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Quantitative Performance Assessment of Humanitarian Maritime Corridors: A Multi-Level Effectiveness Framework Applied to the Black Sea Grain Initiative

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ABSTRACT

Maintaining maritime trade routes operational during armed conflicts poses complex challenges requiring creative mechanisms to balance humanitarian needs with maritime security issues. The article develops and applies a comprehensive quantitative model for measuring the performance of humanitarian maritime corridors, using the Black Sea Grain Initiative (BSGI) as a case study. The multi-level effectiveness framework assesses the performance of the corridor on operational, strategic, and humanitarian levels based on measurable indicators. These include vessel transit volumes, assessing cargo throughput, inspection efficiency, security incident frequency, and market price stabilization. Each indicator shall be backed by quantitative measures for performance assessment. BSGI was successful, albeit with certain limitations; 1,139 vessels that carried about 32.9 million metric tons of grain to 45 countries were allowed passage. It was also effective in contributing to a 15.6% decline of the Food and Agriculture Organization (FAO) Cereal Price Index during this time. The study found that technical and operational factors alone do not determine success for humanitarian maritime corridors. In contrast, institutional design and optimization of the procedures render substantial impacts on the effectiveness of humanitarian maritime corridors as long as there is political will. However, operational limitations such as ineffectiveness of inspection, diplomatic weakness, and dependence on voluntary cooperation damaged performance and finally led to their closure, in July 2023.

1. Introduction.

Protecting maritime trade routes during armed conflicts represents one of the world's most complex security challenges. When military operations jeopardize critical supply chains, the international community faces foundational tensions involving humanitarian, economic, and political concerns. The Black Sea Grain Initiative (BSGI) took place from July 2022 to July 2023. It represented an unprecedented experiment to establish a humanitarian maritime corridor. However, given the ongoing hostilities at the time, the BSGI demonstrated both the possibilities and limitations of such actions.

The conflict between Russia and Ukraine that began in February 2022 quickly turned the Black Sea into a battleground, disrupting grain exports from one of the most important agricultural regions in the world (Ahn et al., 2023). Ukraine's ports used to allow around 90% of grain and oilseed exports in Ukraine. However, since the start of the war, they have become inaccessible (UNCTAD, 2023).

The invasion disrupted global food supplies. As a result, food prices skyrocketed, while countries reliant on Ukrainian and Russian grain exports faced food security crises, especially in Africa and the Middle East (Hidalgo, 2022). According to

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BSGI (2024), mediation between Turkey and the UN allowed commercial vessels to navigate through safe sea corridors even though there was war going on, and this was considered a diplomatic victory.

However, the initiative's actual effectiveness raised numerous questions, despite limited systematic evaluations. As official reports spoke of tonnage exported and vessels transited, critical questions began to emerge about the corridor's true effectiveness. Did it offer dependable protection? How did performance vary across operational, strategic, and humanitarian dimensions? What factors determined success or failure? How can lessons be learned to enhance humanitarian maritime operations in conflict environments?

According to Slim (2015), existing literature on humanitarian corridors has focused primarily on land-based operations, with limited research on maritime contexts. Traditionally, maritime security research has focused on piracy, territory disputes, and freedom of navigation (Bueger, 2015; Till, 2018). However, ensuring commercial shipping can operate through active conflict zones requires a different analytical lens. The area where humanitarian law and maritime operations with crisis management intersect is an extremely complex one, with existing frameworks being inadequate (Guilfoyle, 2009; Bueger and Edmunds, 2017). Many evaluations of the BSGI have been qualitative and descriptive in nature, rather than employing rigorous quantitative frameworks that systematically assess performance. When future battles will likely require similar mechanisms, it is quite a challenge, as policymakers are not equipped with investigational devices to effectively design, implement, and evaluate.

