (WCED, 1987). According to this point of view, the World Maritime Theme of "Sustainable Shipping for a Sustainable World" will provide more accuracy in implementing the 2030 Agenda and making 2020-2030 a decade of action (IMO, 2019).

IMO develops effective institutions for safe, secure, and environmentally friendly maritime commerce. Therefore IMO needed to make a strategy according by SDGs and it is determined. A summary of IMO's strategy for SDGs is shown in IMO's SDGs targets in Table 1. Each SDG has corresponding IMO strategies. In accordance, IMO supports the entire SDG adaptation to maritime and aims to accomplish sustainable marine targets. Undoubtedly, IMO holds the SDGs in high regard and prioritizes the link between maritime operations and sustainable objectives. To manage the oceans, ships, and waterways sustainably, IMO will establish standards and ecologically beneficial regulations.

Table 1. IMO’s SDGs targets (IMO, 2019)

SDG number	SDG	IMO’s SDG Target
SDG1	No Poverty	IMO laws keep shipping safe, secure, and clean, fostering green and blue economy growth.
SDG2	Zero Hunger	IMO and UN partners fight illegal, unreported, and unregulated fishing to protect a critical food source.
SDG3	Good Health and Well-being	IMO accords reduce shipping-related pollution in ports and coastal areas by decreasing sulfur in ship fuel oil.
SDG4	Quality Education	IMO sets seafarer training requirements and runs global higher education institutions.
SDG5	Gender Equality	Women in Maritime and other IMO initiatives promote gender equality.
SDG6	Clean Water and Sanitation	The waste-management cycle, which ensures clean water, is regulated by IMO.
SDG7	Affordable and Clean Energy	IMO mandates shipping energy efficiency and promotes sustainable energy research.
SDG8	Decent Work and Economic Growth	Seafaring provides jobs, especially in poor nations. IMO prioritizes seafarer health and wellbeing.
SDG9	Industry, Innovation, and Infrastructure	Autonomous ships and port sector innovations can boost global stability and sustainability.
SDG10	Reduced Inequality	Technical collaboration from IMO helps developing nations build shipping industry capabilities.
SDG11	Sustainable Cities and Communities	Secure supply chains support sustainable communities. IMO protects global logistical infrastructure by ensuring marine safety and security.
SDG12	Responsible Consumption and Production	IMO regulates ship dumping, reduces ship litter, and promotes safe and clean ship recycling.
SDG13	Climate Action	According to the Paris Agreement, IMO has devised methods to reduce shipping sector GHG emissions and a global strategy to eliminate them.
SDG14	Life Below Water	IMO's global ship pollution prevention efforts support SDG14.
SDG15	Life on Land	IMO strengthens port security and fights wildlife trafficking globally.
SDG16	Peace and Justice Strong Institutions	IMO develops effective institutions for safe, secure, and environmentally friendly maritime commerce.
SDG17	Partnerships to Achieve the Goal	IMO has partnerships with approximately 60 intergovernmental organizations (IGOs) and over 70 non-governmental organizations (NGOs), including significant worldwide environmental groups and bodies.

IWT, which offers so many advantages, must be accurately assessed to enable strategic development. One of the fundamental analyses that link strategic development and an established and wide technique for facilitating strategy development is SWOT analysis (Dyson, 2004). For almost a quarter of the century, SWOT analysis is used first step to study about the strategic planning process (Helms and Nixon, 2010; Bamler *et al.*, 2021; Santén *et al.*, 2021). SWOT analysis is utilized in studies to design IWT for sustainable maritime transportation. As a result, SWOT assessments are illustrated as the strategic analysis for sustainable development. The origin of the term "SWOT" is unknown (Helms and Nixon, 2010). SWOT analysis and other related methods for strategic management

