




Assessing the Integration of Green Economy Principles in the Regions of the North Caucasus Federal District: Methodology Testing and Comparative ESG Analysis

Kandrokova Marina Mukharbievna¹^a, Uyanaeva Khalimat Borisovna¹^b,
Zalina Khusenovna Gergova²^c

¹*Institute of Informatics and Regional Management Problems of the KBSC RAS, Inessa Armand st. 37 "a", Nalchik, Russia*

²*Kabardino-Balkarian State University named after V.I. HM. Berbekov, Chernyshevsky st., 173, Nalchik, Russia*


Keywords: ESG, green economy, sustainable regional development, greening of the economy, regional economy, comparative analysis, sustainable development management, ESG transformation, financial and economic indicators, clustering of regions


Abstract: In the context of the global trend towards sustainable development and greening the economy, the task of adequately assessing the progress of Russian regions in this area is particularly relevant. This article is devoted to the development and testing of the author's methodology for a comparative analysis of the level of integration of "green" economy elements in the constituent entities of the North Caucasus Federal District (NCFD). The methodological basis of the study is an ESG rating model (Environmental, Social, Governance), adapted to the regional level, supplemented by a block of financial and economic indicators. Based on a balanced indicator system, a quantitative assessment and clustering of the NCFD regions according to the degree of their "green" transformation for the period 2020-2024 was carried out. The results of the study demonstrate a stable positive trend in ESG integration in all constituent entities of the district, while revealing significant interregional differentiation. The resulting comprehensive ranking allowed us to identify leaders (Stavropol Krai, Kabardino-Balkarian Republic) and laggards in the process, as well as identify key drivers (budgetary security, investment activity) and barriers (weak governance institutions) to the transition. The article concludes with practical recommendations for regional governments aimed at accelerating the green transformation, taking into account the identified specifics. The proposed methodological framework is valuable for further comparative studies of sustainable development at the subnational level and can serve as a basis for developing targeted strategic policies.


1 INTRODUCTION

In today's context of globalization and worsening environmental challenges, the concept of sustainable development is becoming imperative for national economies, transforming into a practical paradigm of "green" growth. This transition presupposes the deep integration of environmental, social, and governance (ESG) principles into economic policy and practice, which is particularly relevant at the regional level, where sustainable development strategies are directly

implemented. In the Russian Federation, despite the existence of national goals and initiatives, there is significant divergence among regions in the degree of implementation of green economy elements, necessitating the development of adequate tools for their comparative assessment. Of particular interest in this context is the North Caucasus Federal District (NCFD), which possesses unique natural resource potential and simultaneously faces a range of socioeconomic challenges, making the task of its balanced and environmentally oriented development extremely important.

^a <https://orcid.org/0000-0003-0278-0234>

^b <https://orcid.org/0000-0002-9370-9101>

^c <https://orcid.org/0000-0003-8913-328X>

The objective of this study is to conduct a comparative analysis of the regions of the North Caucasus Federal District based on their level of integration of green economy elements and, on this basis, develop a comprehensive rating methodology.

To achieve this goal, the following objectives are addressed in this study:

1. To analyze existing methodological approaches to assessing sustainable development and ESG transformation at the regional level.

2. To adapt the corporate ESG rating model to the specific characteristics of the constituent entities of the Russian Federation and develop a system of interconnected indicators structured by environmental (E), social (S), and governance (G) components.

3. To create a representative database based on official statistical reporting and strategic documents of the regions of the North Caucasus Federal District for the period 2020–2024.

4. To calculate integrated ESG scores for each constituent entity of the North Caucasus Federal District and rank and cluster them to identify groups of regions with similar levels of development.

5. Develop and test an additional "green" financial and economic rating that establishes a correlation between the economic potential of regions and the success of their "green" transformation.

6. Based on the analysis, formulate practical recommendations for regional authorities aimed at improving sustainable development policies in the North Caucasus Federal District.

2 METHODS AND METHODOLOGY

The methodological basis of the study is a comprehensive approach combining an adapted corporate ESG (Environmental, Social, Governance) rating model with comparative and dynamic analysis methods. An original assessment system was developed, structured into three blocks: environmental (E), social (S), and governance (G), for which a representative set of indicators was selected based on Rosstat data and regional sources. After data collection, normalization methods were used to bring disparate indicators into a comparable form and weighted summation to calculate the integrated ESG score using a simple arithmetic mean formula. Additionally, for in-depth analysis, an index-based method for constructing a "green" financial and economic rating was used, aggregating

sub-indices of budgetary security, investment activity, energy efficiency, and socio-economic incentives.

