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The Socio-spatial stratagems of human capital development in the Southern Federal Districts of Russia

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Abstract

Purpose: is to substantiate promising strategies for sustainable development of human capital in the current conditions of the demographic crisis on the basis of scientific generalization of key social and spatial aspects of the formation, use and accumulation of human capital.

Methods: the application of expert-rating methods based on the Lorentz curve and the Gini index to determine the reasons for the disparities in personal income is done in addition to the use of conventional and specific approaches.

Results: the research examines the existing situation of human capital and defines strategic means of promoting its growth. The findings of the analysis of trends in human development parameters, which are one of the factors ensuring macroeconomic growth and competitiveness in the South Federal Districts of Russia and should be based on various socio-spatial development strategies, are presented. A self-sufficient socio-spatial-economic system and human capital, which provide competitive advantages, are the foundations of sustainable economic development. The key factors influencing the state of human capital and the trends of its integral indicators show low rates of socio-spatial development.

Conclusions and Relevance: the research findings revealed certain negative tendencies in human capital indicators, which point to the necessity for rethinking and additional inventive adjustments to the system of social and spatial management. The work-out of mechanisms for the regulation of imbalances in its development, reversing trends in the narrowing of the labour market, developing socio-spatial programs for institutional support and regulation of labour migration, and spatial human development are among the strategies for human capital that are proposed as the top priorities.

Keywords: stratagem, human potential, human development index, socio-spatial development, comparative asymmetry, labour migration, demographic factors

Conflict of Interest. The Authors declare that there is no Conflict of Interest.

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Научная статья

Социально-пространственные стратегии развития человеческого капитала в Южном федеральном округе России

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Аннотация

Цель статьи состоит в обосновании перспективных стратегий устойчивого развития человеческого капитала в сложившихся условиях демографического кризиса на основе научного обобщения ключевых социальных и пространственных аспектов формирования, использования и накопления человеческого капитала.

Методы. Наряду с традиционными и специфическими методами научного поиска, в работе применены методы экспертно-рейтинговой оценки, основанные на кривой Лоренца и индексе Джини, для определения причин диспропорций в распределении личных доходов и асимметричности тенденций развития человеческого капитала. Эти методы дополняют традиционные расчетно-графические приемы.

Результаты работы. В исследовании изучается состояние воспроизводства и накопления человеческого капитала, а также определяются перспективные стратегические пути обеспечения его развития. Представлены результаты анализа трендов показателей человеческого развития. Это один из факторов обеспечения макроэкономического роста и конкурентоспособности регионов Южного федерального округа России. Процесс должен основываться на различных стратегиях социально-пространственного развития. Базисом устойчивого экономического развития регионов ЮФО являются самодостаточная социально-экономическая пространственная система и человеческий капитал, который обеспечивает конкурентные преимущества. Однако ключевые факторы, влияющие на состояние человеческого капитала и тренды его развития, демонстрируют низкие темпы социально-пространственного развития.

Выводы. В результате исследования определены отрицательные тренды некоторых показателей развития человеческого капитала, которые свидетельствуют о необходимости переосмысления и дальнейшего инновационного изменения системы социального и пространственного управления в стране. Предложены приоритетные пути устойчивого развития человеческого капитала, в частности, формирование механизма государственного регулирования диспропорций его развития; преодоление тенденций сужения рынка труда; формирование социально-пространственных программ налаживания институциональной поддержки и регулирования внешней трудовой миграции и пространственного человеческого развития и др., которые, на наш взгляд, входят в число важнейших компонентов стратегий развития человеческого капитала региона.

Ключевые слова: стратегия, человеческий потенциал, индекс человеческого развития, социально-пространственное развитие, сравнительная асимметрия, трудовые миграции, демографические факторы

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Introduction

Human capital has become one of the key determinants of the potential to reach the required volumes of the gross regional product under the prevailing socio-spatial conditions. However, the concept of "human capital" is relatively new in economic theory,

and approaches to assessing human capital, its contribution to socioeconomic growth, socio-spatial development, and its management at the meso-level have not been thoroughly researched and are being developed in response to modern realities. Trends in all qualitative and quantitative indices of human capital have an impact on Russian socio-spatial and

economic development. A persistent decline in the demographic parameters of Russia as a whole and its regions in particular characterizes these tendencies.

Under these conditions, there is a shift in the socio-spatial paradigm of society: low-skilled labour depreciates while entry barriers to the market for high-skilled employees grow due to technical complexity, and social stratification accelerates.

Human participation in social production amid the demographic crisis, as well as the digitization of economic processes, necessitate complicated tasks in order to build an environment that delivers the required quality of human capital. Human potential development is a multi-vector strategy to address human needs, develop life skills, and offer opportunities for improvement, creativity and societal realization.

The subject of paying more attention to the factors of socio-spatial development of human capital comes as a result of regional divergence, local concentrations of high-quality labour, distinct scientific and technological potentials, internal migration limits. This is critical for improving labour productivity, limiting internal migration, and developing regional development strategies.

The issues of reducing the negative impact of transformational processes on the formation and use of human capital, as well as the search for opportunities for its social and spatial development, remain extremely relevant while considering the relationship between the level of regional socioeconomic development and the degree of differentiation, on the one hand, and the quality of human capital, on the other hand.

The study is aimed at generalising the main social and spatial aspects of the formation, use and accumulation of human capital to substantiate promising strategies for their use as the main factors of its development at the meso-economic level. Given the trends in economic digitalization, as well as the change of methods to its development and human capital development (HCD) connected with these processes, many economists highlight the necessity to increase the rate of real sector production.

