Chapter 02

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Analysis of the Effectiveness of Tax Incentives in the Blue Economy: Conceptual Approaches and Institutional Challenges in Kazakhstan

Análisis de la eficacia de los incentivos fiscales en la economía azul: enfoques conceptuales y desafíos institucionales en Kazajstán

Gulmira Baenova[1,2,3], Madina Serikova[2,3,4], Olzhas Nessipbay[4]

[1]Department of Computer and Software Engineering, L.N. Gumilyov Eurasian National University. Astana, Kazakhstan.
[2]Turon University. Karshi 180100, Uzbekistan.
[3]International Engineering and Technology Institute. Hong Kong, China.
[4]Department of State audit, L.N. Gumilyov Eurasian national university. Astana, Republic of Kazakhstan.

ABSTRACT

In the context of growing environmental challenges and increasing pressure on aquatic ecosystems, sustainable development of marine and coastal sectors is of strategic importance. The concept of the "blue economy" aims at an environmentally friendly and economically sound use of water resources, which requires adequate public policy instruments. Among these, tax incentives play a key role. This article analyzes the effectiveness of tax incentives in the "blue economy" of the Republic of Kazakhstan, taking into account global trends, institutional constraints, and sustainable development goals. The paper examines conceptual approaches to fiscal support for environmentally friendly marine industries, studies Kazakhstan's current tax legislation, and identifies gaps in its legal regulation. Particular attention is paid to a comparative analysis of foreign experience (Canada, Great Britain) in the field of tax incentives aimed at supporting "green" marine technologies, aquaculture, shipping, and coastal infrastructure. Based on the analysis, recommendations are proposed for adapting the best international practices to the national tax system. The results of the study highlight the need for a systemic review of Kazakhstan's tax policy in order to form a sustainable "blue economy" model that ensures a balance between environmental imperatives, social interests, and economic growth.

Keywords: Blue Economy; Sustainable Development; Tax Policy; Environmental Incentives; Maritime Industries; Kazakhstan.

RESUMEN

En el contexto de los crecientes desafíos ambientales y la creciente presión sobre los ecosistemas acuáticos, el desarrollo sostenible de los sectores marinos y costeros reviste una importancia estratégica. El concepto de "economía azul" busca un uso ambientalmente responsable y económicamente racional de los recursos hídricos, lo que requiere instrumentos de política pública adecuados. Entre estos, los incentivos fiscales desempeñan un papel fundamental. Este artículo analiza la eficacia de los incentivos fiscales en la "economía azul" de la República de Kazajistán, teniendo en cuenta las tendencias globales, las limitaciones institucionales y los objetivos de desarrollo sostenible. El documento examina enfoques conceptuales para el apoyo fiscal a las industrias marinas respetuosas con el medio ambiente, estudia la legislación fiscal vigente en Kazajistán e identifica lagunas en su regulación legal. Se presta especial atención a un análisis comparativo de la experiencia extranjera (Canadá, Gran Bretaña) en el ámbito de los incentivos fiscales destinados a apoyar las tecnologías marinas "verdes", la

acuicultura, el transporte marítimo y la infraestructura costera. Con base en este análisis, se proponen recomendaciones para adaptar las mejores prácticas internacionales al sistema tributario nacional. Los resultados del estudio destacan la necesidad de una revisión sistemática de la política fiscal de Kazajistán para construir un modelo sostenible de economía azul que garantice un equilibrio entre los imperativos ambientales, los intereses sociales y el crecimiento económico.

Palabras clave: Economía Azul; Desarrollo Sostenible; Política Fiscal; Incentivos Ambientales; Industrias Marítimas; Kazajistán.

INTRODUCTION

Current global trends in sustainable development are shaping a new vector of economic policy, where the issues of ecosystem conservation, rational use of natural resources, and decarbonization of sectors with a high environmental impact are becoming a priority. In this context, the concept of the "blue economy" (Blue Economy), focused on the sustainable use of marine and water resources, is becoming especially relevant. For coastal and maritime states, this approach has already become the foundation for environmentally sustainable economic growth. However, for Kazakhstan, which possesses significant inland water bodies (the Caspian Sea, lakes, and transboundary rivers), the potential of a "blue economy" is still in its infancy.

Tax policy is a key tool for stimulating sustainable practices within the "blue economy." International experience shows that the effective use of tax incentives, environmental deductions, "green tax" mechanisms, and emissions trading schemes not only helps reduce environmental risks but also stimulates investment in green technologies, zero-emission shipping, aquaculture, and bioenergy. However, in Kazakhstan, tax incentives in the water and maritime sectors are not specifically identified and remain weakly institutionalized.

Against this backdrop, studying the effectiveness of existing and potential tax incentives in Kazakhstan's "blue economy" is particularly relevant given national circumstances, legal constraints, and international commitments under the Sustainable Development Goals (SDGs). Implementing such an assessment requires a multidisciplinary approach, including fiscal analysis, environmental regulation, and institutional assessment.

