



## Integral Indicator Assessment of Municipalities Sustainability in the Leningrad Region

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**Abstract.** Sustainable development has become a prominent reference point in strategic planning and territorial improvement. Economic growth necessitates intensified efforts to utilize resources, often resulting in increased pressure on the environment and heightened social inequality. The application of sustainable development principles holds particular importance for urbanized territories. Assessing the regional sustainability integral indicator can help alleviate unequal socio-economic development among municipalities. This indicator comprises indexes of the sustainability of individual territories. The authors propose the integral indicator as the arithmetic mean of indexes reflecting the sustainable development level of each component (economic, social, environmental). The authors applied this tool to municipalities in the Leningrad Region. Additionally, they conducted a ranking of municipal districts in the region based on the integral indicator. The leaders in sustainable development were the districts included in the St. Petersburg agglomeration. The authors suggest that a significant factor in the sustainable development of a territory is the presence of small enterprises, which possess the necessary flexibility for innovation in the social and environmental spheres. The authors propose distributing the elements of small and medium-sized enterprises (SME) potential according to the sustainable development factors of the region. The obtained data will enable the making of administrative decisions at the municipal and regional levels, including those related to the intensity and support for SMEs operating in relevant industries. This methodological approach to assessing the sustainability of the region and its internal municipalities, particularly concerning SMEs, can be utilized to make optimal administrative decisions related to government support for specific business areas.

**Keywords:** Medium-sized enterprises (SME); Municipal territories; Region; Sustainability indicator; Sustainable development

### 1. Introduction

The concept of sustainable economic development emerged in the mid-20<sup>th</sup> century when various environmental and socio-economic challenges began to pose threats to the well-being of both current and future generations (known as the "sustainable development" concept). There is a note that issues related to sustainable development (SD) have become relevant in the last few decades. The idea of sustainable development corresponds to the global nature of society's problems, and many states and their constituents use it to develop effective management strategies for socio-economic systems (Gutman *et al.*, 2022;

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Brazovskaia and Gutman 2021).

Sustainable development has particular importance for highly urbanized areas, including agglomerations. In general, we can say that even though there are some studies on the relationship and contradictions between the goals of sustainable development and urbanization (Zhang *et al.*, 2023; Chen *et al.*, 2022; Griazev *et al.*, 2021; Shkiperova and Kurilo, 2021; Solovyova and Bogdanova, 2021; Li and Lu, 2021; Hák, Janoušková, and Moldan 2016), there are no unified ideas about all the factors affecting the sustainable development of territories.

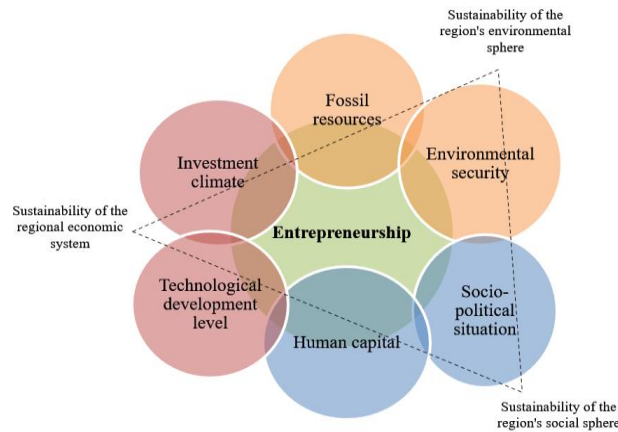
Several authors emphasize the improvement of public and municipal governance, including digital technologies, as a necessary condition for the sustainable development of territories (Halla, Merino-Saum, and Binder, 2022; Konstantinova *et al.*, 2022; Tanina *et al.*, 2022; Tanina *et al.*, 2021; Feleki, Vlachokostas, and Moussiopoulos, 2020; Zaborovskaya, Kudryavtseva, and Zhogova, 2019). Other researchers emphasize transforming commercial enterprises based on sustainable development principles (Evseev, Morozova, and Vasileva 2021). Yet some authors highlight social and environmental entrepreneurship, which serves the realization of public goals (Tanina *et al.*, 2023; Gregori, Holzmann, and Wdowiak 2021; Méndez-Picazo, Galindo-Martín, and Castaño-Martínez, 2021). However, the problem of assessing the impact of environmental and social entrepreneurship development on the achievement of sustainable development goals is still unresolved, although some studies have considered individual enterprises in sustainability aspects (Diaz-Sarachaga and Ariza-Montes, 2022; Grilo and Moreira, 2022; Kichigin *et al.*, 2021; Chivu, 2019; Egorova *et al.*, 2019). To ensure sustainable socio-economic development in countries, it is essential to focus on the development of regions and territories (Kuznetsova, 2014).