2. Objectives.

The paper fills these gaps by formulating and applying a comprehensive quantitative framework to assess the performance of humanitarian maritime corridors. This research pursues three objectives:

1. To devise a multi-level effectiveness framework for humanitarian maritime corridors that includes measurable indicators capturing the operational, strategic, and humanitarian dimensions of corridor performance.
2. To apply this framework to the BSGI in order to generate empirical evidence regarding its actual effectiveness across these dimensions.
3. To identify patterns, constraints, and lessons for future humanitarian maritime operations in conflict areas.

The contribution of this work is threefold, this paper goes a step further than descriptive analyses through the introduction of measurable indicators and quantitative assessment tools implemented for maritime humanitarian corridors, based on established performance measurement frameworks from the operations research literature (Beamon and Balcik, 2008) but tailored to the unique features of maritime operations in conflict zones. In this paper, we present the first comprehensive performance assessment of the BSGI based on systematically collected data, analysing 1,139 vessel transits and approximately 32.9 million metric tons of cargo movements. From a theoretical perspective, the research builds on existing humanitarian operations and maritime security frameworks, consolidating findings from both into an integrated analytical framework while highlighting the different challenges faced by maritime corridors compared to land-based humanitarian operations.

While previous studies have mainly examined the BSGI through geopolitical and diplomatic lenses, this study employs performance-based empirical evidence (Vazquez, 2023; Whitfield, 2024). The main question is not whether the initiative existed or was successful in diplomatic terms, but rather how well it functioned in practice and its effectiveness across different dimensions. Assessing what succeeded, what failed, and under what conditions provides the basis for designing more effective mechanisms in future crises requiring maritime humanitarian corridors.

3. Research Methodology.

The method used in this paper combines numerical analysis with structured framework development to assess humanitarian corridor performance. This research employs descriptive data collection and analysis of corridor performance criteria and indicators across three dimensions. According to Beamon and Balcik (2008), the design follows the principles of operations research and performance measurement. However, it is adapted to humanitarian maritime operations in conflict zones.

3.1. Research Design and Data Collection.

This study examines the BSGI comprehensively, covering all operations conducted during the period under study, i.e., July 2022 to July 2023, with a comparison to the pre-conflict baseline. The study area encompasses the north western Black Sea region, consisting of maritime routes and Ukrainian ports such as Odessa, Chornomorsk, and Yuzhny/Pivdennyi (see Figures 1 and 2). Maritime Security Corridors (MSC) connect these areas to maritime ports in other countries.

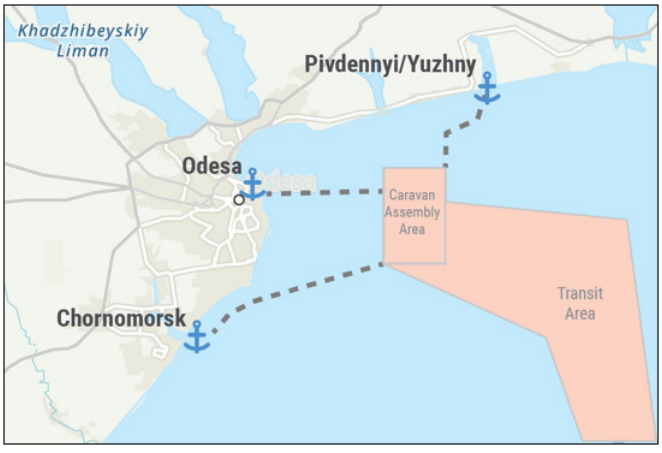
The primary quantitative data source comprises official Joint Coordination Centre reports from the UN, providing information about vessel transits, cargo volumes, inspection processes, and timings (BSGI, 2024). These records constitute the official basis for corridor performance measures. We utilized specialized marine traffic data platforms (Marine Traffic and Vessel Finder), which offer AIS-based tracking information enabling reconstruction of vessel routes and identification of navigation patterns (Madariaga et al., 2013).

t Incident data were obtained from multiple sources, including the Joint War Committee's list of enhanced risk areas and maritime security firms such as EOS Risk Group and Dryad Global. International Maritime Organization circulars, including Circular Letter 4611 that establishes the BSGI operational framework (IMO, 2022), contain additional security information. The Food and Agriculture Organization, which uses the Laspeyres formula with a reference period of 2014-2016, developed the Cereal Price Index used here (FAO, 2022).

