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Integration of Climate Risks into Corporate Sustainability Strategies: A Case Study of Companies in the Aquaculture Sector

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ABSTRACT

Subject. The article addresses the integration of climate risks into corporate sustainability strategies, using the example of publicly listed companies in the aquaculture sector of Russia and Norway. **Objective.** To compare Norwegian companies (Mowi, Lerøy, and Grieg Seafood) with the Russian company INARCTICA in terms of the presence of sustainability strategies, identification and management of climate risks, and the existence of a dedicated governing body on the board of directors; and to systematize climate risks for companies operating in the Arctic region according to the classification standards of the Task Force on Climate-related Financial Disclosures (TCFD). **Results.** The study finds that Norwegian companies demonstrate higher maturity in managing climate-related risks. **Practical significance.** It is recommended that Russian companies enhance their sustainability strategies by conducting a qualitative assessment of climate risks in line with TCFD standards. The article outlines risk mitigation measures based on best international practices.

Keywords: sustainable development; corporate governance; climate risks; ESG strategy; climate reporting; TCFD; climate adaptation; aquaculture; low carbon development

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INTRODUCTION

According to reports by the World Economic Forum, environmental and climate-related risks have consistently ranked among the top global risks for several consecutive years. In 2025, risks associated with extreme weather events fell to second place behind armed conflicts. Nevertheless, in a ten-year perspective, they occupy the top four positions among the most significant risks — namely: extreme weather events, loss of biodiversity, depletion of natural resources, and anthropogenic environmental pollution (ecosystem degradation¹).

Combating climate change requires multilateral coordination of efforts at the international level, including within regional intergovernmental organizations. Thus, at the BRICS Summit held in Brazil in July 2025, the member states reaffirmed their commitment to the UN Framework Convention on Climate Change, while emphasizing the need to uphold the principle of “common but differentiated responsibilities and respective capabilities, taking into account different national circumstances.”² In this context, Russian companies have been adapting their ESG strategies to the evolving political and economic realities.

According to a 2024 study by the B 1 Group, 72% of large organizations have already revised or plan to update their sustainable development goals, focusing on national regulation, decarbonization, local supply chains, and reporting in line with Russian requirements. Nevertheless, there remains a strong interest in international standards (GRI, TCFD, ISSB), which underscores the strategic value of ESG tools for accessing the Asia-Pacific and MENA markets, as well as their importance for enhancing resilience and investment attractiveness.³

Against this backdrop, risks associated with the introduction of the Carbon Border Adjustment Mechanism (CBAM) by the EU and the UK have become increasingly relevant [1]. Despite the ongoing international debate surrounding this measure, Russian businesses are paying growing attention to climate

risks and threats. Unlike financial or geopolitical risks, climate-related risks cannot be neutralized through local managerial decisions or short-term diversification. They require a comprehensive approach that includes both technical mitigation measures and the strategic adaptation of business models to changing environmental conditions.⁴ Disclosure of ESG criteria — including climate-related risks — has a positive impact on financial performance [2]. In this context, the environmental component of ESG becomes a key factor of resilience, while climate risk management emerges as an integral part of long-term strategic planning [3].

This issue is of particular importance for industries whose activities directly depend on the quality and stability of the natural environment. Among these is aquaculture — a rapidly developing sector both in Russia and abroad. According to a UNEP,⁵ report, the impact of climate change on aquatic ecosystems has already become systemic, affecting both biota and infrastructure. Research published in *Nature Sustainability*⁶ has shown that more than 90% of global aquaculture sites are exposed to significant climate-related risks, including rising water temperatures, increasing parasitic risks, oxygen depletion, and instability of hydrological regimes [4, 5].

Nevertheless, despite the high vulnerability of the sector, most Russian companies have yet to demonstrate a mature strategy. Climate risks are generally not identified as a separate category in corporate reporting, are not quantitatively assessed, and are not disclosed in accordance with the standards of the Task Force on Climate-related Financial Disclosures (TCFD), the Carbon Disclosure Project (CDP), or the Science Based Targets initiative (SBTi). In this context, the question of Institutionalization climate risk management in Russian practice becomes particularly relevant, as does the adaptation of best international practices under conditions of limited regulation and methodological uncertainty.