The authors suppose that small businesses are a significant factor in the territory's sustainable development. A reason is that small businesses have the optimal flexibility to innovate in the social and environmental spheres, but it is necessary to provide public support to increase efficiency (Orel and Zaborovskaya, 2021; Pokrovskaya, Dolotova, and Pavlova, 2021). Most authors believe sustainable socio-economic development considers the unity of the economic, social, and environmental spheres, so we claim the triad "economy - social sphere - ecology." Thus, the article of Berawi (2023) describes the ideas of balancing economic progress and environmental restoration for social well-being. The authors consider the sustainability of the regional economic system as a constituent element of the sustainability of socio-economic development.

Ensuring the sustainability of the regional economic system implies, on the one hand, giving priority attention to the conditions for economic activity in the region. This approach aims to facilitate economic growth as a prominent source of regional resources. On the other hand, this economic activity should consider the needs of the social sphere and environmental protection while achieving social and environmental objectives using market mechanisms and principles. The authors (Orel and Zaborovskaya, 2021; Pokrovskaya, Dolotova, and Pavlova, 2021) propose to understand the sustainable development of the regional economic system based on the triad "economy - social sphere - ecology", in which the regional economy development is considered based on a balance of economic, social, and environmental objectives with reliance on the "green economy" principles. It ensures economic growth and solves social and environmental problems using adequate instruments.

Several factors impact the sustainability of the regional economic system (Figure.1): economic factors (investment climate and the innovative development level); social factors (socio-political situation and human capital); and environmental factors (fossil resources and environmental safety).

Entrepreneurial activity can be an element that can provide complex interrelationships of these factors. At the same time, it affects the aspects and is affected by them at the same time. Investment climate and entrepreneurship are also inextricably linked. The investment climate, as a set of economic, financial, and socio-political conditions in a region, significantly impacts an investor's propensity to invest and, consequently, an entrepreneur's propensity to do business in the territory.



**Figure 1** Entrepreneurship as a factor affecting each element of the "economy - social sphere - ecology" triad

The entrepreneur gains access to financial resources, more developed infrastructure, and a larger market. In turn, a high level of private sector development in the territory is a positive signal for the stakeholders to decide on further investments. The technological development level and entrepreneurship are also interrelated categories. Entrepreneurs actively introduce innovations and modern technologies to optimize costs and increase profits. In entrepreneurship, natural and fossil resources are used as the basis for commercial production activities. The same basis could be relevant to renewable resources. Some entrepreneurs use them to achieve a competitive advantage within the green economy framework. Environmental safety within the entrepreneurial activity framework is relevant to improving competitiveness and increasing the attractiveness of commercial organizations to investors. At the same time, the ecological security state-formed requirements restrict entrepreneurship development.

The socio-political situation influences the level of entrepreneurial risk activity, the prospects for infrastructure development in business, and the growth of specific branches of specialization. Simultaneously, the level of entrepreneurship development and the nature of its activities can have an impact on the socio-political landscape. Human capital is a pivotal factor in shaping the entrepreneurial activity context. The human capital quality and quantity development level depends on the business climate and the socio-economic situation. The big business's role in achieving sustainable development goals is recognized. There is a confirmation by the relevance of the ESG (environmental, social, governance) agenda, which determines the corporate policy of large, advanced companies in the social and environmental spheres, as well as management, because of the high level of their financial capabilities.