Figure 1: BSGI Maritime Security Corridor.

Source: UN - BSGI.

Figure 2: BSGI Maritime Corridor Port Entry Channels.



Source: UN - BSGI.

3.2. *The Multi-Level Effectiveness Framework.*

Corridor performance can be studied through three main dimensions: operational, strategic, and humanitarian. Each dimension has specific measurable indicators calibrated to performance standards used for humanitarian maritime operations in conflict settings.

3.2.1. *Operational effectiveness.*

The operational effectiveness of the corridor is regularly assessed through four key indicators, shown in Table 1, which measure whether the corridor can safely and effectively facilitate maritime traffic:

- Vessel Transit Volume: Total number of vessels transiting the designated corridor during a specified time period. The thresholds for performance were based on pre-conflict baseline traffic. The basic level is less than 50 vessels/month. The acceptable level is 50-100 vessels / month. A good level is 100-150 vessels/month. The optimal level is more than 150 vessels / month.

- Cargo Throughput: This indicator refers to the quantity of grain throughput in million tons through the corridor. There are four thresholds for cargo throughput: basic, acceptable, satisfactory, and optimal levels. The assessment is undertaken on the basis of monthly MT, which can be beneficial for humanitarian action or potential impact on the global market.

- Inspection efficiency: The average time between the departure of a vessel from Ukrainian ports and the end of inspections. This indicator measures operational coordination effectiveness in four levels: Basic (>12 days average), Acceptable (8-12 days), Good (4-8 days) and Optimal (<4 days).

- Geographic Reach: The number of different destination countries that receive shipments via the corridor, as the indicator above divided in four levels: Basic (<10 countries), Acceptable (10 countries), Good (16 countries), and Optimal level (>20 countries).

Table 1: Operational Effectiveness Indicators.

INDICATOR	BASIC	ACCEPTABLE	GOOD	OPTIMAL
Vessel Transit Volume (Vessels/Month)	<50	50 to 100	100 to 150	>150
Cargo Throughput (MT/Month)	<500,000	500,000 to 1,000,000	1,000,000 to 2,000,000	>2,000,000
Inspection Efficiency (Days)	>12	8 to 12	4 to 8	<4
Geographic Reach (Countries)	<10	10 to 15	16 to 20	>20

Note: MT = Metric Tons. Performance thresholds were established based on pre-conflict baseline traffic and humanitarian needs assessment.

Source: Authors.

3.2.2. *Strategic effectiveness.*

The corridor's strategic effectiveness is evaluated through three indicators, enumerated in Table 2, which are related to security and diplomacy according the following factors:

- Incident Frequency: The frequency of security incidents (attacks, threats, disruptions) affecting corridor operations (per vessel transit or time). When incident rates are low, it demonstrates safety and effective threat deterrence. This indicator represents the number of reported incidents divided by total vessel transits as a percentage.

- Operational Continuity: This indicator determines system resilience to disruption and its ability to continue operating despite hostile action or diplomatic fallout. The formula used is Operational Continuity = (Total operational days - Days of Suspension) / Total period days × 100.

- Compliance and Coordination: Assessed through compliance with pre-established specifications, effectiveness of institutional coordination between parties of the Joint Coordination Centre, and implementation of solutions concerning international maritime security. This indicator qualitatively measures the multilateral cooperation achieved, and we also use the principles of Naval Cooperation and Guidance for Shipping (NCAGS) as a reference framework (NATO, 2018).

Table 2: Strategic Effectiveness Indicators.

INDICATOR	BASIC	ACCEPTABLE	GOOD	OPTIMAL
Incident Frequency (incidents per 100 transits)	>5	3 to 5	1 to 3	<1
Operational Continuity (%)	<75	75 to 85	85 to 95	>95
Compliance and Coordination (qualitative)	Weak	Moderate	Strong	Excellent

Source: Authors.