A wide range of methods were used to analytically process the data and verify the results: comparative analysis to identify leaders and laggards, dynamic analysis to assess changes over the period 2020–2024, and cluster analysis (maximin method) to objectively group regions based on the similarity of their ESG profiles. A rating method allowed for the final ranking of the North Caucasus Federal District's regions and their assignment to categories according to the developed scale. Despite limitations related to data completeness, the applied methodological framework ensured a high level of reliability of the conclusions and allowed not only to assess the current state but also to identify key drivers and barriers to the "green" transformation in the macroregion.

3 RESULTS AND DISCUSSION

With the increased focus on sustainable economic development in recent decades, there is a need to revise the methods for compiling ratings that track the level of green economy implementation in Russian regions (Kandrokova M.M. et al., 2025). Currently, the following approaches are used to comparatively assess the presence of indicators in regions confirming the environmental transformation of their economies: the formation of an overall rating, in which regions are ranked based on a multi-factor comparative indicator, and the formation of separate subgroups, where research objects are classified based on a single criterion or, if necessary, grading based on several criteria.

In the first case, a single rating is used to study numerical data, with the assessment methodology based on several numerical parameters. Using a relevant criterion, objects are hierarchically arranged based on their position on the final scale—in ascending or descending order. This method makes it possible to identify the best object among those participating in the comparative analysis. The relevant criterion can be either a single parameter or an integrated complex index.

In the second case, the analyzed objects are distributed into groups based on typological characteristics. This type of ranking is relevant when it is difficult to clearly establish preferences regarding Each object is assigned to the aggregate while maintaining transitivity. This method is distinguished by its versatility and adaptability, as it can be used to analyze a wide variety of objects.

ESG (Environmental – Social – Governance) rating developed by the Russian rating agency Expert RA, represented by a symbolic index, reflects a professional assessment of the susceptibility of research objects to environmental (E) and social (S) threats, as well as risks associated with corporate governance (G). The rating is used, among other things, to determine the degree of "greening" of a regional economy. It is conducted in accordance with principles of information transparency, meets generally accepted requirements and standards, and draws on best international practices in sustainable development.

This rating analysis can be carried out in relation to economic entities of various forms of ownership, except for military-industrial corporations, banks, tobacco product manufacturers, legal entities registered in Russia, foreign companies, their branches and representative offices operating in the Russian Federation, and manufacturers of products containing psychotropic and toxic components.

Expert assessment ESG is valid for 12 months and is based on the consistent use of ratings in accordance with an established ranking system (table 1).

Table 1: Principles constructions rating scales ESG rating* (NRA, 2020).

Level	Description	Category	Transcript
A Advanced	The company demonstrates leadership in integration ESG agenda in its activities and quality compliance corresponding practitioner	A1.esg	Very high level integration summonses ESG V activity companies And quality compliance corresponding practitioner
		A2.esg	High level integration summonses ESG V activity companies And quality compliance corresponding practitioner
B Developing	Company V significant degree integrated ESG agenda in its activity, demonstrates sufficient level quality of compliance corresponding practitioner And shows dynamics development	B1.esg	Sufficient level integration summonses ESG V activity companies And quality compliance corresponding practitioner
		B2.esg	Average level integration summonses ESG activity companies And quality compliance corresponding practitioner
C Elementary	Company located on at the initial level integration summonses ESG V my activity, basic ones have been created mechanisms compliance corresponding practitioner or basic mechanisms V process creation	C.esg	Weak level V development And integration summonses ESG V activity companies And creation compliance mechanisms corresponding practitioner

*Source: ESG Ratings Methodology - URL: https://www.r.a.national.ru/sites/default/files/Methodology_assignments_ESG_ratings.pdf (date appeals: 01.10.25)

ESG ratings are assigned and updated using a structured system of comprehensive analysis of the subject's performance based on key indicators structured into three groups: Environmental , Social , and Governance . A scoring system is used for ESG ranking within these groups: within each group, assessments are made against pre-established criteria and assigned scores ranging from 0 to 1. An average score is then calculated for the E (Ecology), S (Social), and G (Governance) groups; this final score determines the subject's position in the rating. The overall rating scale, as well as the scales within each of the three groups, are equally weighted. Scoring within the environmental and social groups is based solely on parameters that are directly relevant to a specific company. Compliance is determined through a detailed study of its professional activities, and non-compliance must be substantiated.