At the same time, there is an underestimation of the SME's potential to achieve sustainability in the regional economic system. The 17 Sustainable Development Goals (SDGs) adopted by the United Nations in 2015 should serve as guiding principles for the region's development.

The SME sector influences the recruitment and stability of the middle class, which is innovatively active. The efficiency growth of small enterprises contributes to the increase of the region's economic potential. The choice of the environmental and social spheres as the basis allows us to gain a synergetic effect (table 1). Table 1 highlights the areas of influence of SMEs on the sustainability of the region's socio-economic development. There are numbers of the «Sustainable Development Goals» (SDGs) adopted by the United Nations in parentheses.

**Table 1** Elements of the SME sector's potential for regional development in terms of sustainable development factors

Economic factor	Social factor	Ecological factor
improving the financial well-being of the people ( <i>SDG №1</i> - No Poverty); inclusion and significant contribution to the region's exports ( <i>SDG №8</i> - Decent Work and Economic Growth); a significant contribution to the GDP region ( <i>SDG №8</i> - Decent Work and Economic Growth); making a competitive environment in the region ( <i>SDG №11</i> - Sustainable Cities and Communities); stable inflow of tax revenues to the budget ( <i>SDG №8</i> - Decent work and economic growth)	middle-class formation, a layer of small owners in the region, which leads to an increase of the social stability in the society ( <i>SDG №10</i> - Reduced inequalities); ensuring the new jobs ( <i>SDG №8</i> - Decent work and economic growth); reducing inequality of incomes and opportunities ( <i>SDG №10</i> - Reduced Inequalities); promotion of human potential development, satisfaction need for self-realization ( <i>SDG №8</i> - Decent work and economic growth); prompt introduction of new innovative developments ( <i>SDG №9</i> - Industry, innovation, and infrastructure)	implementation of resource-saving technologies ( <i>SDG №12</i> - Responsible consumption and production); restoration of natural objects ( <i>SDG №15</i> - Life on land); implementation of activities in service and environmentally friendly industries ( <i>SDG №12</i> - Responsible consumption and production)

At the same time, within the "green economy" framework, the reference types of entrepreneurial activity simultaneously solve economic, social, and environmental problems using innovations.

Determining the priorities of regional economic policy to support small and medium-sized enterprises, the authors made a methodological approach to improving regional monitoring based on a spatial map of the sustainability triad "economy - social sphere - ecology" for municipalities of the region.

## 2. Methods

The authors used such research methods in the study as analysis, synthesis, grouping, generalization, and ranking. Using analysis and synthesis, the authors obtained data on the current state of the studied objects.

The authors chose the Leningrad region as the approbation object of the proposed methods. Some reasons conditioned such choice. The Leningrad region is a leading region in terms of socio-economic and innovation development, often referred to as a donor region as it contributes more to the federal budget than it receives from it. Accordingly, the Leningrad Region can implement programs to aid small and medium-sized enterprises. These aid programs have significant financial funding. Thus, the funds allocated in 2023 from the regional and federal budgets to aid SMEs in the Leningrad Region are 1 billion 230 million rubles ([Government of the Leningrad Region, 2023](#)). However, this region does not have a concept or strategy for sustainable development, and there is a high level of differentiation in the development of municipalities. Therefore, it is necessary to improve

the distribution of financial funds for SME aid, considering the need to achieve sustainable development and the differences between municipalities in the region.

The grouping and generalization methods could identify and group the primary elements of the Leningrad Region's sustainable development and define the specifics of the municipalities' development. The ranking allowed us to obtain a rating of municipal territories in the region according to the sustainability indexes proposed by the authors.