have been widely used since the 1950s, with varying degrees of sophistication and concentration (Leigh, 2010). In 1972, an example of SWOT analysis was found (Stait, 1972). In strategic management, the SWOT analysis performed by stakeholders is crucial (Leigh, 2010). SWOT analysis is conducted by stakeholders at a strategic planning stage (Namugenyi *et al.*, 2019). SWOT analysis helps you assess your "strengths, weaknesses, opportunities, and threats" from the outside. (Longsheng *et al.*, 2022). There are two main steps to the analysis. In the first step, SWOT factors and matrices are identified. Second, the SWOT matrix matches internal and external aspects to discover the optimum strategy. (Jiskani *et al.*, 2020). In this

study, strengths, weaknesses, opportunities, and threats for IWT, in general, are found by looking at both external and internal factors for a SWOT analysis in literature (Hricová, 2013).

The Van Lake requires a long-term strategy for IWT implementation, including the alignment of national goals with the IMO's SDG aims to support regional priorities. Therefore, a SWOT analysis is performed as the initial stage in designing a long-term plan for IWT implementation and coordination in Lake Van. The goal of this study is to outline the fundamental functions and operations of Lake Van's IWT in terms of SWOT analysis.

2.1. SWOT Analysis of Van Lake IWT

Using a study that applied SWOT analysis for IWT and expert opinion, a SWOT analysis of Van Lake's IWT is conducted. (Bakhshian and Mohammadpour Kachlami, 2019; Bamler *et al.*, 2021; Barros *et al.*, 2022; Barutca, 2006; Engström and Anna, 2019; Hricová, 2013). Strengths, weaknesses, opportunities, and threats are given in Table 2.

Table 2. SWOT analysis of Van Lake's IWT

SWOT	Item
Strengths	Water freight's environmental benefits
	Strong connections between Europe and East Asia
	Geography is more suitable for building waterways compared to other transportation bases
	Local waterway potential that can connect cities in the region
	Reduced road congestion in the surrounding
	There is already a sample of intermodal logistics on Lake Van.
	Costs competitiveness compared to road transport
	IWT is untouched for Lake Van so innovative and initiative-taking improvements in the maritime sector can be easily applied.
	Vessels available to charter
	Issues with truck use (congestion near the port). The use of IWT can reduce congestion on roads.
International authorities support this environmental transportation.	
No tax on fuel for ships	
Weaknesses	IWT is applied by countries, their outputs are available
	Maritime education institutions in the region emphasize IWT on Lake Van
	Lack of scale of investment
	Lack of educated and skilled workers
	Absence of a long-term strategic policy framework
	The inflexibility of specialized vessels
	Low organization capacity between IWT stakeholders and low awareness
	Dependency on third-party funding, i.e., public money, to improve/modernize the asset
	Deficiencies of infrastructure and seafarers
	IWT could result in a conflict of interest concerning agriculture and fishing
Infrastructure maintenance	
Opportunities	Creates new business opportunities, benefits regional development
	Hydrogen-based fuels and green mode in IWT make IWT the most acceptable mode of transport
	Increase in air quality, awareness of environmental awareness
	Owing to intermodal transportation and its IWT links benefits to be gained
	More transport allows more products to reach the region. offering opportunities for IWT in the spot market with IWT
	Waterways can offer an alternative
	Waterside developments could be encouraged
	Stakeholders, especially owners of ships and ports, set goals and they support IWT
	IWT can be used to be a simulation of oceangoing ship operation, crew training
	Improvement of IWT and digitization in the maritime industry
In the field of automation, IWT is considerable	
Autonomy brings technological developments at every stage of life	
Threats	Because of climate changes, withdrawal in Lake Van may complicate port operations
	Freight flows are unpredictable, and threatening in market
	Advanced and developmental other transport modes are threatening IWT.
	Legislation for IWT is slowed down

Conflicting interests between national and international interests
Unqualified crew and port employees could cause accidents and errors.
Lack of financial resources from the trust
Possible threats to the environment and marine life that come with maritime transportation
Failure to achieve sustainability

3. RESULTS AND DISCUSSION

Maritime transportation offers opportunities a variety of SDGs (Wang *et al.*, 2020). However, there could be a conflict between SDGs; for instance maritime transportation has opportunities for SDG 13 “Climate action”, at the same time, it could have potential threats for SDG 14 “Life below water” and SDG 6 (Clean water and sanitation). Ballast water management and coastline restoration could be present a solution for mentioned conflict. Also toxic coating is a complex problem for marine ecosystem. To solve the problem, preferring alternative vessel hull coatings, enhancing non-toxic hull coatings, improving vessel hull cleaning methods, and cultivating non-governmental organizations' roles should be evaluated (Kim, 2021).