¹ URL: <https://www.weforum.org/publications/global-risks-report-2025/>

² URL: <https://tass.ru/mezhdunarodnaya-panorama/24444363>

³ URL: <https://b1.ru/analytics/b1-esg-trends-survey-2023/>

⁴ URL: https://www.cbr.ru/Content/Document/File/143643/Consultation_Paper_21122022.pdf

⁵ URL: https://wedocs.unep.org/bitstream/handle/20.500.11822/45915/Executive-Summary-Foresight-Report_RU.pdf

⁶ URL: <https://www.ey.com/no/en/services/sustainability/climate-risk-in-aquaculture>

The current political and economic environment — including sanctions and limited access to international sustainable finance — requires a rethinking of ESG strategies within the Russian context. Despite these challenges, ESG approaches remain highly relevant, as they contribute to managing sanctions-related risks, strengthening stakeholder trust, and enhancing the internal resilience of companies. National rating agencies, such as ACRA, have adapted their methodologies to align with Russian regulatory realities, introducing an ESG rating scale (ESG-AAA to ESG-C) and an assessment of ESG maturity levels.

John Elkington's concept of corporate sustainability defines a corporation through the 3P model — People, Planet, Profit — whose elements form a symbiotic relationship [6,7]. This approach has become a standard framework for preparing corporate sustainability reports based on the disclosure of ESG factors.

The term ESG was first introduced in the report *Who Cares Wins*⁷ and is commonly used to describe the performance criteria of corporations [8]. Companies that integrate ESG factors are better positioned to manage operational and environmental risks and are less likely to face technogenic incidents resulting in financial losses or a decline in corporate value [9].

As evidenced by analyses conducted by the International Association of Credit Portfolio Managers (IACPM)⁸ and the global audit and consulting network KPMG⁹ in 2022 and 2025, respectively, environmental and climate risks have become an integral part of market, reputational, and credit risk assessment. Companies and financial institutions worldwide are adapting their internal structures, developing specialized risk assessment models, and strengthening corporate governance in the field of sustainability — reflecting the shift of ESG considerations into the category of mandatory elements of corporate strategy.

⁷ URL: <https://documents1.worldbank.org/curated/en/280911488968799581/pdf/113237-WP-WhoCaresWins-2004.pdf>

⁸ URL: https://members.iacpm.org/common/Uploaded%20files/Samples/Downloadable%20content/Research_ESG%20and%20Climate%20Risk/IACPM-Research-ESG-Climate-Risk-Management-Frameworks-White-Paper.pdf

⁹ URL: <https://assets.kpmg.com/content/dam/kpmg/gr/pdf/2025/01/gr-kpmg-esg-risk-survey-for-banks.pdf>

APPROACHES TO THE DEFINITION AND CLASSIFICATION OF ENVIRONMENTAL AND CLIMATE RISKS

Recent studies in the domain of corporate sustainability strategies have indicated a mounting emphasis on the incorporation of climate risks into management systems. In particular, M.A. Izmailova [10] and N.V. Pakhomova et al. [11] emphasize the role of ESG strategies as a key tool for enhancing corporate resilience.

A separate body of research is devoted to the study of climate risks. For example, Z. Korzeb and co-authors identified a low level of attention to this topic after analyzing 891 publications from 2000 to 2023 [12]. M. Akhtaruzzaman and other scholars, based on an analysis of 22,820 company observations across 13 countries, found a positive relationship between awareness of climate risks and the level of environmental innovation [13].

A. Ozkan, H. Temiz, and Y. Yildiz [14], as well as Y. Tang, D. Gao, X. Zhou [15], and D. Duan [16], demonstrated that the disclosure of such information positively correlates with ESG performance indicators and companies' financial results — particularly in sectors characterized by a high degree of digitalization and access to sustainable finance.