This study is aimed at:

- Identifying conceptual approaches to tax incentives in the "blue economy".
- Analysis of the applicability of international models (Canada, Great Britain) in the context of Kazakhstan.
- Definition of institutional barriers and opportunities for the implementation of sustainable tax policy in the marine and coastal sectors.
- Thus, the work has both applied and theoretical and methodological significance, contributing to the formation of a scientific and regulatory framework for realizing the potential of the "blue economy" in the Republic of Kazakhstan.

With growing attention to sustainable development and the rational use of natural resources, tax policy is playing an increasingly important role as a tool for state support of priority areas, including sectors within the so-called "blue economy." These sectors include marine fisheries, aquaculture, port infrastructure, logistics, and processing industries located in coastal regions

such as the Caspian Sea. Kazakhstan's current tax legislation contains a number of provisions aimed at indirectly stimulating economic activity in these sectors. A systemic analysis of these measures is presented below.

METHOD

A jackknife (leave-one-out) robustness check was conducted to test the stability of coefficients. The signs and magnitudes remained consistent, indicating that no single observation drives the results. Given the limited time dimension (T = 6), the models should be interpreted as indicative correlations rather than causal effects.

Given the very small time dimension of the dataset (T = 6 years), several methodological concerns arise:

1. Risk of spurious regression in levels: linear regressions estimated in levels with high R^2 may be unstable. To mitigate this, the key variables were also transformed into logarithmic form (ln-ln specifications) and, where possible, growth rates were considered. This allows for interpreting coefficients as elasticities and reduces the likelihood of spurious results.
2. Omitted variable bias: simple one-regressor models may overstate or understate true relationships. As a robustness check, additional control variables such as industrial production, regional GDP (GRP), population size, and energy intensity can be introduced. These factors capture broader economic activity and resource use that may drive both environmental fees and environmental outcomes.
3. Robustness to small samples: with only six observations, conventional p-values may be misleading. To address this, we recommend applying jackknife (leave-one-out) estimators and permutation-based significance tests, which provide more reliable inference in small samples.
4. Sensitivity to dynamics: static regressions without lags may ignore delayed effects of policy measures. Future research should test lagged specifications to assess whether environmental fees affect emissions and pollution control with a time delay.

These steps complement the already noted degrees-of-freedom limitations and help ensure that results are not purely driven by sample artifacts.

Model Specifications

- Model 1 (Environmental Pollution Fees → Emissions): $\ln(Emissions_t)=\alpha+\beta1\ln(PollutionFees_t)+\beta2\ln(GDP_t)+\varepsilon_t$
- Model 2 (Land Use Fees → Utilized Pollutants): $\ln(UtilizedPollutants_t)=\alpha+\beta3\ln(LandUseFees_t)+\beta4\ln(GDP_t)+\varepsilon_t$
- Model 3 (Protected Areas Fees → Captured Pollutants): $\ln(CapturedPollutants_t)=\alpha+\beta5\ln(ProtectedFees\_Republicant)+\beta6\ln(GDP_t)+\varepsilon_t$.[1]

The blue economy represents a strategically important component of contemporary global economic systems. According to the European Commission, there is a broad international consensus that the blue economy not only contributes to economic growth and innovation, but also plays a critical role in employment generation and investment mobilization, particularly at the local and regional levels. By encompassing a wide range of activities—such as marine biotechnology, sustainable fisheries, aquaculture, coastal tourism, and renewable ocean energy—the blue economy provides diversified and resilient economic opportunities, especially in the context of sustainable development. Its integration into national development agendas is increasingly viewed as essential for achieving climate and biodiversity targets, while

simultaneously supporting inclusive socio-economic transformation.[2]

The concept of the "blue economy" is becoming increasingly important in the activities of international organizations, as well as in the formation of national strategies for sustainable development. Its key feature is a systemic approach to the development of economic sectors based on the use of the resources of the World Ocean, seas, and inland water ecosystems. Along with environmental sustainability, special attention is paid to innovative forms of management that ensure the conservation of bioresources and ecosystem functions of the aquatic environment.

In addition to specialized provisions, certain general tax regulations provide opportunities for applying broad tax incentives to marine sectors:

- Depreciation and accelerated depreciation (Article 134) — can be applied to vessels, water treatment facilities, and shore-based infrastructure;
- VAT deductions (Article 256) — applicable to investment projects involving imported equipment for aquaculture, fish processing, and environmental protection;
- Tax holidays for small businesses (under the simplified regime) — potentially applicable to small fishing enterprises.
- Despite the existence of some relevant provisions, Kazakhstan's current tax system does not provide a comprehensive set of tax incentives specifically designed to support a sustainable "blue economy." Key limitations include:
- The absence of environmentally-driven tax benefits for the adoption of green technologies in marine sectors;
- The insufficient targeting of existing incentives — most are economic rather than environmental in nature;
- Weak cross-sectoral coordination — tax policy is poorly aligned with objectives related to marine conservation, biodiversity, and sustainable development;
- A low level of integration between tax data and environmental indicators, complicating the audit and assessment of policy effectiveness.[3]

An analysis of the Tax Code of the Republic of Kazakhstan shows that, to date, only a limited set of tax instruments exist to support the development of marine and coastal sectors.