Several scientific studies have formed the position that the socio-spatial human capital development is systematically implemented through the evolution of digital transformation in various socio-economic, functional-demographic, and differential-educational processes, as well as other trends in the formation and improvement of the labour market on an innovative basis. Therefore, the directions for the social and spatial development of human capital available in the scientific literature need to be clarified.

In these settings, the scientific and practical generalizations of socio-spatial elements of human

capital formation, functioning and accumulation are very significant. In the context of this essay, we have covered three important points:

- defined the essence of the stratagem as a socio-historical, economic category that reflects a solid, well-calculated sequence of activities aimed at performing a certain task or reaching an implicit goal, while considering the object's psychological tendencies and other considerations [1];
- the essence of human capital is defined, as includes not only the population's total knowledge, educational and professional characteristics (total human capital) but also spiritual, psychophysical and demographic qualities, as well as human development capital without improvement, which is unthinkable [2, 3];
- determining the necessary conditions for the preparation and successful implementation of stratagems: the ability to calculate moves and anticipate their consequences; knowledge of the economic, demographic and psychological characteristics of those against whom the plan is aimed; and the persistence of the plan's author in stratagem implementation [4, 5].

The most important idea is to identify the main drivers of human capital development in the modern socio-economic space, taking into account digital realities. The authors propose to use methodological approaches to the study of systems of predictive scenarios for the development of socio-spatial human capital for the formation of effective, functioning human capital, introduce various forms and mechanisms for its further regulation.

Literature Review

The socio-spatial features of HCD were considered in the works studied by domestic and foreign researchers such as A.L. Borshch and A.R. Zharova [2], A.L. Kekkonen, A.V. Simakova and I.S. Stepus [3], V.V. Stofarandova, M-G.O. Omarov [6], as well as many foreign researchers such as Y. Wang and Chao Ni [7], Z. Fang, J. Zhu and R. Deng [8], S.G. Shulgin and Yu.V. Zinkina [9] and other.

The proposed by many authors approach provides a computational, mathematical and empirical apparatus to interpret current trends and indicators of human capital development, making it possible to substantiate strategies for sustainable human development in modern conditions. A comprehensive analysis of the factors influencing the trends in human capital formation and use in the SFD is needed.

Human capital is extremely important in terms of the strategic development of a country. At the same time, it is considered from two analytical positions [10]:

- from a microeconomic point of view, human capital is essential for increasing labour productivity

through education, advanced training, and the level of education of people of working age;

- from a macroeconomic point of view, human capital is a key factor in ensuring the cumulative impact of the labour factor in the regional economy, contributing to technological innovation and sustainable economic growth.

We can identify the key drivers of human capital development, which are the driving force of sustainable socio-spatial development, based on the literature [2, 4]. Among them are socioeconomic and political circumstances; labour market conditions; higher and additional professional education and training; employee motivation; employee health and maintenance resources; social and financial circumstances; social and cultural contexts; psychological state, etc.

The strategic approaches to the development of various spheres of the state aim to integrate Russia into the Eurasian community. A human-centric approach and a system to ensure high standards of living are essential for achieving high human potential. This vision is also based on global approaches to human development, and human capital, which are regularly researched and analyzed in human development reports based on calculations of various parameters: the human development index (HDI), the human capital index, the index of social development, etc.

"Human capital" refers to the ability and efficiency of people's activities in the production of consumer goods, and it is widely recognized that these skills can be acquired through the education system [8, 9]. Even though the scientific essence of human capital is clear, the development of an integral indicator of the socio-spatial development of human capital becomes an important point [10].

In the context of the objectives of this work, an important point is the study of theoretical and practical aspects of the content and significance of the socio-spatial HCD and the identification of the main factors influencing the dynamics of its main determinants. It is important to determine the content and main provisions of the socio-spatial development of labour resources to ensure their sustainability. The emergence of the study on spatial development problems is primarily related to an understanding of limited resources and an awareness of the necessity for their optimal utilization under existing conditions, which are determined by specific areas, zones, influencing variables, and geographical features.

L.M. Borshch explains that the scientific methodology for determining and analyzing economic categories involves referring to terminology already included in the system of economic knowledge. The category "spatial development" has unique features of the

fundamental categories "space" and "development", which presuppose the existence of an ordered organization. The integral category "spatial development" is broad and vague in its scientific interpretation due to its philosophical, mathematical, physical, humanitarian, and other approaches to its essence [2].

"G. Leybnits came closest to a static understanding of space, concluding that space cannot exist outside matter and material processes" [3]. "According to I. Kant, space is not an empirical category that can be derived from external experience. The understanding of space is a representation that underlies all contemplations" [6].

The broadest definition of the category "space" was developed by L.M. Borshch, who separately investigated its interpretation from the following five standpoints (approaches): the philosophical-physical approach, the mathematical approach, the geographical approach, the socio-humanitarian approach, and the philosophical-epistemological viewpoint [2].

"Explaining the meaning of the category "space", the most clearly defined definition is given by A.I. Kekkonen, A.V. Simakova, and I.S. Stepus, who interpret space as "...a set that consists of elements of any nature, in which their limiting relations are determined in one way or another" [3].

Turning to the interpretation of the term "development", we note that, in accordance with generally accepted approaches, it denotes a qualitative change of objects, that is characterized by a purposeful and irreversible nature and as a result of which conditions are created for further self-movement [6].

The theoretical and methodological analysis of the indicators of human capital in Russia as a whole and the Southern Federal District (SFD), in particular, proves their sufficiently high level; at the same time, the efficiency of their use is low, and labour productivity does not allow for the necessary socio-spatial and economic development of the country and its regions [11].

Approaches that determine the socio-spatial HCD, which is key to ensuring sustainable development, remain ineffective. Insufficient investments in education, health, and social protection have resulted in a lack of human resources. Another problem is regional peculiarities, which are manifestations of social, spatial, economic, and other regional factors that directly impact the trends of human capital.