It is possible to ascertain whether companies or industries are performing effectively right now and develop a successful strategy for the future with the use of a SWOT analysis. In addition, a SWOT analysis could identify out industry- or company weaknesses. The following strengths, weaknesses, opportunities, and threats related to Lake Van were uncovered by the current study. Considering the strength of Lake Van following advantages stand out. Lake Van is already a multimodal logistics example. In addition, it is connected Europe with Middle Asia. Hence, access to the network between Middle Asia and Europe is made simple by the local waterway system. One of Lake Van's major strengths over more hilly terrain is that its surroundings are favorable to trying to enhance IWT. It is also important to note that the area already has a modest network of small waterways that connect the many regional inland ports/terminals. Cost-effectiveness is relative to vehicle transport; the seaports in the region have rail connections.

Ships so IWT is available to charter. Environmentally friendly transportation is supported by international agencies so investment can be made. No tax is imposed on ship fuel. Maritime education and training centers/organizations in the region are also interested in IWT on Lake Van. IWT is undeveloped for Lake Van, making it simple to implement innovative and initiative-based maritime sector changes. As evidenced by all of the advantages and qualities described, IWT necessitates the gathering and evaluation of a wide variety of data to facilitate and support sustainable maritime transportation. These strengths are so natural and ambitious that this issue can be called an obligation. Thus, a sustainable IWT for Lake Van should be provided and realized as soon as possible.

On the other hand, Lake Van IWT has various weaknesses. Lack of scale of investment, inflexibility of specialized vessels in the region, prioritization of land and waterborne transportation, lack of educated and skilled workers, absence of a long-term strategic policy framework; low IWT stakeholder organization and awareness; Public financing to improve/modernize the asset, infrastructure. Resilient infrastructure and seafarers' deficiencies; IWT could cause an agriculture-fishing conflict; Upkeep is a weakness for Lake Van' IWT are shown in this study. These weaknesses seem very important, and some weaknesses must be resolved, such as the lack of investment. This resulted in an underutilized area where there is a high potential for seaborne transportation but a low level of economic activity, or even undeveloped activities that would be well suited to the region's current capabilities.

Lake Van IWT offers economic, social, and environmental benefits. IWT boosts commercial and regional development. Intermodal transportation and IWT linkages have many benefits. Transport brings additional goods to the region. IWT has spot market opportunities. Ship and port owners set targets and promote IWT. IWT could promote waterfront development. IWT gives autonomy, which advances technology throughout life. IWT simulates oceangoing ship operating and crew training.

Alternatives include waterways. Hydrogen-based fuels and green mode make IWT the best form of transport for air quality improvement. The mentioned opportunities will come with sustainable IWT, and they will make significant profits.

It should not be forgotten that there are also challenging threats, thus further effort is needed to create sustainable transportation on Lake Van with the effective use of data to address imbalances in terms of scientific, technical, inventive, and economic capacities. Climate change may affect port operations by withdrawing Lake Van. Also, market-threatening freight flows are unpredictable. Advanced and developing transit options, regulations governing for other transportation modes, and high infrastructure standards for other modes challenge IWT. Unqualified port workers and crew may also cause mishaps. The mismatch between the strengths of the natural environment and the strengths of the promoted applications is a structural problem since Turkey has no IWT regulations (Bayirhan and Nas, 2018).