Russian researchers propose various classifications of environmental risks. For instance, A.V. Norko [17] and E.A. Alekseeva [18] categorize them according to: type of impact (direct/indirect), source (natural/anthropogenic), scale (local/regional/global), duration (acute/chronic), and manageability (controllable/uncontrollable). E.A. Alekseeva, in particular, highlights the need to distinguish between environmental risks that directly affect ecological safety and their economic consequences for businesses. L.A. Mochalova [19] identifies risks arising from technological, logistical, and natural-climatic factors as being particularly relevant to industrial enterprises.

The distinction between environmental and climate factors has not only conceptual but also practical significance for the development of corporate strategies. Environmental risks encompass a broad range of threats associated with the disruption of natural ecosystems, environmental pollution, resource degradation, and biodiversity loss. These

risks are typically local or regional in nature and can be directly linked to a company's production activities.

Climate risks, by contrast, are associated with global processes of climate change. Unlike environmental risks, they require long-term strategic planning, scenario analysis, and often cannot be mitigated through local measures alone [2, 12, 13].

Thus, environmental and climate factors should be viewed as intersecting but not identical categories: climate risks represent a specific subset of environmental risks, characterized by a high degree of uncertainty, cross-border impact, and long-term temporal horizon [12, 14, 16].

In international practice, the classification proposed by the Task Force on Climate-related Financial Disclosures (TCFD¹⁰) has gained the widest acceptance. The IFRS S 2¹¹ standard, adopted in 2023, formalized this approach by requiring disclosure of both climate-related risks and associated opportunities in corporate reporting. Accordingly, the following categories are distinguished:

- physical risks, resulting from acute events (e.g., hurricanes, floods) and chronic changes (e.g., global warming, sea-level rise);
- transition risks, arising from the shift toward a low-carbon economy (including regulatory, market, technological, and reputational factors).

The classification developed by the Bank of Russia is largely consistent with the TCFD.¹² framework. However, while about 80% of Russian companies disclose some form of climate-related information, only 20% align their reporting with the TCFD and IFRS S 2¹³ standards.

Based on the above, the following research questions were formulated:

1. How are climate risks addressed and incorporated in the strategic documents of companies within the aquaculture sector?

2. What types of climate risks are most relevant to aquaculture companies, and how do they correspond to the international TCFD classification?

3. What mitigation measures can be applied to reduce the impact of climate risks for Russian companies in this sector?

MATERIALS AND METHODS

For the analysis, PJSC "INARCTIKA" (hereinafter — Inarctica) was selected as the focus company — the largest aquaculture producer in Russia and the only publicly listed Russian corporation in this sector¹⁴ — along with its direct Norwegian competitors: Mowi ASA (Mowi), Grieg Seafood, and Lerøy Seafood Group (Lerøy). The key selection criterion was geographical comparability: all companies operate in the Barents Sea region under Arctic or sub-Arctic climatic conditions, ensuring the relevance of both climate-related risks and operational opportunities. The Norwegian companies are among the top 40 publicly listed firms in Norway by revenue.

The main data sources included:

- Annual and non-financial reports (including sustainability and climate reports in line with TCFD recommendations);
- ESG assessments from international agencies (CDP, Sustainalytics);
- Publications on official corporate websites;
- Industry analytical reviews;
- ESG ratings from Russian agencies (NRA, RAEX) for the analysis of Inarctica's case.

Climate risk assessment was based on the TCFD classification, which distinguishes between physical and transition risks. Additionally, content analysis of corporate strategies was conducted to identify climate-related goals, the degree of specificity, and the presence of quantitative targets.

The comparison criteria included both financial and non-financial indicators, such as: availability of climate and ESG strategies; participation in sustainability ratings; level of information disclosure; identified and reported climate-related risks.

¹⁰ URL: <https://www.fsb-tcfd.org/publications/>

¹¹ URL: <https://www.ifrs.org/content/dam/ifrs/publications/pdf-standards-issb/english/2023/issued/part-a/issb-2023-a-ifrs-s2-climate-related-disclosures.pdf?bypass=on>

¹² URL: <https://www.cbr.ru/Crosscut/LawActs/File/7666>

¹³ URL: <https://b1.ru/local/assets/surveys/b1-overview-of-russian-companies-ifrs-s2-climate-related-reporting.pdf>

¹⁴ The company's shares are included in the first level of the Moscow Exchange listing; in 2010, the IPO was held, and in 2023— SPO.