Methodological approaches should be used to understand the state of human capital and its components at the socio-spatial level, in addition to traditional methods and scientific research. One

such approach is the concept of system-oriented human development, for whose implementation it is necessary to use the components that are the foundation for ensuring an appropriate level of human capital [12].

The calculation of the regional HDI index includes 33 indicators combined into 6 blocks, respectively, for the main aspects of socio-spatial human development: population reproduction; territorial-spatial and social status; comfortable life; welfare; decent work; education, etc. [2, 13, 14].

Systemic impact strategies on all institutions of human capital investment are required to provide labour law guarantees, assure the effectiveness of tools for their protection, and motivate participants in labour relations to seek out corridors of social cooperation. This work compares the structure of socio-spatial parameters in the SFD using the GRP index and Gini and Lawrence indices, taking into account methodological difficulties in determining them in the dynamic structure.

Materials and methods

The methodological foundations of this study are based on tracking the current state of human capital development and determining the socio-spatial strategic ways of its development. Then the traditional methods and specific scientific search techniques based on the generalization of scientific literature published and indexed in domestic and international scientific and metric databases of the RSCI, Google Academy, Research Gate, Scopus, Web of Science, etc., were applied.

The disclosure of the theoretical and logical essence of human capital was based on the generalization of R. Solow's model of economic growth (an increase in the level of education, qualifications, and health of an employee can increase the efficiency of a unit of simple labour), understanding the HCD at the heart of the process of direct impact on it due to the growth rate of labour productivity, and the introduction of innovative assessment and justification of the need to establish the actual pace of the global competitiveness index and the integral index of human capital development, etc.

To display the study findings and key conclusions, computational and graphical approaches (system-comparative analysis, expert-rating assessment of the asymmetry of the trend of the HCD, etc.) are used. The use of these methods make possible to substantiate the system of parameters for evaluating trends in the development of human capital, to identify socio-economic factors of the current state of human capital development, to establish the causes of the disparity of indicators of socio-spatial HCD, such as the calculated HDI (x_{HDI}), potential life expectancy index

(x_{LEI}), education level index (x_{EI}), index of personal income (x_{IP}), and etc. The basis for supporting the gap in the value of regional personal income was a comprehensive investigation of trends in the average value of the comparative asymmetry of HCD, the index of GRP per active part of the population [15].

The state of the socio-spatial HCD was revealed by calculating the Gini coefficient [7] and presenting its trend using the Lorentz curve, which was the basis for forming a model of the algorithm for the socio-spatial HCD using a system-oriented approach. Thus, various qualitative and quantitative indicators of the measurement of human capital and general human development trends have been proposed in the empirical literature, such as literacy rates, school enrollment rates, years of study, and test results [10, 16].

Although some indicators that measure the proportion of the population who have completed primary, secondary, and higher education are subjective parameters of well-being [6], they do, to some extent, reflect the desired level of education and qualifications of the labour potential in the country and its regions.

Results

Human capital is an important aspect in the development of regional socio-spatial systems since it activates other productive forces. The study of human capital's spatial distribution helps us to analyze the current and prospects of regional socioeconomic growth. This necessitates justifying the human capital development strategy in today's demographically risky environment.

Human capital development is a process that occurs as a result of economic agents' investments in the formation of a stock of knowledge, skills, experience, health, and also intellectual and physical abilities to work that can or are used for economic purposes to obtain or increase the income of society, enterprise or employee [17].

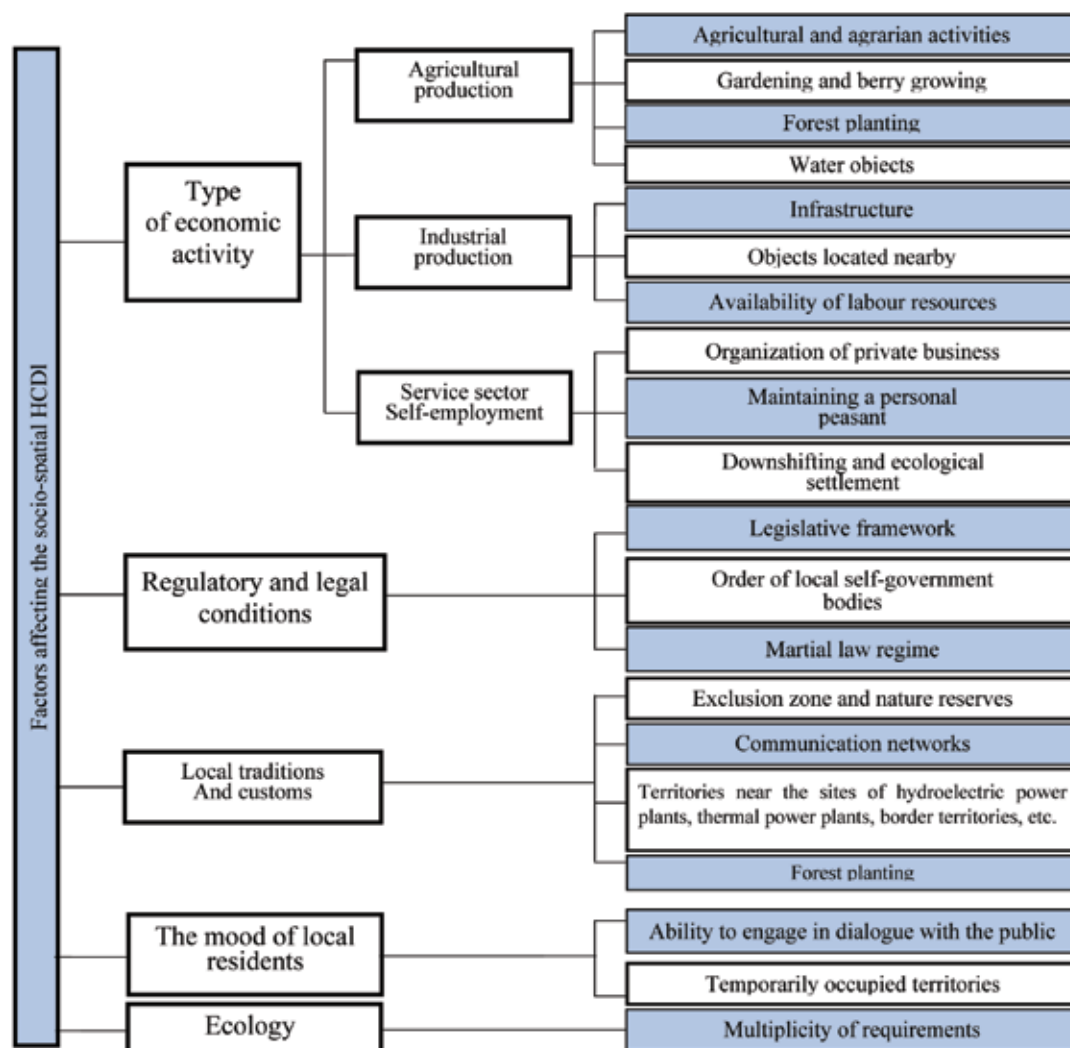
Stratagems are sequences of actions aimed at solving a task or achieving an implicit goal, taking into account the psychological inclinations of the object and other factors. Our position completely coincides with the point of view of many researchers of spatial problems [1, 17, 18], who claim that stratagems are an ordered collection of tactical and demographic-psychological techniques used by rulers and military leaders in specific cases.