Strengths and opportunities for IWT in Lake Van are substantial amount and quality. It is a fascinating discovery that a transportation system with so many chances and so many strengths has not yet been realized. In Turkey, the maritime industry is still developing, hence IWT requirements have not yet been implemented appropriately (Erdogan and Cetin, 2021). The share of maritime transportation also IWT in intermodal and bimodal transport is smaller than the share of other modes of transport (Balik *et al.*, 2015). Because maritime transportation is more environmentally friendly and economically than other modes of transport, industrialized nations formulate policies accordingly. IWT and maritime transportation may present the extraordinary potential for Lake Van.

European inland ports provide transit, supply chains, and regional development. Multi-entity characterization is a best practice in public-private partnerships (Montwiłł, 2019). Also European IWT could be best practice for IWT on Lake Van. Even just IWT has best practice potential for transportation (Maes and Vanelslander, 2015). Examples of IWT is exist for Lake Van, best practice could be determined

by authority. This is another opportunity to choose IWT.

4. CONCLUSION

Sustainability is a concept that has been explored in a variety of industries, but it is especially relevant in the maritime industry due to the economic, environmental, and social advantages of maritime transportation. IWT is one of the sub-sectors of maritime transportation. Although IWT integration with other modes of transportation has just recently started, it is believed that this trend will quickly expand throughout Europe and many other developed economies. Given that sustainable maritime transportation is an intersecting issue and is crucial to achieving the majority of SDGs of the 2030 Agenda for Sustainable Development, efforts should be focused on this issue immediately. Considering Lake Van and its surroundings were recently designated as a "naturally protected, sustainable conservation, and managed area" and Turkey's largest lake, the Lake should be appropriately conserved in addition to the actions taken to combat climate change. Therefore, it is essential to encourage structural change, innovation, and sustainable mobility on Lake Van through financial investments in transportation infrastructure and improved IWT policymaking.

In this study, Lake Van transportation was evaluated as an inland waterway, and the necessity of performing a formal scientific evaluation of IWT on the lake was raised. The primary goal of the study is to assist efforts that aimed to transform Lake Van transportation into a more competitive, job-rich, and sustainable one. SWOT analysis is thus employed in the study as it is one of the most well-known and reliable methods for strategic analysis. Despite its many advantages, IWT activity on this lake does not match what was expected. The findings of the study emphasize the importance of improving communication among shareholders to build cooperation connections and the importance of developing new ways to integrate the SDGs into regulatory and policy plans to enhance innovative infrastructure planning and investment solutions. Both of these focuses are

outlined by the importance of developing new ways to integrate the SDGs into regulatory and policy plans to develop strategies through innovation-driven growth carried out under IWT. In this manner, it is become possible to develop harmonized strategic investments in transportation infrastructure and improved IWT policymaking.

One of the most important key drivers in boosting an industry's sustainability capabilities is constant innovation. However, limited studies have been committed to achieving sustainable development on IWT (Barros *et al.*, 2022). This study presents the results of a SWOT analysis for Lake Van's IWT, one of the best effective analyses in strategic planning that consider the interests of all the parties involved. IWT and maritime transportation for Lake Van are highlighted, along with their respective strengths and possibilities. In addition, weaknesses and threats prompt stakeholders and policymakers to exercise extreme caution. Consequently, more research should be conducted from this perspective. Strategies to support maritime transportation in Lake Van can be put forward by using decision support systems for various purposes, based on the SWOT analysis, which is the output of this study, in future studies.

AUTHORSHIP STATEMENT

Ismail KARACA: Conceptualization, Methodology, Validation, Formal Analysis, Resources, Writing - Original Draft, Writing-Review and Editing, Data Curation, Software, Visualization, Supervision, Project administration, Funding acquisition.

Ömer SÖNER: Conceptualization, Methodology, Validation, Formal Analysis, Resources, Writing - Original Draft, Writing-Review and Editing, Data Curation, Software, Visualization, Supervision, Project administration, Funding acquisition.

CONFLICT OF INTERESTS

The author(s) declare that for this article they have no actual, potential, or perceived conflict of interest.