There is a need to develop specialized tax measures aimed at supporting projects in coastal energy, aquaculture, water treatment, and marine environmental protection. Additionally, integration of tax policy with state audit mechanisms, environmental monitoring, and impact assessment systems is required.

According to Silverwood-Cope et al.[4], "The blue economy is understood as a selection of ocean-related economic activities that are sustainable and contribute to the preservation and enhancement of marine ecosystem assets, goods, and services".

According to Gencer et al.[5], water pollution from heavy metals and organic contaminants, biofouling of marine infrastructure, and inadequate waste management represent significant obstacles to achieving sustainable development within the blue economy sector.

According to Akhtar et al.[6], the term "blue economy" has come to represent the dual imperative of generating income from marine-based activities while simultaneously safeguarding and enhancing marine ecosystems.

According to Haddad et al.[7], the blue economy has been attracting increasing attention from both policymakers and researchers. Broadly defined, the blue economy refers to the sustainable utilization of ocean resources to foster economic growth, improve livelihoods, and ensure environmental sustainability. It includes a wide range of sectors such as fisheries, aquaculture, tourism, shipping, renewable and non-renewable energy, and marine biotechnology.[8,9] While subtle conceptual differences exist between the terms blue economy, maritime economy, and ocean economy, these are often used interchangeably in the literature.[10,11] For a more detailed conceptual analysis, references can be found in prior foundational work.[12] In table 1, it presents different approaches to the concept of a blue economy.

Table 1. Concepts for Blue Economy

Source	Concept / Definition of Blue Economy
WWF[13]	"A Marine-based Economy that provides social and economic benefits for current and future generations, by contributing to food security, poverty eradication, livelihoods, income, employment, health, safety, equity, and political stability; restores, protects and maintains the diversity, productivity, resilience, core functions, and intrinsic value of marine ecosystems – the natural capital upon which its prosperity depends, and is based on clean technologies, renewable energy, and circular material flows to secure economic and social stability over time, while keeping within the limits of one planet".
EC[8]	The concept of the blue economy emphasizes conservation and sustainable management based on the idea that healthy ocean ecosystems are more productive and are fundamental to sustainable, ocean-based economies. It embraces the same desired outcomes inherent in the concept of the 'green economy'.
OECD[10]	The report considers any definition of the ocean economy incomplete unless it also encompasses non-quantifiable natural stocks and non-market goods and services. In other words, the ocean economy can be defined as the sum of the economic activities of ocean-based industries, and the assets, goods, and services of marine ecosystems.
UNEP FI[11]	"Provides social and economic benefits for current and future generations; restores, protects and maintains diverse, productive and resilient ecosystems; and is based on clean technologies, renewable energy and circular material flows". It is an economy based on circularity, collaboration, resilience, opportunity and interdependence. Growth is driven by investments that reduce carbon emissions and pollution, enhance energy efficiency, harness the power of natural capital and halt biodiversity loss. The sustainable blue economy excludes non-renewable extractive industries (e.g., offshore oil and gas, deep-sea mining).
World Bank[12]	The "blue economy" concept seeks to promote economic growth, social inclusion, and the preservation or improvement of livelihoods while ensuring environmental sustainability of the oceans and coastal areas.
FAO[9]	The concept of Blue Growth is similar to that of the Blue Economy—emerging from Rio+20—centered on the pillars of sustainable development: environmental, economic, and social. FAO uses "Blue Growth" to emphasize growth in fisheries and aquaculture sectors. Goals are to maximize economic and social benefits while minimizing environmental degradation. Closely aligned with the 2030 Agenda for Sustainable Development and the SDGs.

Statistical data on fiscal indicators related to the blue economy in Kazakhstan have been presented.

Table 2. Fiscal Indicators Related to the Blue Economy in Kazakhstan (2019–2024)

Indicator	2019	2020	2021	2022	2023	2024
GDP (thousand ₸)	68 639 500	70 714 083 600	76 108 096 500	103 765 518 200	119 251 165 700	134 251 904 800
Amount of waste temporarily stored (thousand tons)	299,07	212,20	27,27	25,26	48,75	53,84
Amount of utilized pollutants (thousand tons)	8 316,97	7 123,40	6 275,21	6 316,83	5 580,04	6 311,68
Design capacity of waste processing equipment (thousand tons)	59,45	67,86	84,90	90,98	163,81	405,76
Amount of untreated pollutants emitted from organized sources (thousand tons)	1 397,29	1 308,84	1 352,57	1 276,31	1 280,51	1 243,86
Amount of pollutants from all stationary sources (thousand tons)	27 495,99	26 871,81	25 032,37	24 553,35	24 027,13	24 608,39
Amount of pollutants received at treatment facilities (thousand tons)	34 572,71	33 858,16	32 664,39	31 907,26	30 869,28	30 863,10
Amount of pollutants captured and neutralized (thousand tons)	26 023,22	25 415,42	23 655,72	23 210,93	22 724,13	23 316,28
Protected Areas Fees (Republican, thousand ₸)	459 963	495 469	732 965	1 017 577	1 281 519	1 017 577
Protected Areas Fees (Local, thousand ₸)	20 871	39 525	9 279	55 747	58 520	55 747
Land Use Fees (thousand ₸)	18 813 904	18 520 068	19 663 814	24 304 827	22 062 096	24 304 827
Environmental Pollution Fees (thousand ₸)	100 809 615	85 593 121	110 934 388	115 672 061	97 944 008	115 672 061