The generalization of theoretical characteristics of the category of socio-spatial development of human capital in the literature allowed for the identification of numerous approaches to its interpretation, but its purpose has not been sufficiently specified. As a result, it is prudent to prioritize human capital as the

primary factor in the economic development. At the same time, it should be noted that many academics study the idea of socio-spatial development, primarily in a territorial context; hence, socio-spatial HCD is regarded as the physical positioning of human potential in a specific territory [6, 19].

The dynamic feature of the category "The spatial development of human capital" suggests that at its

different stages, different sets and combinations of these factors that determine the characteristics of socio-spatial development are important. It is worth emphasizing that if the socio-spatial HCD is polarized, then the spectrum of human resource concentration is necessarily allocated as the center of the poles of socio-economic development [11]. In practice, the socio-spatial HD consists of the provisions depicted in Figure 1.



Compiled by the authors based on [11].

Fig. 1. The factors impacting the socio-spatial development of human capital

Составлено авторами на основе [11].

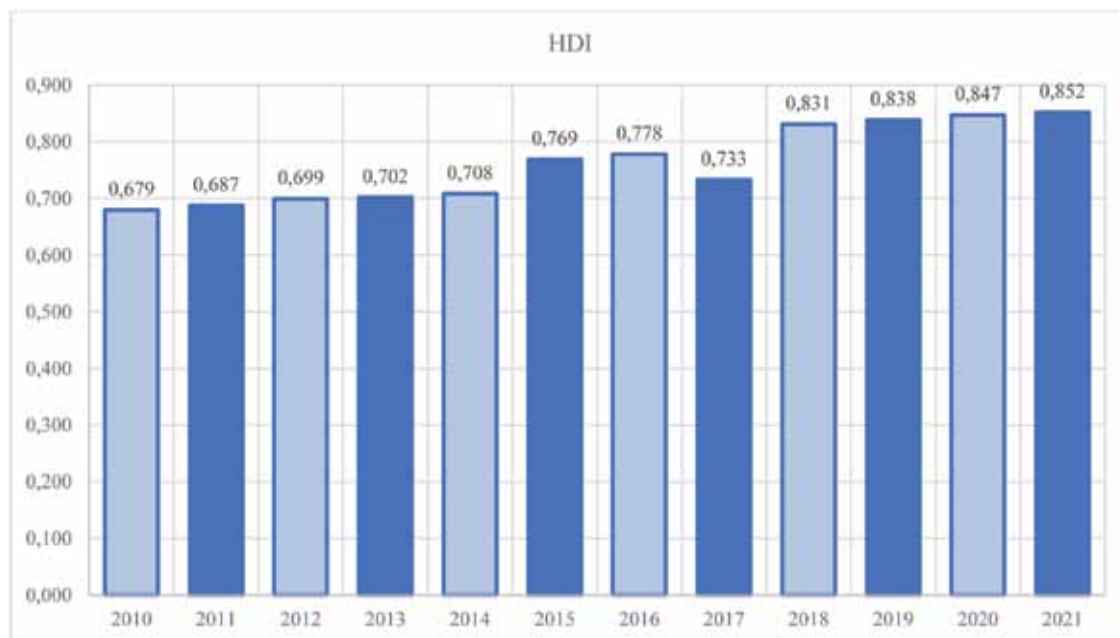
Рис. 1. Факторы, влияющие на социально-пространственное развитие человеческого капитала

The development of conditions for socio-spatial HCD benefits territorial formations as well as sectoral production and non-production organizations in these territories. The creation of many theoretical provisions for the development of the concept

of socio-spatial HCD can address, in addition to scientific, certain practical, and socio-economic difficulties, since spatial development of human potential can accomplish numerous positive trends: the rationally planned provision of economic entities

with the necessary labour potential to meet the needs of territorial entities and territorial communities; ensuring the organization's effective staffing; creating a labour infrastructure for the protection of cultural heritage and the environment, etc.