3.2.3. Humanitarian Impact.

The humanitarian impact has an effectiveness in addressing food security with the navigation corridors, whose levels are represented in Table 3, is assessed through three indicators:

- Price Stabilization: Price stabilization is measured using monthly percentage change in the Food and Agriculture Organization (FAO) Cereal Price Index during corridor operations. The variation formula ((Current month price - Previous month price) / Previous month price) × 100 is a standardized measure of market volatility. Performance standards: Basic level (more than 8 percent volatility per month), Acceptable level (5.1-8 percent volatility), Excellent level (2.1-5 percent volatility) and Optimal level (less than 2 percent volatility).

- Beneficiary Reach: Measured by the proportion of shipments directed to food-insecure countries or least developed countries (LDCs) as classified by the World Food Programme and United Nations Development Programme. This indicator reflects the corridor's success in serving populations most vulnerable to grain supply disruptions. (UNCTAD, 2023).

Table 3: Humanitarian Impact Indicators.

INDICATOR	BASIC	ACCEPTABLE	GOOD	OPTIMAL
Price Stabilization (monthly volatility %)	>8	5.1 to 8	2.1 to 5	≤2
Beneficiary Reach (% to food-insecure countries)	<15	15 to 25	25 to 40	>40

Source: Authors.

3.3. Analytical Procedures.

Data analysis employs descriptive statistics to characterize corridor performance across different indicators; time series analysis to identify temporal patterns or phases; comparison of pre-conflict and corridor operation periods; and correlation analysis to examine relationships between operational variables and outcomes. We used standard formulas for statistical calculations. Price data, following the Laspeyres Index[4] method, was treated according to FAO standards.

Different validation procedures ensure that the findings are accurate and reliable. To confirm the accuracy of information from the Joint Coordination Centre, we use triangulation to identify discrepancies between our data and media reports. Temporal analysis examines the consistency of patterns across operational phases. In this instance, we focus on a natural experiment: the corridor suspension in October 2022. Unlike other observations, we can observe the effects of the cessation on market prices and shipping volumes.

The framework's indicator thresholds are based on empirical observations from the BSGI case and normative standards drawn from the humanitarian literature (Beamon and Balcik, 2008; Tatham and Kovács, 2010). The methodological limitations are acknowledged, notably the reliance on published data. Because of this, they may miss classified security information. Reported official statistics may also be biased; consequence attribution is complex, and results have multiple causes in a complex environment. This method provides a way to systematically assess maritime corridor performance quantitatively in humanitarian terms while remaining appropriately cautious about conflict contexts. The framework can be used to plan future humanitarian maritime operations. It includes indicators and measurement methods. These indicators can be adapted across different geographic and geopolitical settings.

[4] The Laspeyres index measures price changes over time using a fixed basket of goods from a base period. It's calculated as $L = (\Sigma p1q0 / \Sigma p0q0) \times 100$, where p1 represents current prices, p0 base-period prices, and q0 base-period quantities. Essentially, it answers: "What would today's cost be for the same quantities purchased in the base year?" While widely used, it tends to overstate inflation since it doesn't account for consumer substitution toward relatively cheaper alternatives.

4. Results and Discussion.

The Black Sea Grain Initiative operated for one year, allowing 1,139 shipments, transporting about 32.9 million metric tons of grain to 45 countries (BSGI, 2024). Based on the investigation of the official BSGI database, the throughput suggests that the technical feasibility of maritime corridors for humanitarian assistance can be established in an active conflict zone. The performance, however, exhibited some unexpected characteristics that create doubts about conventional assumptions regarding operational maturity.

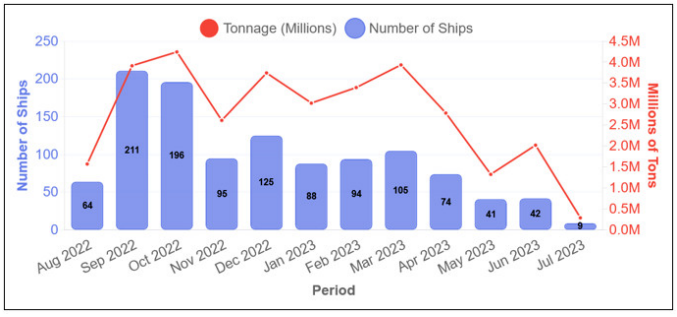
4.1. Operational Performance Assessment.