Table 1

Comparative Analysis of ESG Criteria in Company Strategies for the Selected Sample

Company Name	Availability of a Sustainability / ESG Committee in the Board of Directors	Availability of an ESG or Sustainability Department	Presence in International/ National ESG Ratings	Availability of TCFD for 2023
Mowi	Sustainability Committee (hereinafter SC) as part of the Board of Directors	There is a Director for SC issues/ ESG topics are included in the “Leading the Blue Revolution” strategy and implemented in such areas as feed, farming, and processing	Sustainalytics: Medium Risk Coller FAIRR Protein Producer Index: 1st place in the world	No (only for 2022)
Lerøy	–	An ESG and Quality department operates	Sustainalytics: Medium Risk Coller FAIRR: 2nd place in the world (2023)	Yes
Grieg Seafood	–	–	Sustainalytics: High Risk Coller FAIRR: 3rd place in the world (2023)	Yes
Inarctica	Sustainability Committee	Environmental Service, Scientific Research Department	RAEX ESG- rating: ranked 62nd out of 144 companies ¹⁵ ESG-Rating of Russian Industrial Sector Companies, version 2.0, NRA – 0,500 points, 4th group (developing ESG maturity level)	–

Source: compiled by the authors.

Note: * URL: https://raex-rr.com/news/press-reliz/esg_ranking_final_2024/

RESULTS

Both Inarctica and its Norwegian competitors have developed sustainability or climate strategies. All Norwegian companies conduct greenhouse gas (GHG) emissions calculations across Scopes 1–3 and hold a CDP score of A–, which indicates the implementation of advanced solutions aimed at achieving carbon neutrality and the setting of science-based targets (SBTi) (see Table 1).

As shown in Table 1, Mowi holds a leading position among the reviewed aquaculture companies worldwide in terms of integrating climate-related ESG aspects into strategic management. The company implements a range of policies, including those on climate change and energy use, incorporating relevant initiatives into its “Leading the Blue Revolution” strategy. Its key priorities include reducing greenhouse gas emissions, improving resource-use efficiency, and promoting environmentally responsible production practices.

The corporate structure features a Sustainability Committee within the Board of Directors

and a Director of Sustainability. According to Sustainalytics, Mowi is classified as a medium-risk company, while the Coller FAIRR Protein Producer Index ranks it first globally among animal-protein producers. In the aquaculture sector, its financial performance is also the strongest worldwide: in 2023, the company reported revenues of USD 6.03 billion and net profit of USD 0.82 billion.¹⁵

Lerøy, ranked second among the analyzed companies, also pursues climate and energy policies.¹⁶ Although its Board of Directors does not include a dedicated ESG committee, the company maintains a specialized ESG and Quality Department. Its ESG assessment by Sustainalytics is similar to that of Mowi, and in the Coller FAIRR Index it ranks second globally. Financially, Lerøy closed 2024 with revenues of USD 2.87 billion and a profit of USD 0.26 billion.

¹⁵ URL: <https://companiesmarketcap.com/norway/most-profitable-companies-in-norway/?page=1>

¹⁶ URL: <https://www.leroyseafood.com/en/sustainability/sustainability-library-2023/policies/policy-climate/>.