Socio-spatial aspects of human development in Russia and its regions are still behind the necessary trajectory, which should have been achieved if target indicators had been achieved during the study period (Figure 2).



Compiled by the authors based on [11].

Fig. 2. The state of the Human Development Index in the Russian Southern Federal District

Составлено авторами на основе [11].

Рис. 2. Состояние индекса человеческого развития в Южном федеральном округе России

The data in Figure 2 shows that the HDI in the SFD has risen relatively, rising from a low of 0.679 in 2010 to a high of 0.852 in 2021, an increase of 0.173 or 25.5%. The innovation economy seeks to eliminate the potential consequences of a downward trend in human development by increasing labour productivity, elevating knowledge and intellectual abilities, strengthening education, activating capital investments in human capital, and emphasizing the importance of R&D expenditures [7, 14].

Considering different approaches to the structure of human capital, we shall analyze and consider its main components through various scientific approaches. It would be noted that, like many indicators requiring world comparison, the HDI, by date, is published every 2 years after its placement in state statistical collections.

Formulas are used to calculate the HDI (x_{HDI}) [8, 9]:

$$x_{HDI} = \frac{x - \min_x}{\max_x - \min_x} \quad (1)$$

where $\min_x$ and $\max_x$ are the minimum and maximum values of the indicator among all the countries studied.

The HDI (x_{HDI}) of a particular country or region depends on the following three indicators:

Life Expectancy Index (x_{LEI})

$$x_{LEI} = \frac{LE - 20}{85 - 20} \quad (2)$$

Education Index (x_{EI})

$$x_{EI} = \frac{MY SI + EY SI}{2} \quad (3)$$

where the index of average duration of training $MY SI = \frac{MY}{15}$ and the index of the expected duration of training x_{IP} .

The index of income of the population (x_{IP})

$$x_{IP} = \frac{\ln(GNI_{PC}) - \ln(100)}{2} \quad (4)$$

where GNI_{PC} – is the value of GNI per capita calculated by purchasing power parity.

The HDI is the average geometric parameter of all the higher designated indicators (x_{HDI}):

$$x_{HDI} = \sqrt[3]{x_{LEI} \cdot x_{EI} \cdot x_{IP}} \quad (5)$$

The Resolution of the Cabinet of Ministers of Russia "Some Issues of Improving the System of Monitoring and Evaluating the Effectiveness of the Implementation of State Regional Policy" [8, 12] identified indicators that are used in calculating the regional HDI: a long and healthy life (average life expectancy at birth, the total coefficient of population growth (reduction), the mortality rate from intentional self-harm), prosperity and decent working conditions (the volume of expenditures of local budgets, the ratio of the average wage to the minimum, the level of employment of registered unemployed), education (net coverage of preschool academic institutions for children aged three to five years, the number of graduates of higher educational institutions of I-IV levels of accreditation) [18].

The indicators for calculating the integral indicator of the HDI are presented in Table 1. Based on the main approaches to the structure of human capital, we shall consider the differences between the regions of the SFD regarding the indicators of regional human development, using the methodology of measuring socio-spatial human development. It follows from Table 1 that the Integral Assessment of Regional Human Development in 2010–2021 ranged from a minimum value of 0.706 (Crimea) to a maximum value of 0.829 (Vologda Oblast).

Accordingly, up to six main components are considered in determining the integral evaluation of socio-spatial human development. The minimum and maximum values by region are shown in Table 1 and Figure 3, which reflect for comparison the asymmetry of the socio-spatial HCD in some districts such as Dagestan, Rostov Region, the Kabardino-Balkarian Republic, the Karachayevo-Circassian Republic, the Republic of Kalmykia, etc., the main indicators of which are mainly in the interval between the maximum and minimum values of the HDI of the district.

Table 1

The human development indices in the regions of the Southern Federal District on average for 2010–2021

Таблица 1

Индексы человеческого развития в регионах Южного федерального округа, в среднем за 2010–2021 гг.