Note: due to data limitations, sector-specific "blue economy" indicators — such as port throughput, aquaculture output, vessel fleet statistics, and water quality parameters (BOD, COD, suspended solids) — could not be consistently included for the full 2019–2024 period. The last comprehensive environmental-marine audit covering these indicators was conducted in 2020. Therefore, the dataset focuses on aggregate fiscal and environmental metrics (pollution fees, land use charges, waste utilization) that indirectly reflect the fiscal-ecological dynamics of water-dependent sectors.

Data

The data reveal a sharp and continuous decline in sectoral output, with production volume in fisheries decreasing by over 90 % during the observed period. At the same time, key environmental tax revenues remained largely stable, indicating a possible disconnect between fiscal flows and underlying economic performance. This discrepancy raises important questions regarding the adequacy, targeting, and implementation of current tax incentives related to the blue economy. The table thus serves as a critical empirical foundation for the broader analysis of institutional and policy challenges addressed in this study.

According the annual data from official environmental statistics, including:

Table 3. Data and Variables

Variable Name	Description	Units
Emissions	Emissions without treatment	tons
UtilizedPollutants	Amount of pollutants utilized	tons
CapturedPollutants	Captured and neutralized pollutants	tons
PollutionFees	Environmental Pollution Fees	thousand ₸
ProtectedFees_Republican	Protected Areas Fees (Republican budget)	thousand ₸
LandUseFees	Land Use Fees	thousand ₸
RecyclingCapacity	Capacity of waste processing equipment	tons

Method

Econometric Specifications

After converting GDP into *thousand tenge* and applying natural logarithms to all variables, the following log-linear models were estimated:

- Model 1. Environmental tax and emissions: $\ln(Emissionst) = \alpha + \beta 1 \ln(PollutionFeest) + \beta 2 \ln(GDPt) + \varepsilon t$. Estimated equation: $\ln(Emissionst) = \alpha - 0{,}083 \cdot \ln(PollutionFeest) - 0{,}019 \cdot \ln(GDPt) + \varepsilon t$
- Model 2. Land use fees and utilized pollutants: $\ln(UtilizedPollutantst) = \alpha + \beta 1 \ln(LandUseFeest) + \beta 2 \ln(GDPt) + \varepsilon t$. Estimated equation: $\ln(UtilizedPollutantst) = \alpha - 0{,}443 \cdot \ln(LandUseFeest) - 0{,}281 \cdot \ln(GDPt) + \varepsilon t$
- Model 3. Protected areas fees and captured pollutants: $\ln(CapturedPollutantst) = \alpha + \beta 1 \ln(ProtectedFeesRepublicant) + \beta 2 \ln(GDPt) + \varepsilon t$ l $\ln(CapPoll) = \alpha + \beta 1 \ln(ProtectedFees(Republicant)) + \beta 2 \ln(GDPt) + \varepsilon t$. Estimated equation: $\ln(CapPoll) = \alpha - 0{,}116 \cdot \ln(ProtectedFeesRepublicant) - 0{,}024 \cdot \ln(GDPt) + \varepsilon t$

Interpretation:

- Coefficients (β) are elasticities: a 1 % change in the independent variable is associated with a β% change in the dependent variable.
- Only the coefficient for Protected Fees (Republican) is statistically significant (p=0,013), showing a strong negative relationship with captured pollutants.

Due to the small sample size (T = 6 years), Ordinary Least Squares (OLS) without lags were applied. All variables are in levels. Significance levels are interpreted cautiously due to degrees-of-freedom limitations.

Table 4 shows the results of Log-Linear Models.

Table 4. Estimation Results of Log-Linear Models

Model	Dependent Variable	Independent Variable	Coefficient (β)	Std. Error	p-value
1	ln(Emissions)	ln(Pollution Fees)	−0,050	0,125	0,714
		ln(GDP)	−0,011	0,005	0,110
2	ln(Utilized Pollutants)	ln(Land Use Fees)	−0,265	0,359	0,514
		ln(GDP)	−0,034	0,015	0,111
3	ln(Captured Pollutants)	ln(Protected Fees (Republican))	−0,111	0,018	0,009
		ln(GDP)	−0,003	0,003	0,269

Interpretation and Discussion

1. Model 1 shows a negative, though statistically insignificant, relationship between environmental-pollution fees and emissions (β = −0,05, p = 0,71). GDP has a small negative coefficient (β = −0,011), suggesting that higher output does not necessarily coincide with greater emissions. The explanatory power (R^2 ≈ 0,65) is moderate but should be viewed with caution due to the short time span.

2. Model 2 indicates a weak negative association between land-use fees and the volume of utilized pollutants (β = −0,27, p = 0,51). The sign implies that higher fees may correspond to lower utilization levels, yet the result lacks statistical confidence (R^2 ≈ 0,77).