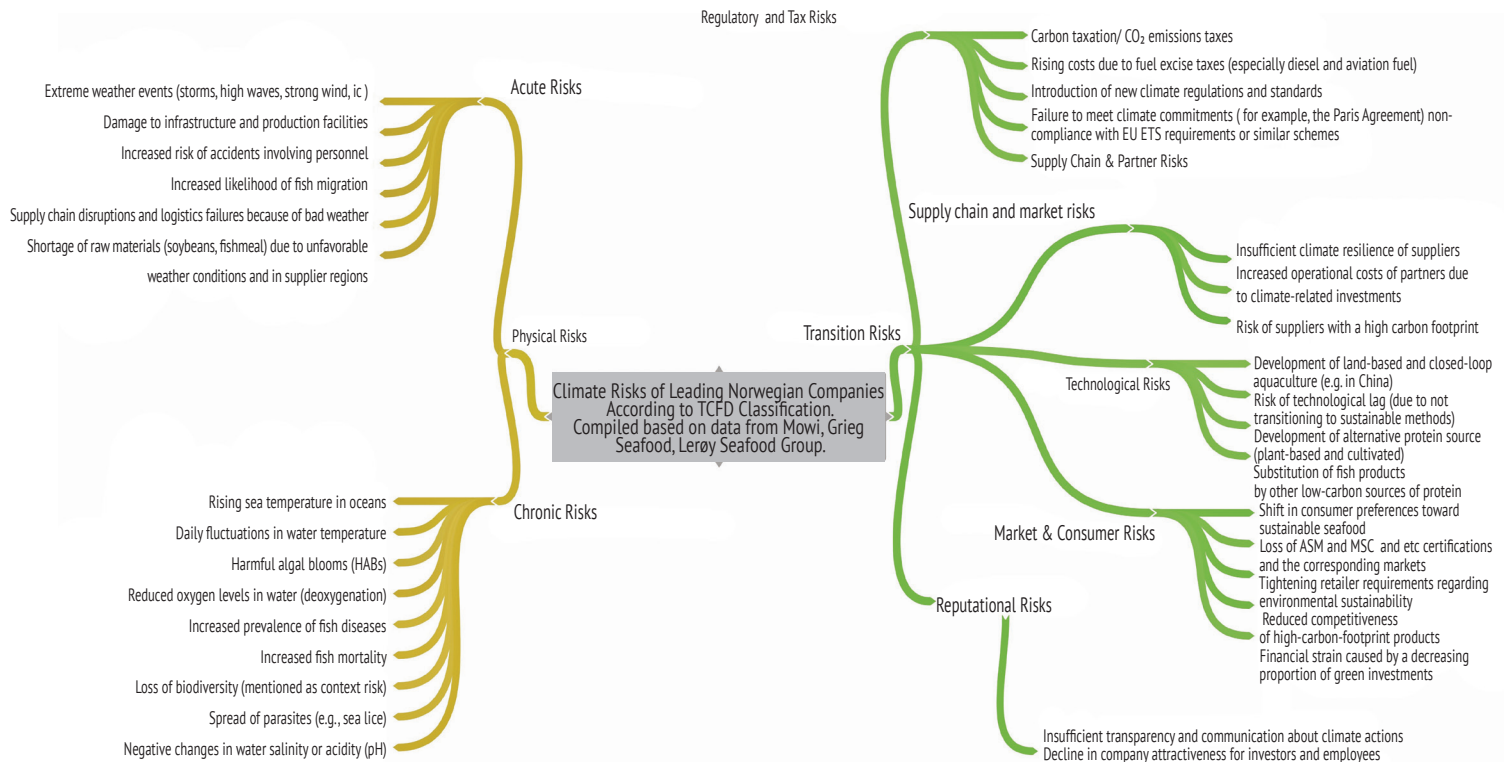


Fig. Climate Risks of Leading Norwegian Companies under TCFD Classification up to 2050

Source: compiled by the authors.

Grieg Seafood lags significantly behind the first two companies in terms of production volume (72 thousand tons in 2023,¹⁷ compared with 484 thousand tons for Mowi¹⁸) and ended 2024 with a negative financial result (a loss of USD 0.24 billion). The company has neither a dedicated ESG or sustainability department nor a board-level committee, and no publicly available strategic document on climate change. Its ESG ratings are notably lower, indicating higher exposure to sustainability-related risks.

Inarctica trails far behind its Norwegian competitors in both production and financial scale (28.2 thousand tons of output, revenues of USD 0.31 billion, and net profit of USD 0.08 billion¹⁹). Although it does not disclose Scope 3 emissions or climate-related risks in line with TCFD recommendations,

it has established a relatively well-developed sustainability governance system: the Board of Directors includes a Sustainability Committee, and the company's operational structure comprises an Environmental Department and a Research and Development Department.