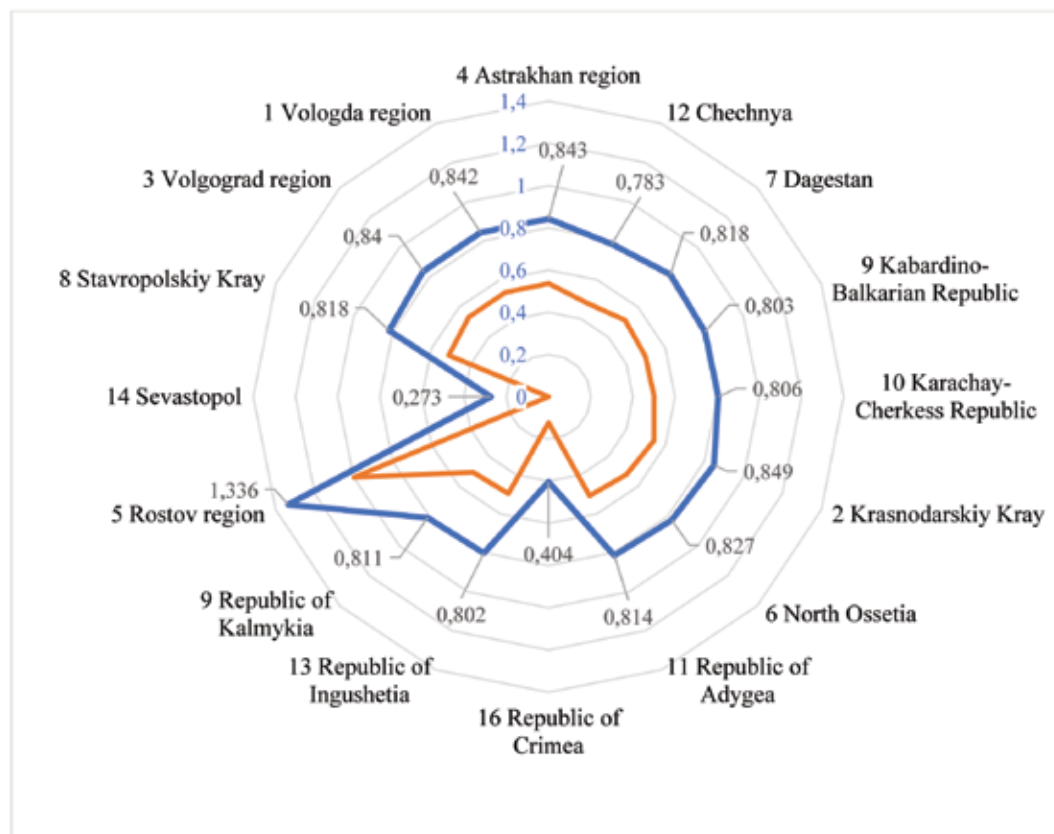
Rang according to the HDI	Regions of the Southern Federal District	HDI, on average for 2010–2021	x_{HCD}	x_{LEI}	x_{EI}	x_{IP}	x_{HDI}
4	Astrakhan region	0,843	0,536	0,768	0,907	0,772	0,813
12	Chechnya	0,783	0,479	0,815	0,858	0,652	0,77
7	Dagestan	0,818	0,513	0,871	0,858	0,678	0,797
9	Kabardino-Balkarian Republic	0,803	0,498	0,827	0,866	0,69	0,791
10	Karachay-Cherkess Republic	0,806	0,501	0,823	0,875	0,682	0,789
2	Krasnodarskiy Kray	0,849	0,542	0,777	0,898	0,787	0,819
6	North Ossetia	0,827	0,522	0,807	0,904	0,712	0,804
11	Republic of Adygea	0,814	0,508	0,788	0,897	0,68	0,783
16	Republic of Crimea	0,404	0,123	0,765	0,922	0,5	0,706
13	Republic of Ingushetia	0,802	0,497	0,931	0,795	0,569	0,75
9	Republic of Kalmykia	0,811	0,506	0,791	0,9	0,696	0,791
5	Rostov region	1,336	1	0,766	0,915	0,748	0,806
14	Sevastopol	0,273	0	0,804	0,949	0,5	0,725
8	Stavropolskiy Kray	0,818	0,512	0,795	0,873	0,717	0,792
3	Volgograd region	0,84	0,534	0,769	0,904	0,779	0,815
1	Vologda region	0,842	0,535	0,755	0,909	0,83	0,829

Source: compiled by the authors based on [19].

Источник: составлено авторами на основе [19].

When examining the indices that comprise socio-spatial human development, the coefficient of

asymmetry must be examined. The asymmetry coefficient indicates complete symmetry of human



Compiled by the authors on excel-interpolation of Table 1.

Fig. 3. Comparative asymmetry of HCD in the Southern Federal District

Составлено авторами на основе excel-интерполяции табл. 1.

Рис. 3. Сравнительная асимметрия развития человеческого капитала в Южном федеральном округе

development and the HCD in all studied components. The greater the deviation from unity, the higher the asymmetry of population growth and human capital development [3].

Based on the calculation of regional asymmetry coefficients, it can be seen that in 2017, the fluctuations of values lie in the range from 0.273 (Sevastopol) to 1.336 (Rostov region) (Figure 3). Four regions (out of 15 studied) have asymmetry coefficients closer to the regional average (0.838).

The type of socio-spatial human development that belongs to the pre-average has a conditionally negative nature in terms of ensuring decent work and income. Progress indices, which measure the growth rates of private HDI from 2010 to 2021, can be used to categorize the feature. The population income index (0.5) with a high education index is the weakest sign of success in Crimea and Sevastopol (0.922-0.949). The best coefficient is in the Krasnodarskiy Kray (0.849) with an education index of 0.909. Using the approach commonly utilized in such

computations and the range of variation of human capital development indices, three groups can be formed:

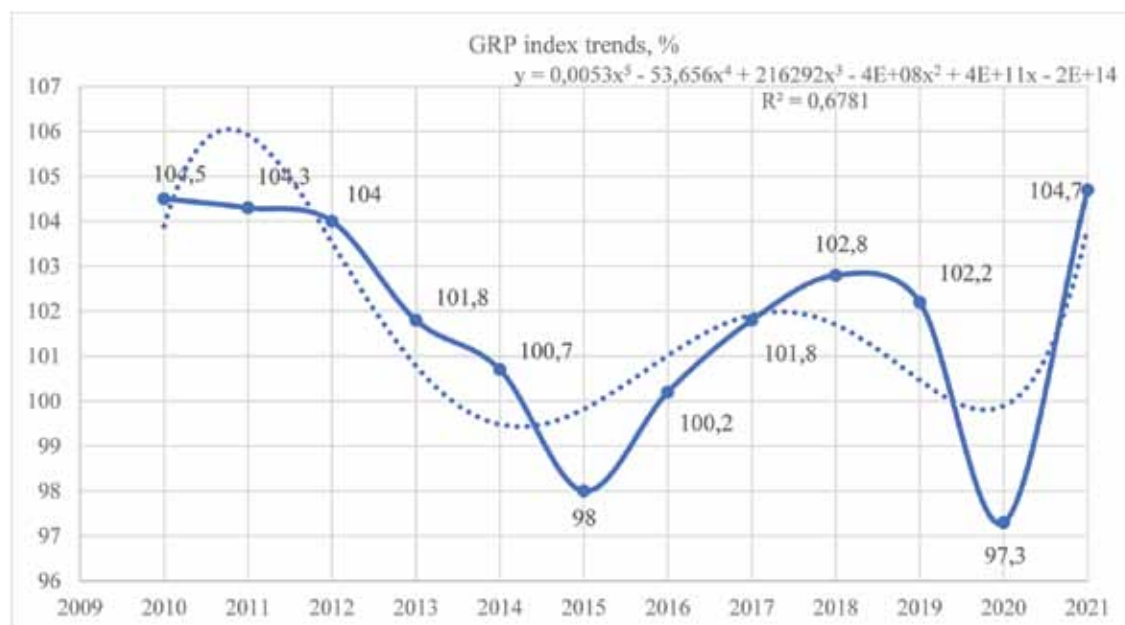
- 0.849–1.000 (regressive);
- 1,000–1.336 (minor progress);
- and more than 1.336 (the presence of progress).