The vessel transit and cargo throughput, monthly shipment data reveals three operational phases that are counterintuitive. The first one, or "implementation phase" (August - October 2022), resulted in significant vessel throughput, with an average of 140 vessels each month (471 total shipments). This exceeded the 'optimal' threshold (>150 vessels/month), making the first phase the highest-performing period of the corridor.

The "consolidation phase", during November 2022-April 2023, saw a contradictory decline to an average of 84 vessels per month (579 total shipments) that fell to "Acceptable" levels of 50-100 vessels/month, as shown in Figure 3. This tendency contradicts long-standing assumptions about operational learning, suggesting that political factors rather than procedural ones determined vessel participation. Finally, the phase "terminal decline" in this initiative represents a clear drop in all indicators of ship traffic and grain tonnage until its end.

Cargo throughput remained stable in first and second phases at approximately 3.24 million metric tons monthly, indicating that fewer vessels during consolidation carried larger or more optimally loaded cargoes. The sustained volume of this commodity demonstrates performance in the "Good to Optimal" category (>2 million MT/month), representing approximately 50-60% of pre-conflict Ukrainian export capacity (UNCTAD, 2023).

Figure 3: Monthly Vessel Transits and Cargo Volume August 2022 - July 2023.

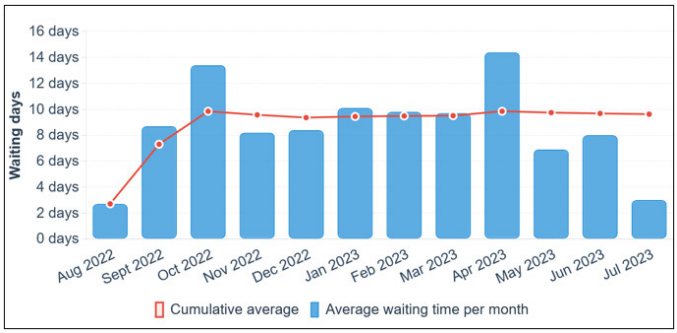


Source: Authors.

The inspection procedures represented persistent bottlenecks, contrary to improvement expectations. The initial phase averaged 9.8 days from departure to inspection completion, approaching "Basic" performance (>12 days). The consolidation stage showed minimal improvement. This essentially reveals the structural constraints of joint inspection regimes, which require agreement from parties with differing perspectives (IMO, 2022).

Most efficiency improvements occurred during the final phase with an average of 6.9 days, rated as "Good" (4-8 days timeframe). However, this improvement came belatedly, as the dramatic drop in vessel participation rendered efficiency gains strategically irrelevant (see Figure 4). Extended waiting periods exceeding 10 days created cascading delays that undermined overall operational efficiency.

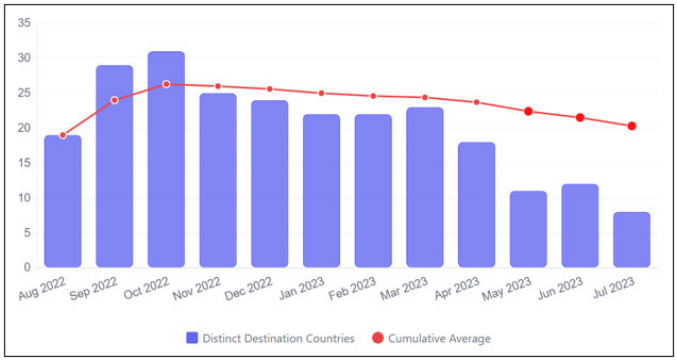
Figure 4: Inspection efficiency August 2022 - July 2023.



Source: Authors.