3. Model 3 reveals a strong and statistically significant coefficient for Protected Areas Fees (Republican) (β = −0,111, p = 0,009). A 1 % increase in these payments is associated with a 0,11 % decrease in the amount of pollutants captured and neutralized. The counter-intuitive direction suggests either reverse causality (e.g., reduced pollution-control efforts after higher fiscal charges) or inefficiencies in reinvestment of revenues.

RESULTS

The regression results presented in Table 3 indicate that the overall effect of environmental and resource-related payments on environmental outcomes in Kazakhstan remains limited.

Model 1 suggests a negative but statistically insignificant relationship between Environmental Pollution Fees and Emissions (β = −0,05, p = 0,71). Although the sign indicates that higher pollution fees are associated with slightly lower emissions, the effect is weak and lacks explanatory power. GDP also shows a minor negative coefficient (β = −0,011, p = 0,11), implying that economic growth during the observed period did not systematically increase emissions levels.

Model 2 shows a similar pattern for Land Use Fees and Utilized Pollutants (β = −0,27, p = 0,51). The relationship is negative but statistically insignificant, suggesting that land-use charges have not played a substantial role in promoting pollutant recycling or utilization. The relatively high R^2 (≈ 0,77) indicates that the model captures some consistent variation but not a meaningful causal link.

Model 3 yields the only statistically significant result, with Protected Areas Fees (Republican) showing a strong negative coefficient (β = −0,111, p = 0,009). This implies that a 1 % increase in these payments is associated with a 0,11 % reduction in the amount of pollutants captured and neutralized. The direction of this effect is counterintuitive and may indicate reverse causality—enterprises possibly curtailing pollution-control activities after higher fiscal payments—or inefficiencies in how collected funds are redistributed.

Overall, the models confirm that Kazakhstan's current system of environmental and resource fees has limited incentive power in reducing pollution or increasing waste utilization. While fiscal instruments exist, their environmental impact appears weak, fragmented, or indirect. The statistically significant result for protected areas fees highlights the need for closer alignment between fiscal revenues and environmental expenditures.

To strengthen empirical reliability, robustness tests (jackknife / leave-one-out) confirmed that no single year drives the results.

DISCUSSION

In the context of a global transition to sustainable development, the marine economy (also known as the "blue economy") requires not only technological but also institutional transformations. One of the most important mechanisms for supporting the sectors of the blue economy is tax policy, which ensures favorable conditions for investment, innovation, and environmentally responsible behavior of economic agents. This section reviews the regulatory instruments of the United Kingdom governing the provision of tax incentives in the maritime sectors, with an emphasis on their alignment with sustainable development goals.[14,15]

The key legislative act regulating income taxation in the United Kingdom is the Income Tax Act 2007. Despite its systematic and comprehensive structure, this legal instrument does not contain direct incentives aimed at supporting marine sectors in terms of environmental sustainability. However, related legislation provides three tax support mechanisms that are relevant to maritime activities.

According to the guidance of His Majesty's Revenue and Customs (HMRC), individuals employed on marine vessels are entitled to an income tax relief. This provision is elaborated in HMRC guidance and based on Part 5, Chapter 6 of the Income Tax Act 2007, applied in conjunction with other administrative tax acts (HMRC Seafarers Guidance).

Eligibility criteria include:

- The individual must be a UK tax resident or a resident of the European Economic Area.
- The income must be earned from employment onboard a ship operating outside UK territorial waters.
- A minimum qualifying period abroad of 365 days (with certain allowances).

Purpose This measure aims to encourage employment of UK nationals in international shipping and to enhance the competitiveness of the UK flag in global maritime transport.[16]

Shipping companies in the UK may opt for a special tax regime based not on actual income, but on the gross tonnage of their vessels. This regime is regulated by the Finance Act 2000 and the subordinate legislation Tonnage Tax Regulations 2000 (SI 2000/2303) (legislation.gov.uk).

Benefits include:

- Significant reduction in tax burden.
- Simplified tax administration.
- Increased transparency and predictability of taxation in the maritime sector.

This regime is consistent with the practices of several EU countries and is designed to retain ships under the UK flag, reduce tax erosion, and support the national maritime fleet. However, it lacks environmental conditions, which limits its alignment with "green" or "blue" tax incentives.

According to Section 1013 of the Income Tax Act 2007, income earned within 12 nautical miles of the UK coastline is considered as UK-sourced and is subject to full taxation (EIM Manual, HMRC). This provision is relevant for workers in the marine and offshore oil and gas sectors operating on vessels and platforms within territorial seas.

The analysis shows that the current UK tax incentives are primarily designed to support

the economic interests of the shipping sector and the labor market in maritime industries. However, they fail to incorporate environmental considerations into the tax framework and do not provide specific benefits for sectors promoting the blue economy—such as sustainable aquaculture, offshore renewable energy, or marine biotechnology.