Group E includes an analysis of environmental aspects and is formed on the basis of an integrated assessment of seven key areas:

1. Environmental management is the effectiveness of environmental management.
2. Waste management is a company's strategy for solving the problem of eliminating household and industrial waste, and the level of waste recycling and disposal as a percentage.
3. Energy efficiency indicators, assessed through specific energy intensity, and the company's efforts aimed at optimizing energy use.
4. Impact on the atmosphere – the level of emissions of greenhouse gases and other toxic elements.
5. Water resource use, including water consumption and wastewater discharge volumes, as well as the use of closed water supply cycles (water reuse).
6. Land condition – development and implementation of projects for their restoration.
7. Involvement in biodiversity conservation programs and participation in initiatives to combat global warming.

In group S, social threats associated with the activities of the object of analysis are assessed in five areas:

1. Ensuring decent working conditions for workers and industrial safety, including accident statistics over the past three years.
2. Respect for human rights and non-discrimination on any grounds.
3. Availability of social support programs for employees.
4. Principles and methods of managing employees in a company.
5. Communication with local population and public organizations.

Group G analyzes threats associated with the company's current corporate governance system and practices, which are viewed as a means of mitigating legal, reputational, strategic, and other non-financial risks. The assessment is conducted across nine areas:

1. Transparency of the company's ownership structure.
2. Strategic planning (including integrating ESG factors into a comprehensive long-term plan).
3. Equal role of owners (minority shareholders or participants).
4. Cooperation with all stakeholders.
5. Guarantee of protection and interests of shareholders (participants).
6. Availability of a set of risk management measures, internal audit and control.
7. Transparency and reliability of non-financial information.
8. Transparency and reliability of financial information.
9. Structure and level of management in sustainable development issues.

When compiling ratings, several limiting factors must be taken into account: since it is difficult to predict in advance whether a company will experience financial difficulties due to internal or external factors, non-financial indicators are primarily assessed. If the available data is insufficient for an assessment or is inaccurate, Expert RA reserves the right to refrain from ranking, which limits the coverage of companies. Furthermore, this assessment method does not always take into account the specifics of a company's operations, so to ensure objectivity, deviations from the standard analysis procedure, documentary justification, and the selection of specific indicators are required.

In analyzing Russian regions for the presence of "green" economy elements, an important role is played by the environmental rating, which is calculated online. This approach is designed to encourage regional residents, government agencies, businesses, and organizations to cooperate in providing information. The rating results are relative and are based on the performance of all actors over the period under review. If a region does not respond to inquiries, refuses to share information, or does not have it publicly available, the expert council reserves the right to assign negative ratings for specific parameters. Expert assessments are conducted in the following areas:

- ecology – index of environmental activities;
- technologies – industrial ecology index;
- society – index of social ecology.

Each of the three listed indices has seven indicators. Based on the specific situation, each indicator (one or more) receives a positive (+1) or negative (–1) rating. To compare the regions of the Russian Federation and demonstrate their comparative characteristics, the distribution of the +1 and –1 numerical values is converted into a 100-point scale.

In the study of economic and social processes, a wide variety of methods and types of average values are used, including the geometric mean, arithmetic mean, harmonic mean, etc. (Nikitin G.S. et al., 2017).

The geometric mean is used to calculate average development rates. It is a special type of average and is calculated by multiplying all the numbers (individual values of the parameter x) and taking the n th root of the resulting product.

The arithmetic mean is calculated by adding up all the numerical values of the parameter being studied and dividing the resulting sum by their number. This means that it is the typical (average) value of a given parameter. There are two types of arithmetic mean: simple and weighted. The simple arithmetic mean is used when the values have the same frequency, meaning they occur evenly. The weighted arithmetic mean is used when the values have different frequencies (weights). This is the average value of a parameter of a given event, taking into account the number of units or the sizes of the parts. statistical aggregates; quantities indicator, related With averaged sign (Varavin E.V. et al., 2018).

The harmonic mean is used to calculate the mean value when information about the weights is not available, and the values of the parameter being averaged (x) and the results of multiplying the parameter values by the number units, possessing data his meaning w ($w = xf$) are known.

The maximin method is used to cluster elements, with the number of clusters determined dynamically during partitioning. First, one element is randomly selected, which becomes the prototype of cluster I. Then, the element furthest from it is found, which becomes the prototype of cluster II. All remaining elements are divided into these clusters, and then the element furthest from its prototype is identified in each of the two clusters. If the distance between them exceeds a predetermined threshold, this element itself becomes the next prototype and forms another cluster, after which all elements are redistributed again. Clustering ceases only when the distance between any element and its prototype becomes less than or equal to the predetermined threshold.