While Inarctica appears in national ESG rankings, the results presented in *Table 1* indicate a low level of integration of ESG principles into corporate management.

The climate risks specific to aquaculture companies operating in the Barents Sea region are presented in the following figure.

As shown in the *Figure*, acute risks include extreme weather events, infrastructure degradation, production incidents, logistical disruptions, and raw material shortages. Chronic risks refer to long-term changes in the marine environment, while transition risks encompass regulatory, technological, market, and reputational aspects associated with the shift toward a low-carbon economy.

¹⁷ URL: <https://www.inderes.dk/en/releases/grieg-seafood-reports-q4-and-preliminary-results-for-2024-restructures-and-refinances-to-refocus-on-profitable-growth-in-norway>

¹⁸ URL: <https://weareaquaculture.com/news/aquaculture/mowi-reports-all-time-high-harvest-and-eur-136m-operational-revenue>

¹⁹ URL: <https://inarctica.com/investors/reports-and-results/>

Table 2

Climate Risks and Mitigation Measures for Inarctica

Risk Category	Description	Potential Impact	Mitigation/Adaptation Measures
Physical Risks			
Rising water temperature	Warming of Arctic waters increases the prevalence of sea lice and bacterial infections, causing stress to fish populations	Slower fish growth, higher mortality, increased costs for pharmaceuticals	Breeding heat-tolerant fish, implementing deep-water cage technology
Extreme weather events	Climate change increases the frequency of storms and strong winds; complex ice conditions may occur	Damage to cage farm infrastructure, fish escapes – temporary suspension of aquaculture operations	Investment in reinforced, storm-resistant equipment and coastal infrastructure
Oxygen depletion in bays (operational areas)	Higher temperatures and eutrophication reduce oxygen levels, especially in shallow bays	Increased fish mortality	Monitoring oxygen levels, optimizing stocking density
Harmful algal blooms (HABs)	Warmer waters and nutrient influx promote growth of toxic algae, leading to mass fish die-offs	Fish losses due to disease, quality reduction, delayed harvesting; increased monitoring costs	Implementation of monitoring and early warning systems
Spread of diseases and parasites	Rising water temperatures extend parasite lifecycles (e.g., sea lice), increasing fish infestations	Higher treatment costs, antibiotic resistance, reduced fish quality	Use of non-chemical parasite control methods; employment of cleaner fish, e.g., Cyclopterus lumpus, that feed on sea lice
Coastal erosion and flooding	Sea level rise and storm surges threaten coastal facilities	Damage to processing plants and storage facilities	Build infrastructure on elevated sites; improve flood protection measures
Supply chain disruption	Climate-driven transport issues (road washouts, storms) affect feed delivery and product distribution	Operational delays, increased transport costs	Develop local feed production; ensure alternative transport routes
Transition Risks			
Regulatory pressure	Stricter environmental regulations and changing consumer preferences toward climate-safe products	Higher compliance costs; loss of market share if sustainability standards are not met	Adopt sustainability certifications (Aquaculture Stewardship Council – ASC, Marine Stewardship Council – MSC, Best Aquaculture Practices – BAP); invest in low-carbon feed
Market demand and NGO pressure against antibiotic use	Public movement for healthy living, eco-friendly products, and against antibiotics in fish farming	Increased feed and operational costs; potential ecological imbalance in water bodies, ecosystems, and microbiomes	Breed disease-resistant fish

Source: compiled by the authors.

The analysis revealed that in the case of Inarctica, climate risk management remains insufficiently developed. In the company's 2023–2024 reports, natural and climatic factors are addressed only as background context, without a formal classifi-

cation or quantitative assessment in accordance with international standards such as TCFD and CDP. Furthermore, there is no description of managerial approaches to climate risk: they are neither classified nor linked to the KPI system, and have not been

verified under international methodologies. This indicates an institutional gap between the recognition of climate impacts and their formalization within corporate governance, which reduces transparency and limits access to sustainable financing.