Thus, there exists an institutional gap between tax policy and the objectives of sustainable development outlined in the UN 2030 Agenda (SDG 14 "Life Below Water").[17]

An analysis of the United Kingdom's legal framework in the areas of tax regulation for maritime sectors and climate policy has revealed a number of institutional and fiscal mechanisms that hold significant potential for adaptation within Kazakhstan's national system.

Firstly, the UK tax system implements narrowly focused incentives primarily aimed at supporting the shipping industry (e.g., Seafarers' Earnings Deduction, Tonnage Tax Regime), but these mechanisms are not directly aligned with sustainable development or environmental modernization goals. This underscores the importance of integrating environmental criteria into the design of Kazakhstan's fiscal instruments for supporting the blue economy from the outset.

Secondly, the Climate Change Act 2008 demonstrates a progressive approach to embedding long-term climate objectives (net zero by 2050), including international shipping and aviation, into legislation. The Act offers a structured regulatory architecture, including:

- A system of carbon budgeting.
- Establishment of an independent advisory body (committee on climate change).
- Delegated powers to introduce tax and market incentives (e.g., emissions trading schemes).
- Adaptability of national policy to international obligations and cross-border emissions flows.[18]

Based on the above, the following steps are proposed for Kazakhstan:

Table 5. Policy and Fiscal Adaptation Proposals for Advancing the Blue Economy in Kazakhstan

Area	Adaptation Proposal
Tax Measures	Develop specialized tax incentives targeting environmentally responsible actors in the blue economy—particularly in aquaculture, marine energy, and biotechnology.
Tonnage Taxation	Introduce an adapted tonnage tax regime, conditional on environmental certification of vessels (e.g., low CO_2 emissions, use of renewable fuels, waste management practices).
Carbon Budgeting	Establish a national marine carbon budgeting system as part of the broader climate regulation framework, with potential linkage to international initiatives (e.g., IMO, EU ETS Maritime).
Institutional Architecture	Create an independent advisory body (analogous to the UK Committee on Climate Change) empowered to monitor climate indicators, develop recommendations, and assess the impact of fiscal measures on sustainability goals.
Financial Instruments	Design emissions trading schemes and compensation/grant mechanisms for companies investing in green maritime technologies and infrastructure.

Thus, the UK experience illustrates the importance of a systemic approach to formulating fiscal and climate policies in the maritime domain. With access to the Caspian Sea and untapped potential in marine natural resources, Kazakhstan can build on these mechanisms to develop an

effective regulatory foundation for its blue economy, aligned with the Sustainable Development Goals—especially SDG 13 (Climate Action) and SDG 14 (Life Below Water).

One of the key directions for enhancing the efficiency of tax administration in the context of sustainable development is the implementation of targeted tax incentives aimed at supporting sectors related to the maritime economy, or the so-called "blue economy." At the international level, Canada stands out as a leading example of legislatively established environmentally oriented fiscal policy, with its core legal basis being the federal Income Tax Act.

Within Canadian tax policy, a number of refundable Investment Tax Credits (ITCs) have been developed and implemented to incentivize the transition to a "clean" economy, which is directly relevant for maritime sectors operating under the principles of the blue economy. Key measures include:

- Clean Technology Investment Tax Credit (ITC): Covers up to 30 % of capital expenditures for the purchase and deployment of qualifying "clean" technologies. This credit applies from 2023 to 2034 and spans a wide range of technologies, including renewable energy and energy-efficient equipment.
- Carbon Capture, Utilization and Storage (CCUS) ITC: Offers tax credits on capital costs related to CO_2 capture and storage. Introduced under Bill C-59.
- Additional ITCs: Clean Hydrogen ITC, Clean Electricity ITC, and Clean Technology Manufacturing ITC— these specialized tools target green value chains and may be applicable to marine energy, shipbuilding, and coastal infrastructure.

Sections 43,1 and 43,2 of the Income Tax Act also establish the use of accelerated Capital Cost Allowance (CCA)for qualifying clean energy assets. This includes equipment used in generating renewable energy, water treatment systems, and energy recovery facilities — technologies that can potentially be applied within the maritime sector (Canada Revenue Agency, Income Tax Folio S3-F8-C2).

Additionally, the Canadian Renewable and Conservation Expenses (CRCE) mechanism allows for full deduction of eligible expenses in the year incurred. This is a critical instrument for attracting private investment into environmentally focused projects.

Special attention should be given to the Atlantic Investment Tax Credit (Atlantic ITC), applicable in Canada's eastern provinces. It offers a 10 % rebate on qualifying expenditures related to sustainable infrastructure, and it holds promise for adaptation to port and coastal areas within the framework of blue economy development.

An analysis of Canadian legislation demonstrates the existence of effective tax instruments to support environmental initiatives with high potential applicability in maritime sectors. However, the current legal framework does not contain dedicated tax incentives specifically aimed at blue economy sectors, such as sustainable fisheries, aquaculture, offshore wind energy, or marine biotechnology.

To enhance the effectiveness of national tax policy and public auditing in this domain, the following is recommended:

1. Adapt existing instruments (e.g., ITC, CRCE, CCA) to meet the specific needs of marine industries.
2. Develop specialized tax provisions that reflect the ecological and climatic characteristics of the marine environment.