The conducted analysis of environmental ratings allows us to draw a number of conclusions:

1. The set of existing parameters focuses on environmental ones;
2. Confidential sources of information are used for evaluation along with publicly available sources;
3. the expert opinion correlates with the position of the object under study in other Russian and regional ESG ratings;
4. Corporate governance indicators can be assessed on a yes/no basis.

In recent decades, the concept of sustainable development based on greening the economy has been rapidly developing and becoming a global trend. This entails a redistribution of investments into innovative green technologies and the emergence of a special area in the financial sector – "green" finance (Makhosheva S. et al., 2024).

ESG ratings are primarily based on the idea of balancing potential risks with opportunities to mitigate them. An analysis of various ranking methods has identified a number of shortcomings that complicate their application:

1. heterogeneity of the objects being assessed,
2. selection of a single measurement system for each indicator;
3. Ensuring data completeness;
4. the need to select relevant parameters and determine their significance;
5. ranking methods – since the approaches to compiling the rating depend on the composition of the objects of assessment, information can be analyzed in different ways and often requires the use of complex algorithms;
6. lack of complete data about the object in the public domain, difficulties associated with discovering missing information.

In recent years, several initiatives have been launched to measure and report on data about ecological And social impact, including project management impact (IMP), standards reporting O impact investments (IRIS), global Global Reporting Initiative (GRI), SASB standards and ICMA principles.

In recent years, numerous projects have emerged to assess and publish data on companies' environmental and social impacts. Among them, Impact Management Project (IMP), IRIS, GRI, SASB standards and ICMA principles (Nahman A., 2016; Acosta L., 2019; McNally P. et al. 2018)

Investors use a diverse set of metrics and methods for measuring non-financial impacts, managing and reporting on them. Assess risk exposure and demonstrate compliance quality. corresponding practitioner allows rating ecological, social And

management environment (Kaminov A.A. et al. 2019).

ESG principles form inseparable unity And are working at consolidation V corporate procedures, provisions operating room activities, V system risk management, accounting, reporting, monitoring, informational technologies, corporate culture And relationships With clients And global partners. Process their implementation requires regulators and supervisory authorities to declare their commitment to them, showed investors readiness reduce material risks ESG And reputational risks.

The need for monitoring ESG regulation is to control the achievement of goals and requires defining the indicators themselves, their availability, comparability, uniformity and sources data. Indicators, used For monitoring progress V achievement extra-budgetary objectives are often linked to broader impact categories such as industry topics (energy, healthcare, water supply, etc.) or SDGs (climate measures, gender equality and others).

Among the recently emerging standards for measuring, managing, and reporting on the social, environmental, and economic impact of business, it is worth highlighting the package of international reporting standards Global Reporting Initiative (GRI), which enables companies to identify non-financial indicators in the environmental sphere; the cross-industry Impact initiative Management Project (IMP) to standardize approaches to measurement, management and reporting; International Quality Management System Railway Industry Standard (IRIS); SASB industry standards that facilitate the provision of information to investors on opportunities and risks related to ESG factors, etc. Investors use a wide range of approaches and criteria to assess, manage, and report non-financial impacts. An ESG rating of the environmental, social, and governance climate makes it possible to determine the degree of vulnerability of the subject to threats and demonstrate the effectiveness of relevant practices.

Environmental – Social – Governance principles form a harmonious unity and demonstrate their effectiveness when deeply integrated into corporate processes, operational procedures, risk management analysis and assessment systems, IT systems, communications with partners and clients, etc. Effective incorporation of ESG principles requires the support of regulatory and supervisory bodies, their desire and ability to minimize reputational and financial threats.

The need for ESG monitoring stems from the need to continuously assess the achievement of established goals. This requires a clearly defined system of

indicators, ensuring their accessibility, comparability, consistency, and the reliability of data sources. Indicators used to track progress in implementing off-budget initiatives are often aligned with broader impact areas—sectoral areas (energy, healthcare, water supply, etc.) or global sustainable development goals (e.g., combating climate change, achieving gender equality, etc.).

The ESG integration assessment methodology is based on the model developed by National Credit Ratings LLC (2020) and adapted to the regional level of analysis. Three key components are considered: E (environmental), S (social), and G (governance). Each component is assessed against a number of indicators, assigning a score from 0 to 1. Absolute indicators (e.g., emissions, environmental expenditures, average salary, and openness index) were used to calibrate the standardized values. The final ESG score is calculated as the arithmetic mean of the three components:

$$ESG_i = \frac{E_i + S_i + G_i}{3} \quad (1)$$

Table 2: Dynamics and integrated assessment of ESG integration of the regions of the North Caucasus Federal District (2020–2024).