ETHICS COMMITTEE PERMISSION

No ethics committee permission is required for this study.

FUNDING

No funding was received from institutions or agencies for the execution of this research.

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5. REFERENCES

- Akyil, S., Aytas, S., Yusan, S., Aslani, M.A.A., Aycan, H.A., Eral, M., Tuerkoezue, D.A., Isik, M.A., Oelgen, M.K., (2009). Evaluation of Van Lake (Turkey) about radiological and hydrogeological risk. *Ulusal Nükleer Bilimler ve Teknolojileri Kongresi* 328–335.
- Aslan, B., (2022). Van Gölü'nde Gerçekleşen Kazaların Hata Ağacı Analizi ve Denizcilik Faaliyetleri. Yüksek Lisans Tezi, Karadeniz Teknik Üniversitesi, Trabzon, Turkey.
- Aslan, B., Yazir, D., (2022). View of Fault tree analysis of accidents that occurred in Van Lake. *Advanced Engineering Days*, 50–52. <https://publish.mersin.edu.tr/index.php/aed/article/view/192/156>
- Bakhshian, A., Mohammadpour Kachlami, K., (2019). Inland Waterways Logistics Operational Requirements & Vessels' Characteristics, Master's thesis, Chalmers University of Technology, Gothenburg, Sweden. <https://odr.chalmers.se/handle/20.500.12380/256608>.
- Balik, İ., Aksay, K., Şenbursa, N., (2015). Marine Transportation in Turkey and A Future Perspective. *Turkish Journal of Maritime and Marine Sciences* 1(1): 48–60. <https://dergipark.org.tr/en/pub/trjmms/issue/40133/477460>
- Bamler, J.N., Stemmler, L., Rogerson, S., Santén, V., Higham, S., Boll, J.J., Huigens, R., (2021). IWTS 2.0: "Mobilizing small waterway transport potentials". *SWOT Analysis of Selected #IWTS 2.0 Partner Regions*.