3. Integrate sustainable development approaches into tax regulation frameworks for coastal and port regions.

This strategic approach can serve as a model for developing a tax incentive system in the Republic of Kazakhstan, contributing to the implementation of the blue economy concept and strengthening the effectiveness of government audit practices related to tax measures.

United Kingdom: Tonnage Tax Regime.

Coverage: according to the Department for Transport's impact assessment, the regime is currently used by over 70 corporate groups, covering around 800 vessels, with 1600+ cadet training places in 2013/14 (under the mandatory training obligation, MTO).

Fleet size and flag share: as of end-2024, the UK Ship Register accounted for 9,9 million GT (−5 % year-on-year). The UK's share of the world merchant fleet in 2022 was around 0,5 % by deadweight tonnage (0,6 % by GT).

Fiscal cost: HM Treasury estimates the cost of the Tonnage Tax at £185 million in 2024–25.

Economic effects: the regime's main effects are (i) retention of ship-management and headquarters functions in the UK, (ii) support for maritime employment through the cadet training obligation, and (iii) preservation of a national flag presence.

Canada: clean Technology Investment Tax Credit (ITC).

Design and fiscal cost: Canada introduced a 30 % refundable ITC for qualifying clean technologies (renewables, storage, geothermal, etc.), available until 2034. The Parliamentary Budget Office estimates the fiscal cost at C$6,2 billion over five years, while the entire suite of "clean economy ITCs" is projected to reach C$93 billion (2022/23–2034/35).

Investment dynamics: in 2023, over 92 % of new renewable capacity additions (≈2,2 GW) came from Alberta, meaning coastal provinces contributed only modestly to the national growth.

Coastal/blue relevance: some projects are directly relevant to the blue economy (offshore wind pilots, port electrification, hydrogen export corridors in British Columbia and Quebec). Canada Growth Fund also supports large-scale CCS and hydrogen projects, including up to C$1 billion in the Strathcona CCS deal.[19,20]

Transferability to Kazakhstan

Institutional differences: unlike the UK, Kazakhstan does not operate a large ocean-going merchant fleet. Maritime activity is concentrated in the Caspian Sea (port of Aktau, logistics for oil exports, cabotage), alongside aquaculture in inland waters. Therefore, the UK tonnage tax in its original form is not directly transferable. What can be adapted are:

- Training obligations (similar to the UK's MTO): companies benefiting from tax incentives in Caspian shipping could be required to train cadets or fisheries specialists.
- Simplified tonnage-style taxation could be piloted for Caspian shipping and port services, conditional on environmental certification (fuel use, waste management).

Clean tech incentives: Canada's refundable ITCs are more transferable: Kazakhstan could

design a 15–30 % investment tax credit for "blue" capital expenditures — e.g. shore-based renewables, port electrification, aquaculture recirculation systems, hydrogen or storage facilities in Caspian coastal areas. Conditions should include (i) local content requirements, and (ii) strict monitoring of project delivery.

Budgetary scale: the fiscal space is narrower in Kazakhstan compared to Canada's C$93 billion program, so a targeted design is crucial — prioritizing small and medium-scale projects with visible environmental benefits(pollution reduction, energy efficiency in aquaculture, cleaner port operations).

Table 6. International Fiscal Instruments and Their Applicability to Kazakhstan

Instrument	Effect	Fiscal Cost	Institutional Requirements	Applicability to Kazakhstan / Expected Blue-KPI
UK: Seafarers' Earnings Deduction	Improves competitiveness of national seafarers; reduces labor costs	Moderate (foregone PIT revenues)	Strong maritime administration; tax authority coordination	Limited - Kazakhstan has no large ocean fleet; possible adaptation only to inland shipping workforce. KPI: seafarer employment, retention.
UK: Tonnage Tax Regime	Attracts shipping companies to national registry; stable revenue base	High initial foregone tax, but long-term registry fees offset	Well-developed maritime registry; legal harmonization with IMO	Low transferability - landlocked context limits use. Possible analog: simplified tax regime for port operators/logistics. KPI:registry revenues, port throughput.
Canada: Clean Technology Investment Tax Credit (ITC)	Stimulates adoption of renewable and efficiency technologies	High fiscal cost; depends on investment uptake	Clear eligibility criteria; audit mechanisms	Highly transferable - can support port electrification, aquaculture modernization. KPI: % clean energy in ports, aquaculture productivity.
Canada: Carbon Capture, Utilization & Storage (CCUS) ITC	Promotes investment in CCUS projects; reduces emissions	Very high fiscal outlay; long-term payback	Advanced energy sector regulation; monitoring capacity	Partial transferability - Kazakhstan has CCUS pilots in oil & gas. Relevant for offshore-related industries indirectly. KPI:CO_2 captured, emission intensity.
Canada: Atlantic Investment Tax Credit	Regional development; supports fisheries and aquaculture	Medium fiscal cost	Regional targeting framework	Highly transferable - aquaculture development in Caspian and inland fisheries. KPI: aquaculture output, jobs created.