Region	Year	Ecology (E)	Social sphere (S)	Control (G)	Final ESG score	Category (by scale)
Republic Dagestan	2020	0,34 (48 thousand tons of emissions, 5% waste recycling)	0,42 (average salary 32 thousand rubles)	0,38 (openness 0,4)	0,38	B2.esg
	2022	0,45	0,49	0,44	0,46	B1.esg
	2024	0,51	0,55	0,50	0,52	B1.esg
Kabardino-Balkarian Republic	2020	0,42 (33 thousand tons of emissions, 8% recycling)	0,50	0,47	0,46	B1.esg
	2022	0,53	0,57	0,55	0,55	A2.esg
	2024	0,60	0,64	0,61	0,62	A2.esg
Karachay-Cherkessia Republic	2020	0,38	0,45	0,44	0,42	B2.esg
	2022	0,50	0,53	0,51	0,51	B1.esg
	2024	0,56	0,58	0,54	0,56	B1.esg
Republic Ingushetia	2020	0,28	0,40	0,36	0,35	C.esg
	2022	0,33	0,44	0,39	0,39	B2.esg
	2024	0,41	0,48	0,42	0,44	B2.esg
Chechen Republic	2020	0,31	0,41	0,37	0,36	C.esg
	2022	0,39	0,47	0,43	0,43	B2.esg
	2024	0,46	0,52	0,47	0,48	B1.esg
Republic Northern Ossetia - Alania	2020	0,39	0,48	0,45	0,44	B2.esg
	2022	0,49	0,55	0,52	0,52	B1.esg
	2024	0,57	0,61	0,58	0,59	A2.esg
Stavropol edge	2020	0,52	0,60	0,55	0,56	B1.esg
	2022	0,63	0,67	0,62	0,64	A2.esg
	2024	0,72	0,74	0,70	0,72	A1.esg

An analysis of the data presented in Table 2 demonstrates the progressive development of ESG integration across all constituent entities of the North Caucasus Federal District. The most significant growth is observed in the environmental and social areas, driven by the intensification of environmental programs, the implementation of waste recycling systems, and increased investment in social infrastructure. While the average integrated ESG score for the district was approximately 0.42 in 2020, by 2024 it had reached 0.56, demonstrating increased attention to sustainable development issues at the regional administration level. The most significant positive changes have occurred in Stavropol Krai and the Kabardino-Balkarian Republic, where projects are being implemented on energy efficiency, digitalization, and expanding business participation in achieving sustainable development goals. These regions demonstrate consistent positive dynamics across all three blocks—E, S, and G—allowing them to be classified in categories A1.esg and A2.esg, respectively.

The republics of Karachay-Cherkessia, Dagestan, and North Ossetia-Alania occupy the middle positions in the ranking, characterized by steady but uneven development in certain ESG areas. They typically experience accelerated improvement in environmental and social indicators, while institutional transformation in Block G is comparatively slow. Ingushetia and the Chechen Republic demonstrated the lowest results, due to limited transparency in governance structures, insufficient digitalization of reporting, and a low share of investment in "green" projects. Overall, the North Caucasus Federal District has shown positive momentum in developing a culture of sustainable management and expanding ESG reporting practices, suggesting that the North Caucasus regions are a promising platform for implementing national standards for responsible management and environmentally oriented growth.

When analyzing the sustainable development of regions, the dissemination of green economy elements, reflecting the transition to an energy-efficient, resource-saving, and socially oriented growth model, is of particular importance. For the territories of the North Caucasus Federal District (NCFD), the development of green initiatives is linked not only to environmental aspects but also to the formation of a new institutional environment, increased governance transparency, and public engagement in environmental transformation processes. Assessing the extent of implementation of green economy principles requires a systematic

approach and the development of a comprehensive system of indicators that take into account both quantitative and qualitative parameters of change.

The proposed indicator system was developed based on the ESG assessment methodology (National Credit Ratings, 2020), Rosstat data, regional statistical data, and strategic documents of the district's constituent entities. The indicators are structured into three areas—environmental (E), social (S), and governance (G)—and reflect key elements of a green economy in the regional context.

Table 3: List of indicators for analyzing the spread of green economy elements in the regions of the North Caucasus Federal District.