Methodological principles of building an integral indicator of sustainable socio-economic development of the region are considering the UN sustainable development goals, information base availability, simplicity of calculations, possibilities of indicators transformation, and considering the interrelations in the triad "economy - ecology - social sphere."

The authors selected indexes based on statistical data on the development of municipalities and on the ability of these indexes to characterize the sustainability of development (sustainable development goals of municipalities). Also, the authors selected the indexes for all municipalities in the region. Official statistics on municipalities have a limited set of indices, resulting in a constrained range of variables available for the methodology implementation.

The authors also chose the indicators that determine the economic sustainability of the Leningrad Region inner districts: the volume of shipped industrial products in 2022 per capita, in thousand rubles; the investment volume in fixed capital by businesses- total in 2022 per capita, in thousand rubles; retail trade turnover - total in 2022 per capita, in thousand rubles; the balanced financial result of organizations to the number of SME, in million rubles; the number of SME per 1000 people.

The authors used these indicators to calculate social sustainability: average monthly nominal gross salary, in rubles; the average number of employees; registered people in the Employment Center with the status of "Unemployed" and "Looking for work" in 2022 to the population, %; birth rate (per 1000 people) in 2022; death rate (per 1000 people) in 2022.

Also, the authors chose such indicators determining environmental sustainability as the area percentage occupied by forestries, forest parks, and urban forests, %; bathing places (percent of official areas to the number of generic bathing places), %; gross emissions of carbon monoxide (CO) from motor vehicles in large cities of Leningrad Region municipalities, emission ton/year; content of phenol pollutant components in soils of impacted monitoring sites with background values, mg/kg; emissions of pollutants from stationary sources per inhabitant by municipal districts and urban district, kg.

Based on the indicators, it is possible to obtain sustainability indicators for municipalities and the region. There is a proposition to apply the comparative analysis method based on the Euclidean distance approach. It allows us to identify the indicator ideal and then assess the proximity-distance degree of other regions' indicators relative to the ideal value. For this purpose, the authors express indexes of the territories in fractions relative to the ideal index, defined as one (see equation 1):

$$a_i = \frac{x_i}{\max x_i}, b_i = \frac{\min x_i}{x_i}, \quad (1)$$

$a_i, b_i$  – level of development of the  $i$ -th region according to the indicator;

$x_i$  – the indicator value;

$\max x_i, \min x_i$  – the ideal index value, which authors accept as the limit value of indexes.

The authors determine the levels of economic, social, and environmental sustainability by the arithmetic mean (see equation 2):

$$U_j = \frac{\sum_{i=1}^n k_i}{n}, \tag{2}$$

$U_j$  – the sustainability level indicator of each component of sustainable, balanced development ( $U_j$  accepts value  $U_{econ}$ ,  $U_{soc}$ ,  $U_{ecol}$ )

$K_i$ - value of individual indexes of economic, social, and environmental sustainability.

$n$ - number of individual indexes of economic, social, and environmental sustainability.

At the final stage, the authors form an integral indicator as the arithmetic mean of sustainable development level indicators of each component (economic, social, environmental). Based on this, the integral indicator of sustainable socio-economic development of the region is (see equation 3):

$$U = \frac{U_{econ}+U_{soc}+U_{ecol}}{3}, \tag{3}$$

$U_{econ}$  – economic sustainability

$U_{soc}$  – social sustainability

$U_{ecol}$  – ecological sustainability

The integral indicator should be within the range from 0 to 1. An example of ranking the indicator values according to the "traffic light" principle is in Table 2. The ranking is established on the values of the integral index  $U$ . The choice of limit values is based on the need to identify three zones characterizing the degree of sustainability of the municipality's development. It is sufficient at this study stage. As empirical data accumulates in dynamics, the researchers may refine the scale. The approach to scaling is based on the article of Kuznetsova M.N. (Kuznetsova, 2015).