The corridor supplied grains to 45 countries, significantly exceeding the optimal threshold of more than 20 countries (see Figure 5). Approximately 30 percent of shipments reached food-insecure or least developed countries. The remaining 70 percent went to middle- and high-income markets. Thus, commercial priorities prevailed, though a meaningful humanitarian contribution occurred (UNCTAD, 2023).

Figure 5: Different Destination Countries by Month - Performance Levels.



Source: Authors.

4.2. Strategic Performance Evaluation.

Regarding the incident Analysis and security Provision, via transit of designated routes, no mine incident or kinetic attack occurred against participating vessels. This suggests effective security provision or successful deterrence. Despite the agreement signaling non-attack, Russia conducted attacks on port in-

frastructure, including strikes on Odessa terminals just 24 hours after signing (Vazquez, 2023). Vessel navigation GPS jamming caused continual operational challenges, which corridor security could not adequately resolve (Bueger, 2015).

The operational continuity and diplomatic Fragility proved that the corridor was highly susceptible to diplomatic breakdown. Russia suspended its participation from 29 October to 2 November 2022 following a Ukrainian drone attack on the naval base in Sevastopol (Council of the European Union, 2025; United Nations, 2023). Despite lasting only three days, the incident triggered immediate market reactions. In October 2022, the FAO Cereal Price Index increased by 3.0%, demonstrating that market sensitivity operated through expectations rather than actual physical supply disruption (FAO, 2022). Subsequent renewals were increasingly contentious, with November 2022 securing only a four-month extension and then 60-day extensions (March and May 2023) reached at the last minute through brinkmanship. Russia's refusal to renew in July 2023 confirmed the necessity of sustained political will to ensure corridor viability.

A deep analysis of the compliance with maritime security frameworks shows that the corridor successfully implemented principles closely resembling the Naval Cooperation and Guidance for Shipping (NCAGS) proposal, establishing vessel registration systems, designated routes, joint inspection protocols, and real-time coordination. These results validated NATO ATP-02 doctrine concepts regarding civilian-military maritime collaboration (NATO, 2018; Madariaga et al., 2013). However, the corridor's collapse also exposes that these structures are only operational as long as political will persists, lacking independent sustainability mechanisms once it dissipates.

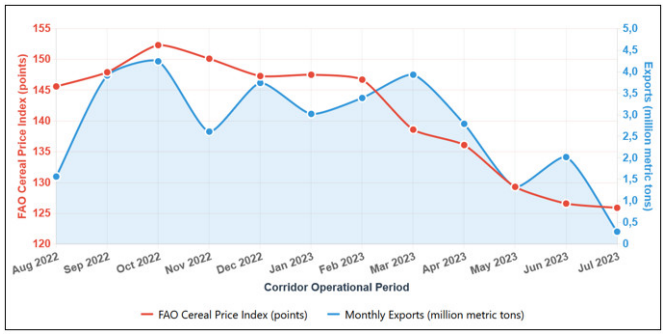
4.3. Humanitarian Impact Evaluation.

The most important indicator was the price Stabilization for Global Cereals, in July 2022, the FAO Cereal Price Index stood at 147.3 points during corridor initiation. Corridor establishment brought immediate stabilization, with the index declining to 145.6 points in August 2022 (-1.2% monthly variation). Through ongoing decline during consolidation, as shown in Figure 6, the index reached 124.3 points by April 2023, representing a cumulative decrease of 15.6% from the July peak. Monthly performance remained within the 2-5% range, classified as "Good" and occasionally "Acceptable" (FAO, 2022).

The three-day suspension in October 2022 resulted in a significant 3% price impact, considerable given the large market capitalization involved. During the final phase, volatility increased, with the index rising to 127.8 points (+2.8%) in July 2023. The impacts of developments regarding Ukraine's alternative export routes were less severe than initially anticipated.