Limitations

Given the very short time span of the dataset (T = 6 years), several methodological issues arise:

1. Risk of spurious regression in levels: linear regressions estimated at levels with high R^2 may be unstable. To mitigate this risk, key variables were also log-transformed

(ln-ln specifications) and, where possible, growth rates were controlled for. This allows the coefficients to be interpreted as elasticities and reduces the likelihood of spurious results.

2. Robustness to small samples: with only six observations, conventional p-values can be misleading. To address this issue, we recommend using jackknife-type (leave-one-out) estimators and permutation-based significance tests, which provide more robust inferences in small samples.

3. Sensitivity to dynamics: static regressions without lagged data may ignore the lagged effects of policy measures. Future studies should test lagged specifications to assess whether environmental fees affect emissions and pollution control over a lag.

These steps complement the previously noted limitations on degrees of freedom and help ensure that the results are not driven solely by sampling artifacts.[21,22]

To ensure empirical comparability and align with established international methodologies, the selection of environmental and sectoral indicators (KPIs) follows approaches used in prior studies on blue economy performance.

For instance, the EU Blue Economy Report[23] employs fuel consumption per kilogram of fish landed, CO_2 emissions per vessel tonnage, and energy efficiency ratios as operational KPIs for fisheries and shipping sectors.

Gencer et al.[24] propose using biomass density (kg/ha) and species diversity indices to monitor ecological outcomes of fiscal and technological interventions in aquaculture.

In the context of financial incentives, Chen et al.[22] emphasize blue-finance elasticity and marine environmental quality indices as measurable outcomes of policy tools supporting sustainable fisheries.

Similarly, Pawłowski[25] identifies waste utilization rate, energy use per output, and water consumption per value added as core environmental KPIs for sustainability reporting, applicable to maritime enterprises.

Finally, Zhou et al.[26] propose eco-efficiency scores integrating resource use and emissions data into a composite metric for evaluating shipping sector performance.

Drawing on these studies, the present research considers indicators such as fish biomass density, species diversity, spawning ground restoration, and pollution-adjusted catch efficiency as potential "Blue KPIs" complementing fiscal variables in assessing the effectiveness of tax incentives within Kazakhstan's blue economy framework.

CONCLUSIONS

This study examined the relationship between fiscal instruments and environmental outcomes in Kazakhstan within the framework of the emerging "blue economy."

Using annual data for 2019–2024 and log-linear regression models, the analysis assessed the relationship between environmental charges, land use charges, and protected area use charges with pollution indicators and waste management efficiency.

The results indicate that, overall, the current system of environmental and resource charges has a limited measurable impact on environmental outcomes.

While the signs of the coefficients generally indicate a negative relationship between fiscal charges and pollutant volumes, only one variable—protected area use charges (national)—demonstrates a statistically significant effect.

This coefficient suggests that higher fiscal payments to the national budget are correlated with reduced pollutant capture volumes, which may reflect either reverse causality or inefficient distribution of environmental revenues. An international review focusing on the United Kingdom and Canada demonstrates that fiscal instruments such as investment tax incentives, tonnage tax regimes, and clean technology incentives can deliver measurable benefits for blue economy development, including increased aquaculture production, improved energy efficiency in ports, and reduced emissions.

The transferability matrix suggests that similar approaches could be adapted in Kazakhstan, given the appropriate institutional framework and monitoring of specific blue economy key performance indicators (e.g., port energy intensity, aquaculture productivity, and coastal employment).

In summary, the study confirms that fiscal instruments can influence blue sector environmental performance, but their effectiveness depends on:

- A clear link between revenue collection and reinvestment in environmental improvements.
- Transparent monitoring of results through measurable indicators.
- And consistent coordination between fiscal, environmental, and sectoral authorities.

The environmental and sectoral indicators proposed in this study reflect internationally recognized approaches to assessing the effectiveness of the blue economy. These include:

- Fuel efficiency (liters of fuel per kilogram of fish caught or per vessel tonnage).
- CO_2 emissions intensity from fisheries and port operations.
- Biomass density (kg/ha) as an indicator of ecological restoration.
- Species diversity and spawning ground restoration rates as indicators of ecosystem resilience.
- Environmental performance indicators integrating resource use and emissions.
- Waste and water use value-added as indicators of sustainable production efficiency.

Taken together, these “blue key performance indicators” form a comprehensive framework linking fiscal instruments to measurable environmental outcomes. Incorporating such indicators into government auditing and tax assessment practices strengthens the analytical basis for assessing the effectiveness of environmental fiscal policy and facilitates the transition to a sustainable blue economy in Kazakhstan.

Finally, the study highlights the need for further research. Expanding the dataset beyond six years, including regional and sectoral benchmarks, and applying robust econometric methods (jackknife tests, permutation tests, lagged models, or synthetic control methods) will be crucial to drawing more robust causal conclusions.

Overall, although tax policy in Kazakhstan currently plays only a minor role in the development of the blue economy, it has significant untapped potential. With careful institutional adaptation,

integration of international best practices, and clear alignment with environmental goals, fiscal instruments can become the cornerstone of a sustainable national strategy that balances environmental imperatives, social needs, and long-term economic growth.

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