**Table 2** Ranking of values of the sustainable socio-economic development integral indicator of territories

Limit values	Sustainable development interpretation	Territory identification zone
0 to 0.1	Unsustainable development	Red zone
0.1 to 0.4	Weakly sustainable development	Yellow zone
0.4 to 0.7	Medium sustainable development	Green zone
0.7 to 0.9	Sustainable development	
0.9 to 1	Highly sustainable development	

### 3. Results and Discussion

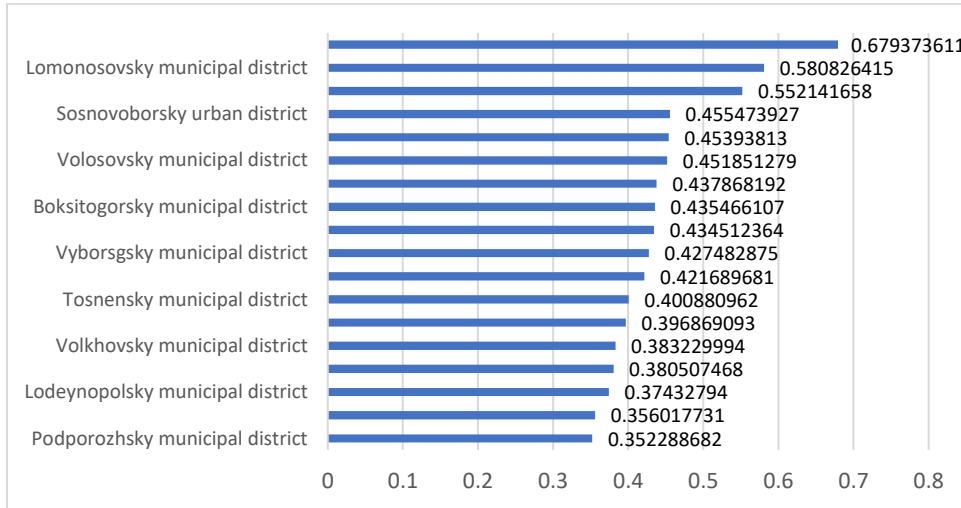
Constructing an integral sustainability indicator methodology for municipal territories allows us to obtain a rating of municipalities in the Leningrad Region by the sustainability and balanced development degree (Figure. 2). According to the adopted ranking, medium sustainable development is characteristic of most municipalities of the Leningrad Region - 12 districts are in the yellow zone. The leaders among the municipal districts of the Region are the Kingiseppsky, Lomonosovsky, and Vsevolzhsky districts. Kingiseppsky District has high economic development per capita due to the significant contribution of the Ust-Luga commercial sea port. The authors note that all of the leading territories in terms of sustainability are part of the St. Petersburg agglomeration. Kirovsky, Volkhovsky, Slantsevsky, Lodeynopolsky, Tikhvinsky, and Podporozhsky municipal districts have weak sustainable development. These districts are in the red zone.

For sustainable development territory formation, it is necessary to improve the regional economic policy. The authors view the regional economic policy supporting Small and Medium Enterprises (SMEs) in the pursuit of long-term sustainable development within the region as an interconnected set of methods, mechanisms, and instruments of



influence on economic entities in the SME sector. This policy is designed to foster economic growth and social development while taking into account environmental constraints.

This regional economic policy type would be an appropriate strategy that combines the planned projects and programs within the sustainable development framework into a coherent system, which makes it possible to choose the most promising and effective strategic support directions from the "green economy" perspective" (Table 3).



**Figure 2** Rating of sustainability of Leningrad Region municipalities and urban areas

There are some offers on implementation tools of regional economic policy. The first is a new approach to the SME classification in the environmental and social sphere to differentiate the economic support. The second tool is a methodology for assessing the sustainability development of municipalities in the region using the proposed indicators and the "traffic light" map. The third tool is an algorithm for provision monitoring of financial support to SMEs according to the sustainability triad.