If an evaluation is carried out regarding the beneficiary reach and the supply chain restoration, Ukraine exported significant quantities of wheat to Somalia, Ethiopia, Yemen, and Kenya. In that order, they received 1.1 million metric tonnes, 815,000 metric tonnes, 725,000 metric tonnes, and 590,000 metric tonnes, much through World Food Programme procurement (UNCTAD, 2023). The majority of commercial recipients were China (8 million MT, 24% of total), Spain (3.2 million MT), Turkey

Figure 6: FAO Cereal Price Index vs Grain Corridor Exports.



Source: Authors.

(2.8 million MT), and Italy (2.1 million MT). This 70%-30% commercial-humanitarian split demonstrates the corridor functioned primarily as a commercial export route with humanitarian benefits as ancillary outcomes.

The 32.9 million metric tons exported represents approximately fifty to sixty percent of normal annual Ukrainian volumes, indicating significant but incomplete supply chain restoration. Damaged port infrastructure, mine presence limiting berthing facilities, and reduced agricultural production constrained profitable foreign sales, which nevertheless kept the agricultural sector engaged and helped prevent Ukraine's economic collapse. Partial capacity restoration prevented markets from completely excluding Ukrainian supplies.

Systematic analysis identifies diplomatic viability as the most essential requirement of corridor sustainability. The corridor's termination despite functional operation demonstrates that diplomatic consensus cannot be considered permanent when arrangement structures conflict with broader conflict dynamics. Russia's termination decision reflected its assessment that continued participation no longer served its strategic interests, exemplifying how humanitarian considerations become secondary to warfare objectives.

The temporal behaviour showing greatest vessel throughput during initial implementation followed by consolidation-phase decline is counterintuitive, challenging traditional operational maturation assumptions. Peak performance resulted from initial momentum rather than institutional learning or gradual improvement, and the decline revealed political rather than operational influence on participation levels. This pattern demonstrates that operational excellence cannot overcome eroding political will.

Political constraints significantly affected effectiveness via institutional design characteristics. The inspection regime introduced chronic efficiency restrictions; 10-day intervals in Phases 1-2 revealed structural limitations that organizational learning could not overcome. Market reaction to the October 2022 suspension demonstrates that expectations influence behaviour differently than actual supply and demand dynamics. Geographic and infrastructural conditions imposed strict developmental limits because Ukrainian port capacity during wartime could not match peacetime levels achieved when security provisions or diplomatic commitments were in place.

As Table 4 demonstrates, the BSGI achieved optimal performance in incident frequency (zero kinetic attacks) and operational continuity (99.2%), reflecting exceptional physical security provision. The humanitarian indicators show a 15.6% decline in the FAO Cereal Price Index and approximately 30% of shipments reaching food-insecure countries, supporting the corridor's dual commercial-humanitarian function. Future maritime corridor assessments can independently verify these findings and replicate the framework thanks to the presented calculation methodologies.

Table 4: BSGI Performance Metrics: Measurements, Results, and Calculations.

INDICATOR	MEASUREMENT	BSGI RESULT	CALCULATION	EVIDENCE
Strategic Indicators				
Incident Frequency	Kinetic attacks on participating vessels.	0 attacks	0 incidents / 1,139 shipments = 0%.	Zero kinetic attacks during entire 12-month period.
Operational Continuity	Days operational without interruption.	99.2%	(365 days - 3 days suspension) / 368 total days × 100.	Only one 3-day suspension (Oct 29-Nov 2, 2022).
Compliance and Coordination	NCAGS principles implementation.	Strong	Successful JCC operations, joint inspections, protocol adherence.	Four-party coordination maintained despite conflict.
Humanitarian Indicators				
Price Stabilization	FAO Cereal Price Index variation.	15.6% decline	(147.3 Jul 2022 - 124.3 Apr 2023) / 147.3 × 100.	The index fell from 147.3 to 124.3 points; the average monthly volatility 2-5%.
Beneficiary Reach	Shipments to food-insecure countries.	~30%	~340 shipments to food-insecure/LDC from 1,139 total.	Somalia 1.1M MT, Ethiopia 815K MT, Yemen 725K MT, Kenya 590K MT.

Source: Author's elaboration based on BSGI database and FAO.