From the conducted justification, separate calculations show that trends in the HCD are the worst indicator of progress (Crimea, 12.3%), excluding Sevastopol (lack of data for evaluation), the best indicator (Rostov region, 100.0%), and life expectancy is the worst indicator of progress (Vologda region, 75.5%), the best indicator (the Republic of Ingushetia, 93.1%). In the analysis of the level of education of the population, the worst indicator is in the Republic of Ingushetia (79.5%), and the best indicator is in Sevastopol (94.9%).

The population well-being indicator is low in Crimea and Sevastopol (50.0%), with the best indicator in Vologda Oblast (83%). The index of the physical volume of the gross regional product (GRP) is an important indicator of human capital's socio-spatial

development. In 2021, the GRP physical volume index grew and was fixed at 104.7%, which is 4.0%

and 6.7% higher than the GRP physical volume index of 2004 and 2015, respectively (Figure 4).



Compiled by the authors.

Fig. 4. GRP physical volume index in the Southern Federal District, in 2010–2021, %

Составлено авторами.

Рис. 4. Индекс физического объема ВРП в Южном федеральном округе в 2010–2021 гг., %

One of the indicators of socio-spatial HCD is the general trend in income among the population. According to statistical data, the volume of average household monetary incomes in the SFD in 2021

increased by 11.7% compared to 2020 and amounted to 34,526 thousand rubles (Table 2). Unfortunately, an increase in income may not always affect the welfare of citizens.

Table 2

The income per capita in the regions of Southern Federal District, on average for 2020-2021

Таблица 2

Доход на душу населения в регионах Южного федерального округа, в среднем за 2020-2021 гг.

Regions	2020, rubles	2021, rubles	2021 to 2020	
			+/-	%
Russian Federation	36240	40040	3800	110,5
Southern Federal District	30910	34526	3616	111,7
Astrakhan region	25206	26799	1593	106,3
Krasnodarskiy Kray	37352	41944	4592	112,3
Republic of Adygea	30320	34556	4236	114
Republic of Crimea	23033	26371	3338	114,5
Republic of Kalmykia	19816	21250	1434	107,2
Rostov region	31519	34955	3436	110,9
Volgograd region	24995	27788	2793	111,2
Sevastopol	29969	33260	3291	111

Compiled by the authors based on [20].

Составлено авторами на основе [20].

Analysis of static data on the standard of living of various social groups in the SFD population from 2010 to 2021 revealed inequality in the distribution of total income, as shown by the Lorentz curve and the concentration coefficient (Gini index), which can range from 0 (uniform distribution of income among the entire population) to 1 (all income belongs to one person) [6]. An interesting point of the study of the socio-spatial HCD is the calculation of the Gini coefficient, which can be calculated [8, 21]:

- according to the Brown formula:

$$G = \left| 1 - \sum_{k=2}^n (x_k - x_{k-1})(y_k + y_{k-1}) \right| \quad (6)$$

or according to the Gini formula:

$$G = \frac{\sum_{i=1}^n \sum_{j=1}^n |y_i - y_j|}{2n^2 \bar{y}} \quad (7)$$

where G is the Gini coefficient, x_k – is the cumulative share of the population (pre-ranked in ascending order of income), y_k – is the share of income, that x_k , n is the aggregated number of households, y_k is the share of household income in total income and y – is the arithmetic mean of the share of household income.

The initial and calculated data on the development of the population and its grouping, differentiated by the 20% factor of the division of individual income, are presented in Table 3.

The parameters justified in this way can be used to calculate the Gini coefficient. To do this, you need to apply the proposed formula and calculate the values of p_i and g_i . At the same time, g_i – is the share of cash income on an accrual basis (column 7) divided by 100.

The practical application of formulas 6 and 7 for calculating the Gini index is shown in Table 4.

Thus, in the period 2020-2021, the Gini index of socio-spatial development of human capital in the regions of SFD amounted to 0.481 (in terms of population) and 0.139 (in terms of total population income), indicating an increase in this indicator of 6.1% points and 11.7%, respectively, in comparison to previous years. Thus, the Lorentz curve in Figure 5 reflects the ratio of the percentages of income and the corresponding percentages of the working population who received them, thus characterizing the uneven distribution (Figure 5).

The Lorentz curve displays the actual state of one of the main indicators (disparity population income) of the socio-spatial HCD in the SFD regions. The curve represents a graphical representation of the income distribution. That is, it shows the proportion of income

earned by given percentage of the population. In the case that everyone has approximately the same average income, we have a very equal society. While in a case where few own the majority of income, we have high inequality.

The following figure depicts the Lorenz curve for SFD in 2020–2021 with varying percent of population income inequality. The green 45o line shows the Lorenz Curve of regional economy with a perfectly equal population income distribution. The orange and brown lines show the regional economy with population income disparities in 2020 and 2021, and the red line depicts a very inequal income distribution. Generally, the further away the Lorenz Curve from the diagonal, the more unequal the wealth distribution. The degree of inequality is often expressed in terms of the Gini coefficient (Table 4).