- Barros, B.R.C., de Carvalho, E.B., de Brasil Junior, A.C.P., (2022).** Inland waterway transport and the 2030 agenda: Taxonomy of sustainability issues. *Cleaner Engineering and Technology* 8: 100462. doi: 10.1016/J.CLET.2022.100462.
- Barua, A., Deka, A., Gulati, V., Vij, S., Liao, X., Qaddumi, H.M., (2019).** Re-Interpreting Cooperation in Transboundary Waters: Bringing Experiences from the Brahmaputra Basin. *Water* 11(12): 2589. doi: 10.3390/W11122589.
- Barutca, H., (2006).** Orta Asya'ya Ulaşımında Demiryolu Alternatifi, Bölgesel Güçler ve Türkiye. *Akademik Bakış* 8(8): 1–13.
- Bayırhan, İ., Nas, S., (2018).** Güzelhisar Deresi'nin Aliğa Organize Sanayi Bölgesi İçin Suyolu Olarak Tasarımı. *Teknik Dergi* 29(1): 8199–8224. doi: 10.18400/TEKDERG.346896.
- Bilgili, L., Şahin, V., (2023).** View of Emission and environmental cost estimation of ferries operating in Lake Van. *Maritime Technology and Research* 5(3): 262215. doi: 10.33175/mtr.2023.262215.
- Dávid, A., Madudová, E., (2019).** The Danube River and its importance on the Danube countries in cargo transport. *Transportation Research Procedia* 40: 1010–1016. doi: 10.1016/J.TRPRO.2019.07.141.
- Demirtürk, D., (2021).** Sürdürülebilir Ulaşımında Sera Gazı Etkisini Azaltmaya Yönelik Çalışmalar. *Journal of Engineering Sciences and Design* 9(4): 1080–1092. doi: 10.21923/JESD.932385.
- Deniz, O., Yazıcı, H., (2003).** Van Gölü'nde ulaşım. *Türk Coğrafya Dergisi* 1(40): 17–33.
- Doğan, H., (2020).** Van gölü bölgesinde gerçekleştirilen intermodal taşımacılık uygulamalarının ekonomik analizi. Yüksek Lisans Tezi, İskenderun Teknik Üniversitesi, Hatay, Turkey.
- Dyson, R.G., (2004).** Strategic development and SWOT analysis at the University of Warwick. *European Journal of Operational Research* 152(3): 631–640. doi: 10.1016/s0377-2217(03)00062-6.
- Engström, E.M., Anna, A., (2019).** Inland Waterway Transportation in Northern Europe What Sweden could Learn from a Modal Shift Process in the Netherlands. Master's thesis, Chalmers University of Technology, Gothenburg, Sweden.
- Erdogan, O., Cetin, O., (2021).** The Effects of Maritime Transport on the Turkish Economy. *SSRN Electronic Journal* 22-31. doi: 10.2139/SSRN.3880804.
- Helms, M.M., Nixon, J., (2010).** Exploring SWOT analysis – where are we now? A review of academic research from the last decade. *Journal of Strategy and Management* 3(3): 215–251. doi: 10.1108/17554251011064837/FULL/PDF.
- Hricová, R., (2013).** SWOT analysis of the Slovak inland waterway transport. *Transport and Communications* 1(2): 6–9. doi: 10.26552/TAC.C.2013.2.2.
- IMO, (2017a).** Linkages between IMO's technical assistance work and the 2030 agenda for sustainable development.
- IMO, (2017b).** SDG Brochure.
- IMO, (2019).** Strategy, Planning and Reform (Vol. 3).
- Jiskani, I.M., Shah, S.A.A., Qingxiang, C., Zhou, W., Lu, X., (2020).** A multi-criteria based SWOT analysis of sustainable planning for mining and mineral industry in Pakistan. *Arabian Journal of Geosciences* 13(21): 1–16. doi: 10.1007/S12517-020-06090-3/TABLES/9
- Kim, H.J., (2021).** Strategic actions for sustainable vessel hull coatings in line with the UN SDGs. *Journal of Advanced Marine Engineering and Technology (JAMET)* 45(4): 231-242.
- Kuhlman, T., Farrington, J., (2010).** What is Sustainability? *Sustainability* 2(11): 3436–3448. doi: 10.3390/SU2113436.
- Kruk, C.B., Donner, M., (2009).** *Freight Transport for Development Toolkit*, World Bank, Washington, DC.
- Lee, P.T.W., Kwon, O.K., Ruan, X., (2019).** Sustainability Challenges in Maritime Transport and Logistics Industry and Its Way Ahead. *Sustainability* 11(5): 1331. doi: 10.3390/SU11051331.
- Leigh, D., (2010).** SWOT Analysis. *Handbook of Improving Performance in the Workplace* 2: 115–140. doi: 10.1002/9780470592663.CH24.
- Longsheng, C., Ali Shah, S.A., Solangi, Y.A., Ahmed, M., Ali, S., (2022).** An integrated SWOT-multi-criteria analysis of implementing sustainable waste-to-energy in Pakistan. *Renewable Energy* 195: 1438–1453. doi: 10.1016/J.RENENE.2022.06.112.
- Maes, J., Sys, C., Vanellander, T., (2015).** City Logistics by Water: Good Practices and Scope for Expansion. In: "Transport of Water versus Transport over Water. Operations Research/Computer Science Interfaces Series". (Editors: C. Ocampo-Martinez, R. Negenborn), Springer, Cham, 58, pp. 413-437. doi: 10.1007/978-3-319-16133-4_21.