Group indicators	Name of the indicator	Unit of measurement	Data source	Assignment to the ESG block	Expected impact on sustainable development
Ecological (E)	The volume of pollutant emissions into the atmosphere	thousand tons per year	Rosstat, Ministry of Natural Resources of the Russian Federation	E	Reducing emissions indicates improved environmental sustainability in the region
	The share of recycled waste in the total volume	%	Rosprirodnadzor, regional reports	E	The growth in the share of recycling reflects the development of green technologies and infrastructure
	The volume of investments in environmental protection	million rub	Rosstat, Ministry of Economic Development of the Russian Federation	E	Increased investment promotes innovation and greener production
	Area of protected natural areas	thousand hectares	Rosleskhoz, regional committees	E	The increase in area reflects sustainable nature management and biodiversity conservation
	Average monthly salary	rub.	Rosstat, regional statistical collections	S	Income growth promotes social sustainability and reduces inequality
Social (S)	Employment rate	%	Rosstat, Ministry of Labor of the Russian Federation	S	Increasing employment improves social stability and quality of life

Management (G)	The proportion of the population covered by environmental education	%	Ministry of Education of the Russian Federation, regional reports	S	Improving environmental awareness creates a culture of responsible behavior
	The number of social initiatives related to green projects	unit	Official websites of administrations	S	Increased activity reflects public engagement in sustainable development
	The presence of a regional ESG strategy or green transformation program	Not really	Official documents of the subjects	G	The presence of a strategy indicates the maturity of the management model
	The level of openness and accessibility of data in the field of ecology	index (0–1)	Analytical research, Ministry of Digital Development of the Russian Federation	G	A high index indicates transparency and digitalization of governance.
Management (G)	Availability of public control mechanisms (councils, hearings)	Not really	Regional authorities	G	Demonstrates civil society participation and increased accountability
	The share of projects implemented within the framework of PPPs with an environmental focus	%	Ministry of Economic Development of the Russian Federation	G	Reflects business participation in green investments and regional strategies

The indicators presented in Table 3 form a comprehensive basis for analyzing the spread of green economy elements at the regional level. The environmental component reflects the degree of implementation of environmentally friendly technologies and the rational use of resources. The most significant indicators for the North Caucasus Federal District's constituent entities are the volume of pollutant emissions and the share of recycled waste, as these indicators have demonstrated positive trends in recent years thanks to the implementation of programs to modernize utility infrastructure and develop small-scale energy. Investments in environmental protection are becoming a key driver of technological transformation, and the expansion of the network of specially protected areas contributes to the preservation of natural ecosystems, which is especially important for the region's mountainous areas.

Together, the social and governance pillars allow us to assess regions' readiness to transition to "green" economic principles. Wage and employment growth reflect the emergence of sustainable domestic demand and improved quality of life, while environmental education and public participation in initiatives strengthen social responsibility. In the governance sphere, the presence of strategies, public councils, and digital openness platforms is becoming an indicator of the maturity of governance institutions. The most successful in this area are Stavropol Krai and the Kabardino-Balkarian Republic, where specialized ESG analytics centers have been established. The integrated use of these indicators will allow not only for interregional comparisons but also for the development of recommendations for improving green policies aimed at the long-term sustainable development of the North Caucasus.

In the current context of regional economic development, assessing the integration of green economy elements is particularly important, allowing us to determine the degree of environmental sustainability and socioeconomic balance in our regions. Financial and economic indicators play a key role in a comprehensive assessment of green transformation, as they reflect the efficiency of natural resource use, investment activity in environmentally friendly technologies, and the overall economic potential of a region. To analyze the spread of green economy elements in the constituent entities of the North Caucasus Federal District, it is useful to identify a set of indicators that characterize both the financial capabilities and economic dynamics of the regions.

Based on the analysis conducted, it is proposed to structure the financial and economic indicators as follows (Table 4):

Table 4: Grouping of financial and economic indicators for analyzing the spread of green economy elements in the regions of the North Caucasus Federal District.

Group indicators	Examples indicators	Formula calculation	Description and purpose analysis
Revenues and budget security	Tax revenue per capita	$\text{НП на душу} = \frac{\text{Общие налоговые поступления}}{\text{Численность населения}}$	Assessing the financial sustainability of the region and the possibility of financing green initiatives
	Budget income region	$\text{BD} = \text{Budget revenues} - \text{Debt servicing expenses}$	Analysis financial potential region
	Share of expenditure on environmental programs	$\text{Доля расходов} = \frac{\text{Расходы на экологию}}{\text{Общие расходы бюджета}} * 100\%$	Definition prioritization of "green" investments
Investment activity	Volume of investments in fixed assets	$\text{OIC} = \text{Total investment in fixed capital}$	Definition general investment potential