**Table 3** Principles of forming a regional economic policy of SME development in the context of achieving sustainable development for the region

Principle	Principle essence
1. Program approach and measurability of goals in the public support implementation	Public support consolidation for SMEs in sectors that contribute to achieving sustainable development of the region. Attracting investments in "green" innovations. Setting key performance indicators for public support programs, measurability of goals based on SMART-analysis
2. Availability of public support at all stages of innovation implementation for SME	Public support promotion by stages (active investment in marketing research, research and development, testing, design, technological and organizational production preparation, and commercial implementation of innovations).
3. Innovation infrastructure advanced development	Effective interaction of executive and legislative authorities, business, and scientific institutions, the purpose of which is the innovation infrastructure development to ensure a "green" transition at small and medium-sized enterprises. The stakeholders must introduce and develop the "single window" principle for business support.
4. Public support transparency for business	Free and clear access (using the "single window" system) will ensure information transparency on the amount, recipients, and characteristics of specific programs (projects) that obtained public support.
5. Identification of activity priority areas	It is a regulatory consolidation of innovative, social, and environmental business goals.

Principle	Principle essence
6. Priority use of market instruments and public-private partnership instruments to stimulate priority business sectors	It is a business infrastructure support for businesses' development that contributes to the sustainable development achievement in the region. There are investments in research and development, promoting them in the markets of "green" innovations with subsequent commercialization. Also, this principle is about scientific and technical initiatives stimulation for young scientists and students of higher education institutions, attracting young people to priority areas.
7. Ensuring the public support effectiveness for innovation activities for socio-economic development goals and federal subjects of the Russian Federation	Introduction of transparent qualitative and quantitative target indicators of the work effectiveness of specialized committees, infrastructure organizations' support, and enterprises receiving support. Monitoring of the SME turnover share by receiving support from enterprises operating in the innovation, social, and environmental sectors.

There is a proposition to monitor the SMEs in the region throughout the year. Also, there is a proposal to assign the monitoring and financial support functions to the executive authorities to the Committee for Support of Small and Medium Business and Consumer Market and the Committee for Economic Development of the Leningrad Region, as well as to the SME support infrastructure organizations - the Entrepreneurship Support Fund of the Leningrad Region and municipal SME support funds. According to the authors, the question of the degree of influence of individual factors on the sustainable development of municipal territories is debatable. A significant error in assessing such an impact may be caused by the lack of reliable and up-to-date statistical information.

This study uses available municipal statistics, which determined the limited list of indexes, as well as the relative simplicity of the methodology. This article ([Gutman \*et al.\*, 2022](#)) studies an impact assessment of business activities on the region's sustainable development. However, the list of indexes utilized in this article poses challenges for application at the municipal level due to a lack of available data. For example, there is data on life expectancy in the region and no data for municipalities. Also, the article authors ([Gutman \*et al.\*, 2022](#)) focus on the impact of large businesses on the regional economy and choose regions with large enterprises for analysis, while the authors of this study concentrate on the impact of small and medium-sized businesses which are dispersed across the territory of the region and municipalities, which makes the methodology applicable to most regions.

The article ([Khaykin and Toechkina, 2021](#)) analyzes service capital as a condition for the sustainable development of society with an emphasis on the social sphere. At the same time, the authors do not provide a quantitative approach to assessing the level of such capital about sustainability; moreover, the environmental component is not considered part of service capital, which makes it problematic to apply the approach to assess the sustainability of municipalities in the region. The article ([Berawi, 2021](#)) describes the intersectoral interaction that helps to achieve the UN Sustainable Development Goals. The aid of small and medium-sized businesses, whose activities are related to solving social and environmental problems of the region, regarding the severity of these problems at the municipal level (which can be assessed based on the proposed methodology), contributes to increasing the effectiveness of intersectoral interaction.

The proposed methodology uses Kuznetsova's methodology adaptation and development ([Kuznetsova, 2014](#)). In the article of M.N. Kuznetsova, "the method of comparative analysis, which uses the method of Euclidean distances, is applied. It allows us to identify the ideal index and assess the degree of proximity distance of indexes of other regions relative to the ideal value".