- Mihic, S., Golusin, M., Mihajlovic, M., (2011).** Policy and promotion of sustainable inland waterway transport in Europe – Danube River. *Renewable and Sustainable Energy Reviews* 15(4): 1801–1809. doi: 10.1016/J.RSER.2010.11.033
- Ministry of Transport and Infrastructure, (2023).** Kabotaj istatistikleri. Accessed Date: 17.05.2023 <https://denizcilikistatistikleri.uab.gov.tr/kabotaj-hatti-istatistikleri> is retrieved.
- Montwill, A., (2019).** Best practices in managing inland ports in Europe. *Zeszyty Naukowe Akademii Morskiej w Szczecinie* 59(131): 100-109.
- Namugenyi, C., Nimmagadda, S.L., Reiners, T., (2019).** Design of a SWOT Analysis Model and its Evaluation in Diverse Digital Business Ecosystem Contexts. *Procedia Computer Science* 159: 1145–1154. doi: 10.1016/J.PROCS.2019.09.283
- Nokelaynen, T., 2018.** Mapping of the environmental impacts of inland waterway transport in Russia. Proceedings of the International Conference GI Support of Sustainable Development of Territory, 131–136.
- Ojile, M.O., (2006).** Draft Report of the Socio-Economic Characteristics for the Idealization of the Port Harcourt Warri Roads Submitted to Messer allots Nigeria. *Limited on Behalf of the Federal Ministry of Works*, Abuja 1–60.
- Oliveira, A.L. R., Cicolin, L. de O.M., (2016).** Evaluating the logistics performance of Brazil’s corn exports: a proposal of indicators. *African Journal of Agricultural Research* 11(8): 693–700.
- Ökmen, S., (2021).** 16-18. Yüzyillarda Van Gölü’ndeki Askerî ve Sivil Faaliyetler. *In Bitlis Eren University*, Bitlis, Turkey
- Paçacı, B., Erol, S., Çubuk, K., (2022).** Sürdürülebilir Ulaşım ile Lojistik Merkez Yer Seçimi. *Toros Üniversitesi İİSBF Sosyal Bilimler Dergisi*, 9(Special Issue 2nd International Symposium of Sustainable Logistics “Circular Economy”) 97–106. doi: 10.54709/IISBF.1182554
- Santén, V., Rogerson, S., Williamsson, J., Woxenius, J., (2021).** Modal shift to inland waterway transport. *European Journal of Transport and Infrastructure Research* 21(4): 43–61. doi: 10.18757/EJTIR.2021.21.4.5474
- Srinivas, R., Singh, A.P., Dhadse, K., Garg, C., Deshmukh, A., (2018).** Sustainable management of a river basin by integrating an improved fuzzy-based hybridized SWOT model and geo-statistical weighted thematic overlay analysis. *Journal of Hydrology* 563: 92–105. doi: 10.1016/J.JHYDROL.2018.05.059.
- Stait, N.H., (1972).** Management training and the smaller company: Swot analysis. *Industrial and Commercial Training* 4(7): 325–330. doi: 10.1108/EB003232/FULL/PDF.
- Solomon, B., Otoo, E., Boateng, A., Ato Koomson, D., (2021).** Inland Waterway Transportation (IWT) in Ghana: A case study of Volta Lake Transport. *International Journal of Transportation Science and Technology* 10(1): 20–33. doi: 10.1016/J.IJTST.2020.05.002
- Trivedi, A., Jakhar, S.K., Sinha, D., (2021).** Analyzing barriers to inland waterways as a sustainable transportation mode in India: A dematel-ISM based approach. *Journal of Cleaner Production* 295: 126301. doi: 10.1016/J.JCLEPRO.2021.126301
- UN, (2016).** Sustainable developments goals Indicators. Accessed Date: 17.05.2023 <https://unstats.un.org/sdgs/report/2016/> is retrieved.
- Wakeland, W., Cholette, S., Venkat, K., (2012).** Food transportation issues and reducing carbon footprint. *Food Engineering Series*, 211–236. doi: 10.1007/978-1-4614-1587-9_9/FIGURES/11_9
- Wang, X., Yuen, K.F., Wong, Y.D., Li, K.X., (2020).** How can the maritime industry meet Sustainable Development Goals? An analysis of sustainability reports from the social entrepreneurship perspective. *Transportation Research Part D: Transport and Environment*, 78: 102173.
- WCED, U., (1987).** Report of the World Commission on Environment and Development: Our Common Future.