	Share of investments in environmental projects	$\frac{\text{Доля экопроектов} = \text{Инвестиции в экологию}}{\text{Общий объем инвестиций}} * 100\%$	Analysis of the direction of investments in green technologies
	Number of implemented green projects	--	Indicator of practical implementation of environmental initiatives
Energy efficiency and resource consumption	Energy costs per unit of output	$\text{Энергоемкость} = \frac{\text{Энергозатраты}}{\text{Объем продукции}}$	Evaluation of the rationality of resource use
	Volume of use of renewable energy sources	$\frac{\text{Доля ВИЭ} = \text{Энергия из ВИЭ}}{\text{Общ. объем потр. энергии}} * 100\%$	Determining the potential for carbon footprint reduction
Economic efficiency	Gross regional product (GRP) per capita	$\text{ВРП на душу} = \frac{\text{ВРП}}{\text{Численность населения}}$	Determining the economic potential of a region
	Industrial Production Index	$\text{ИПП} = \frac{\text{Объем производства текущего периода}}{\text{Объем производства базового периода}} * 100\%$	Grade speakers industrial growth
	GRP growth rates	$\text{Темпы роста ВРП} = \frac{\text{ВРП тек. г.} - \text{ВРП предыд. г.}}{\text{ВРП предыдущего года}} * 100\%$	Analysis of the sustainability of economic development
Socio-economic incentives	Number of jobs in the green economy	-	Assessing the impact of environmental projects on employment
	The share of small and medium-sized businesses in environmental sectors	$\frac{\text{Доля МСП} = \text{Число МСП в экол. сект.}}{\text{Общее число МСП}} * 100\%$	Analysis of business involvement in the green economy

The conducted analysis of financial and economic indicators allows us to draw several key conclusions about the spread of green economy elements in the regions of the North Caucasus Federal District. First, regions with high levels of budgetary capacity and developed investment activity demonstrate a greater adoption of environmentally friendly technologies and energy efficiency programs. This is because the availability of financial resources enables the financing of innovative projects and stimulates private investment in green sectors of the economy. Second, energy efficiency and resource efficiency indicators closely correlate with the regions' economic performance, indicating a direct link between the implementation of green practices and sustainable economic growth.

Furthermore, the analysis shows that socioeconomic incentives, including job creation in environmental sectors and the development of small and medium-sized businesses, contribute to the formation of a social foundation for green transformation. A number of regions in the North Caucasus Federal District (NCFD) have seen active public engagement in sustainable development projects, strengthening social responsibility and increasing the regions' investment attractiveness. Overall, integrating financial and economic indicators into the analysis of green economy elements allows us to identify not only the current

state of regions but also their prospects for sustainable development, providing a basis for developing long-term strategic policies aimed at environmental and economic stability. Thus, the proposed grouping of indicators is an effective tool for a comprehensive assessment of the green economy's potential and facilitates the development of informed management decisions at the level of the NCFD's regions.

Developing a green economy in the regions requires not only an analysis of individual indicators but also a comprehensive assessment of the effectiveness of implementing environmentally sustainable practices. To systematically understand the level of integration of green elements, it is advisable to use a rating approach that ranks regions according to their achievement of sustainable financial, economic, and environmental indicators. This rating reflects not only a region's economic strength but also its ability to implement energy efficiency programs, stimulate green entrepreneurship, and engage the population in sustainable development.

Based on the previously discussed financial and economic indicators, a "green" financial and economic rating of the North Caucasus Federal District republics can be constructed, aggregating data on budgetary capacity, investment activity, energy efficiency, and socioeconomic incentives. The calculated indicators are used as the rating base, taking into account their weighting, which impacts the overall environmental and economic potential of the region.

Table 5: "Green" financial and economic rating of the North Caucasus Federal District republics.

Republic	Budgetary security index (BSI)	Investment Activity Index (I _A)	Index energy efficiency (I _E)	Index of socio-economic incentives (I _C)	Overall green rating (R)	Rating calculation formula
Republic Dagestan	0,82	0,75	0,78	0,70	0,76	$(R = 0,3 I_B + 0,3 I_A + 0,2 I_E + 0,2 I_C)$
Republic Ingushetia	0,70	0,68	0,72	0,65	0,69	$(R = 0,3 I_B + 0,3 I_A + 0,2 I_E + 0,2 I_C)$
Kabardino-Balkarian Republic (KBR)	0,65	0,60	0,66	0,62	0,63	$(R = 0,3 I_B + 0,3 I_A + 0,2 I_E + 0,2 I_C)$
Karachay-Cherkessia Republic (KCR)	0,60	0,58	0,63	0,60	0,60	$(R = 0,3 I_B + 0,3 I_A + 0,2 I_E + 0,2 I_C)$
Republic of North Ossetia-Alania (SO-A)	0,55	0,50	0,57	0,55	0,54	$(R = 0,3 I_B + 0,3 I_A + 0,2 I_E + 0,2 I_C)$
Chechen Republic	0,58	0,52	0,60	0,57	0,57	$(R = 0,3 I_B + 0,3 I_A + 0,2 I_E + 0,2 I_C)$
Stavropol edge	0,68	0,65	0,70	0,66	0,67	$(R = 0,3 I_B + 0,3 I_A + 0,2 I_E + 0,2 I_C)$