The Table 5 reveals a predominantly 'Good' to 'Optimal' performance profile across most indicators. Strategic indicators achieved optimal levels in both incident frequency and operational continuity, while compliance and coordination reached 'Good' classification. Humanitarian indicators uniformly achieved 'Good' performance, with price stabilization showing 2 - 5% monthly volatility, beneficiary reach at ~30% to food-insecure countries, and supply chain restoration at 50-60% of pre-conflict capacity. This balanced performance across dimensions confirms the corridor's technical feasibility while highlighting the political constraints that ultimately limited its sustainability.

Table 5: BSGI Performance Level Classification by Indicator Category.

INDICATOR	BSGI RESULT	PERFORMANCE
Strategic Indicators		
Incident Frequency (incidents per 100 transits)	0	Optimal
Operational Continuity (%)	99.2	Optimal
Compliance and Coordination (qualitative)	Strong	Good
Humanitarian Indicators		
Price Stabilization (monthly volatility %)	2-5	Good
Beneficiary Reach (% to food-insecure countries)	~30	Good
Supply Chain Restoration (%)	50-60	Good

Source: Author's elaboration based on BSGI database and FAO.

Conclusions.

In this study, we develop and implement a comprehensive quantitative framework that assesses the effectiveness of humanitarian maritime corridors in active conflict zones, using the Black Sea Grain Initiative as a case study. The results demonstrate that these systems can function effectively but also expose structural vulnerabilities.

The framework developed for analysis comprises three levels (operational, strategic, and humanitarian) that enable systematic evaluation rather than mere descriptions found in other literature. The quantitative indicators that were established can be replicated in future assessments and provide performance thresholds based on empirical observations from the BSGI case and normative standards from humanitarian operations research.

Study findings reveal a paradox in corridor performance. Conventional expectations of gradual operational maturity increase were confounded by results showing the first phase (140 vessels/month) to be busier than the second phase (84 vessels / month). This counterintuitive behaviour suggests that political factors, rather than procedural ones, drove participation. Therefore, operational excellence could not compensate for eroding political will.

The corridor demonstrated mixed results on humanitarian impacts. The FAO Cereal Price Index declined by 15.6%, during the operational period, and 30% of shipments were directed to food-insecure countries. The fact that commercial shipments to middle- and high-income markets account for 70 percent indicates it functioned as a commercial export route with some humanitarian benefit, rather than a humanitarian corridor per se. This raises the question of optimal institutional design for corridors aimed at maximizing humanitarian impact. The temporary suspension, in October 2022, was short-lived, and during the three-day halt, global markets were relatively unaffected.

The analysis of inspection efficiency reveals that structural deficiencies persist. The initial phase averaged 9.8 days inspection time, improving marginally to 8.2 days, during the consolidation period. This demonstrates joint inspection limitations and insufficient organizational learning. The reduction to 6.9 days during the final phase when participation dropped sharply indicates that efficiency gains came too late to influence the corridor's strategic development.

The most compelling evidence that maritime humanitarian corridors depend on sustained agreement is Russia's unilateral termination of the corridor, in July 2023, despite successful operations. Technical structures and coordination mechanisms are insufficient without sustained political will. This dependence constitutes the main vulnerability of these initiatives.

The implications for future humanitarian maritime corridors are evident. First, institutional design must anticipate potential loss of political will by incorporating incentives to continue participation and diminished reliance on consensus. Second, procedural optimization is valuable but cannot compensate for diplomatic fragility. Third, inspection efficiency requires immediate attention from the outset. Late improvements have limited strategic relevance.

This study acknowledges important limitations. Using publicly available data may exclude classified security information, which limits the findings. Attributing causes in complex cases presents challenges for researchers. Future studies should examine alternative institutional designs that reduce vulnerability to political will changes, as well as whether this framework fits other geographic and geopolitical contexts.

The BSGI case study, indicates that humanitarian maritime corridors can generate considerable operational throughput and measurable humanitarian impact even in conflict zones. However, their sustainability depends on more than technical performance, highlighting the need to embed greater resilience against diplomatic fragility in future corridor design.

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