Accordingly, drawing on the practices of Norwegian companies and other scholarly and applied sources — including the Register of Hazardous and Adverse Hydrometeorological Phenomena and Their Criteria for the Murmansk Region,²⁰ the book *Climatic Myths of the Kola Peninsula* (published by PJSC Norilsk Nickel²¹), and Development Scenarios for the Murmansk Region under Global Uncertainties and Climate Change [20] — the authors have proposed a qualitative assessment of key climate risks relevant to Inarctica. A quantitative assessment, involving risk ranking and scenario analysis, is identified as a potential next stage of the research (see *Table 2*).

The content of *Table 2* serves as the foundation for developing the company's climate strategy. Implementing a climate risk assessment will allow the company to reduce risks, design and implement mitigation measures, and increase compliance with international sustainable development standards.

DISCUSSION OF RESULTS AND RECOMMENDATIONS

The analysis shows that climate and environmental risks in the aquaculture sector are becoming increasingly systemic. However, the effectiveness of risk response depends not only on natural and climatic vulnerability but also on the level of ESG maturity within companies. Where climate impacts are formalized in strategies, metrics, and top management incentive systems (as in Mowi and Lerøy), risk management becomes an integral part of corporate resilience. In companies where this is absent (such as Inarctica), both natural and managerial risks remain significant.

Analysis of public reporting indicates that, despite the presence of environmental initiatives (such as reducing antibiotic use, environmental certification, and developing a research department), climate aspects in the documents of the Russian

company are fragmented and unstructured. The lack of classification of climate risks, as well as the absence of clearly defined climate targets, reduces the company's ranking in ESG ratings, limits comparability with international competitors, and constrains its potential to access sustainable financing.

In this context, several directions can be proposed to develop Inarctica's climate and ESG strategy, taking into account the successful practices of Norwegian peers.

First, it is advisable to formulate clear, quantitatively measurable, and scientifically grounded climate targets. These may include reducing greenhouse gas emissions across all scopes (Scope 1–3) and lowering water consumption.

Second, ensuring transparency of environmental and climate policies through regular reporting according to international non-financial disclosure standards, such as TCFD (IFRS S 2) and CDP. Such openness will help build trust among investors, partners, and regulators, strengthen the company's position in ESG rankings, and facilitate access to sustainable financing mechanisms, including green bonds and adaptation-related financial instruments.

Third, biotechnological modernization of production can be a promising direction, involving the use of seaweed and mussels as alternative feed sources, as well as the development of solutions in bioenergy and sustainable protein. These innovations, already applied by international competitors, not only reduce the carbon footprint but also create opportunities for product and technological diversification.

Additionally, there is significant potential to enhance resilience through the implementation of circular economy principles, including resource reuse, waste reduction, electrification of logistics, and environmentally oriented design of packaging and feed. This approach is increasingly relevant amid growing pressure on global natural resources and the transition to a circular production model.

CONCLUSION

The comparative analysis of practices between Russian and Norwegian companies revealed significant differences in the degree of development

²⁰ URL: <https://murmashi51.ru/city/bezopasnost-municipalnogo-obrazovaniya/informaciya-po-gocho-i-pb/429655/>

²¹ URL: https://www.kolagmk.ru/upload/disclosure/Climate_myths.pdf

of the climate agenda and in its integration into corporate strategies and reporting.

The most advanced practices were demonstrated by Norwegian companies, which integrate climate factors into strategic management and risk management systems. Their experience confirms that comprehensive disclosure of climate risks in accordance with TCFD recommendations, along with clearly defined quantitative climate targets and adaptation programs, enhances corporate resilience and competitiveness.

At the same time, the case analysis of the Russian company Inarktica revealed limited institu-

tional development of climate risk management, a lack of systematic disclosure, and insufficient integration of climate aspects into management practices.

Developing a comprehensive climate strategy focused on transparency, adaptation, and innovation will not only help minimize potential losses from climate-related risks but also leverage the ESG agenda to enhance investment attractiveness.

For aquaculture companies operating in environmentally sensitive regions, such as the Arctic, this should become a strategic management priority.

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