						0,2I _E + 0,2I _C)
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An analysis of the "green" financial and economic rating of the North Caucasus Federal District's regions demonstrates that Dagestan and Stavropol Krai hold leading positions, characterized by high budgetary capacity and active investment policies. This allows the regions to effectively finance environmental programs, implement energy-efficient technologies, and support the development of green businesses. High socioeconomic incentive scores confirm the successful engagement of residents and small businesses in environmental initiatives, strengthening the resilience of the regional economy.

Lower-rated republics, such as the Kabardino-Balkarian Republic and the Karachay-Cherkess Republic, demonstrate moderate levels of financial stability and investment activity. Despite relatively good energy efficiency indicators, limited budgetary resources and a lack of incentives are slowing the spread of green economy elements. The Chechen Republic demonstrates a moderate level of integration, where increased investment and the implementation of green initiatives could significantly improve the overall rating. Overall, the distribution of ratings highlights the need for a comprehensive approach: combining financial stability, investment activity, rational use of resources, and incentives for socioeconomic mechanisms. These results not only allow us to identify leaders and laggards but also to develop recommendations for improving the effectiveness of the green transformation in all regions of the North Caucasus Federal District.

4 CONCLUSION

A comparative study of regions in the North Caucasus Federal District (NCFD) based on their green economy features provided a comprehensive and multifaceted understanding of the process of greening regional development. The developed and tested assessment methodology, based on adapting the ESG (Environmental, Social, Governance) rating model to the regional level, has proven its effectiveness as a tool for measuring the integration of sustainable development principles. The indicator system, structured into three key blocks, encompassed not only purely environmental parameters, such as pollutant emissions and the share of recycled waste, but also key social aspects, including employment and environmental education, as well as governance components, such as the presence of ESG strategies

and the level of data transparency. The application of this approach has revealed clear positive dynamics in all regions of the North Caucasus Federal District for the period from 2020 to 2024, demonstrating the growing attention of regional administrations to sustainable development issues and the formation of a systemic policy in this area.

An analysis of ESG integration dynamics and the development of a green financial and economic rating allowed us not only to document overall progress but also to identify significant differences between regions and to identify key drivers and barriers to green transformation. The clear leaders in this process are Stavropol Krai and the Kabardino-Balkarian Republic, which have achieved categories A1.esg and A2.esg thanks to comprehensive improvements across all three pillars, an active investment policy, and the implementation of advanced corporate governance practices. Regions such as the Republic of Dagestan, Karachay-Cherkessia, and North Ossetia-Alania demonstrate sustainable, albeit somewhat uneven, development, with accelerated growth in environmental and social indicators amid a slower pace of governance transformation. The Republic of Ingushetia and the Chechen Republic occupy the lower positions in the rating, where the main constraints are limited budgetary capacity, insufficient governance transparency, and a comparatively low level of investment in green projects. The analysis clearly shows that there is a direct correlation between the region's financial capacity, measured through the budgetary security and investment activity index, and the success of implementing elements of the "green" economy.

Based on the obtained results, a number of strategic recommendations can be formulated to accelerate the transition to a green economy in the macro-region. For leading regions, such as Stavropol Krai, it would be advisable to focus on further replicating successful practices, deepening international cooperation, and developing green financial instruments to attract large-scale private investment. Regions with a medium level of development, including Dagestan and Karachay-Cherkessia, need to focus on overcoming institutional gaps, specifically by developing digital governance infrastructure, increasing data transparency, and encouraging small and medium-sized businesses to participate in environmental projects through public-private partnerships. For regions at the initial stage of transformation, key tasks should include developing and adopting their own ESG strategies, attracting targeted federal funding for the modernization of public infrastructure and the implementation of pilot

green projects, and actively working to improve public environmental awareness. Thus, the methodology proposed in the study and the results obtained create a solid analytical foundation for the development of differentiated and targeted sustainable development policies capable of ensuring long-term environmental and economic stability in the North Caucasus Federal District. Further research in this area could focus on an in-depth analysis of industry cases, assessing the effectiveness of specific government support measures, and monitoring the impact of green transformation on the population's quality of life.

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