The "ideal" value of the index is determined by the achieved value by the municipalities of the region (i.e., the "best" municipality is selected from those studied by this index). This approach is the ideal system concept (the concept proposition was in the theory of inventive problem solving). The ideal system does not exist but sets some values of indexes, which ideally should be strived for to determine the vector of management actions. The adaptation and development of the approach (Kuznetsova, 2014) consists of selecting new objects (municipalities), justifying the set of indexes for calculating individual indexes for the municipal level, and supplementing the ranking scale with the "traffic light" principle.

The proposed methodology is applicable to analyze sustainability in other regions. However, it is necessary to understand that there are similar data on the development of municipal entities in another region. If data are contrasting, the methodology can be adapted to a new group of indexes. The prospect of further research may be the improvement of methodology for calculating the integral indicator. The weights of each component in the considered approach are assumed to be equal since obtaining estimates of the development balance of municipal entities is a necessary sustainability component. In the future, as data accumulates, the weighted average formula will also be applicable. Accordingly, the task will be to substantiate and determine the weighting coefficients.

The research problem revolves around selecting indexes to characterize the sustainability of municipal development. These indexes should be universally available to facilitate the assessment of all municipalities, involving statistical observation across these indexes for comprehensive evaluation. Unfortunately, the list of indexes of official statistics that satisfy these requirements is currently not broad. One of the research development ways can be the justification and development of the list of indexes of municipal statistics in the sustainability context, which will help to improve regional monitoring. The proposed method applies to the system of regional monitoring. Prospects for further research are related to the specific algorithm development for monitoring implementation.

Directions for further research include studying the economic and political systems of foreign countries with a high sustainable development index, as well as further identifying the dependence of the level of development of social and eco-oriented entrepreneurship on achieving sustainable development in the region.

It is advisable to study the experience of other countries in achieving sustainable development goals for studying sustainable development strategies, mechanisms, and tools for their implementation, including from the point of view of the impact on SMEs whose activities contribute to the sustainability of socio-economic development (primarily environmental and social entrepreneurship). In this context, it is necessary to identify the leading countries in achieving the UN Sustainable Development Goals, analyze the availability and content of sustainable development strategies in foreign countries, including a comparison of these positions with the leading countries, review the SME aid system in the top countries and identify the most effective aid tools with a focus on environmental and social entrepreneurship.

Also, a future research area is the study and generalization of approaches presented in the experience of other countries to environmental and social entrepreneurship identification as an object for priority state aid. This article considers the methodology of obtaining an integral assessment of the sustainability of a municipality and private assessments of economic, environmental, and social sustainability. Based on these assessments, the authors underline "problem" areas for the territory and an opportunity to provide additional state aid to those SMEs that operate in the relevant field (based on the environmental and social entrepreneurship identification) to solve the problems.

#### 4. Conclusions

The article discusses the assessment of municipal sustainability in the Leningrad Region, Russia, with a focus on sustainable development principles. The authors propose an integral indicator for sustainability that considers economic, social, and environmental factors. The authors emphasize the importance of SMEs in achieving sustainable development and suggest distributing SME potential based on sustainability factors. To assess sustainability, the authors select various components related to economic, social, and environmental aspects. The authors propose an integral indicator that combines these components and ranks municipalities of the Leningrad Region based on their sustainability levels. The results show that most municipalities in the Leningrad Region exhibit medium sustainable development, with some districts being stronger in economic sustainability due to factors like commercial seaports. The authors highlight the need for improved regional economic policies to support SMEs in achieving sustainable development. Also, the authors suggest principles for forming regional economic policies, including a program approach, public support at all stages of innovation, innovation infrastructure development, transparency, and priority areas, such as social and environmental fields. In conclusion, the article presents a methodological approach to assess regional sustainability and SME potential, offering insights for making informed administrative decisions related to government support for specific business areas.

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