The distance from the straight line of this line demonstrates an increase in the actual differentiation of the population in terms of well-being. The percentage of the population with an average income per capita less than the minimum subsistence level established by the legislation averaged 1.58% per month in 2021 (a decrease of 1.1% by 2020), while the size of the legally established subsistence minimum for the specified period increased by 10.0%. The percentage of people with income per capita below the per month subsistence minimum decreased in 2021 compared to 2020 in the SFD by 1.3 times and amounted to 28%. The poverty line reached a level of 7863 rubles on average per person per month, an increase of 16%.

According to the adopted law, the minimum wage increased by 10% to 15,279 rubles as of June 1, 2022. However, it varies across Russia, with one of the numerous factor determinants of the state of socio-spatial HCD in the SFD being relatively low [23, 24].

At the same time, both relative and absolute criteria of poverty are identified:

- In relative terms, according to the data 2021, the highest level of poverty in the region in terms of expenditures was in the Republic of Adygea (58.7%, which is 2.4 times higher than the national average) and in the Republic of Ingushetia (42.3%). The Kabardino-Balkarian Republic and the Karachay-Cherkess Republic, with a poverty level in the range of 32–33%, are located in the negative zone. The lowest indicator was recorded in the Volgograd Region (13.7%), the Vologda Region (15.4%), the Republic of Kalmykia (15.7%), Dagestan (16.1%), and the Krasnodarskiy Kray (16.3%). In terms of the depth of poverty, the situation is the worst in the Republic of Ingushetia, Crimea, and Sevastopol. These indicators show that in 2021, there will be no spatial features associated with relative poverty in the SFD.

Table 3

Initial and calculated data of 20% groups and percentages of the population by percentage income, for 2020-2021

Таблица 3

Исходные и расчетные данные по 20-процентным группам и процентам населения в разбивке по процентному доходу на 2020-2021 гг.

№ of groups	20% of the population	as a % of the total in 2020		as a % of the total in 2021		The area of the triangle				Rectangle area				The total area of the figure, S_i			
		1*	1**	1*	1**	2020		2021		2020		2021		2020		2021	
						1*	1**	1*	1**	1*	1**	1*	1**	1*	1**	1*	1**
1	12,5	64,1	1,6	61,5	1,629	6,41	1,6	61,5	1,6	0	0	0	0	6,41	1,6	61,5	1,6
2	25,0	74,5	2,8	76,4	2,85	80,9	4,4	137,9	4,5	12,82	3,2	123	3,258	93,73	7,6	260,9	7,7
3	37,5	80,9	3,1	77,6	3,17	161,8	7,5	215,5	7,6	255,5	15,1	476,4	9,4	417,35	22,6	691,9	17,0
4	50,0	81,5	6,1	80,5	6,02	243,3	13,6	296	13,7	498,9	28,7	772,4	23,0	742,16	42,3	1068,4	36,7
5	62,5	97,0	11,5	96,3	11,53	340,3	25,1	392,3	25,2	839,2	53,8	1164,7	48,2	1179,47	78,9	1557	73,4
6	75,0	98,1	15,0	100,1	14,9	438,4	40,1	492,4	40,1	1277,6	93,9	1657,1	88,3	1715,98	134,0	2149,5	128,4
7	87,5	102,0	25,4	101,2	25,3	540,4	65,5	593,6	65,4	1818,0	159,4	2250,7	153,7	2358,39	224,9	2844,3	219,1
8	100,0	120,8	34,5	121,5	34,6	661,2	100,0	715,1	100,0	2479,2	259,4	2965,8	253,7	3140,4	359,4	3680,9	353,7
Σ														9653,89	871,3	12314,4	837,8

Note: 1* – population size; 1** – income volume.

Compiled by the authors based on [22]. Составлено авторами на основе [22].

- According to the absolute criterion, the highest level of poverty is recorded in the Republic of Kalmykia (42.5%). The Krasnodarskiy Kray (39.8%), the Rostov Region (39.0%), and the Republic of Adygea (37.5%) have high criteria. Poverty rates in Sevastopol (17.5%), Astrakhan Region (18.8%), and Vologda Region (21.0%) are significantly lower than the national average. Compared to 2020, thirteen regions showed an increase in the level of relative poverty. The situation in certain regions has worsened, both in terms of the level and depth of poverty.

According to both criteria of poverty, the worst situation is in the Republic of Kalmykia, the Volgograd Region, and Crimea. In 2021, the real amount of monetary income of the population decreased compared to the level of the corresponding period in 2020 in the Astrakhan region and the Republic of Kalmykia.

From the analysis carried out, it can be concluded that the factors that affect the socio-spatial HCD capital in the regional context demonstrate the low rates of regional development in the studied areas: population reproduction; social status; comfortable living; well-being; decent work; education. According to some researchers, the growth rates of social and spatial human development should be significantly higher [25].

The theoretical studies of the structure of human capital, and Russian normative legal acts on the subject of research confirm the thesis about the key role of social, educational, labour, biological, and professional components in the spatial structure of human capital. The study of the integral assessment of the socio-spatial HCD revealed significant asymmetries in indicators. Out of all 15 studied regions of the SFD, 5 of them have asymmetry coefficients higher than the national average.

Human development is predominantly low and has a negative character in terms of ensuring decent work. All regions, without exception, within the framework of the analysis for 2010–2021, have a type that demonstrates regression in one or more indicators

Table 4

Gini index of socio-spatial development of human capital in the Southern Federal District for 2020-2021

Таблица 4

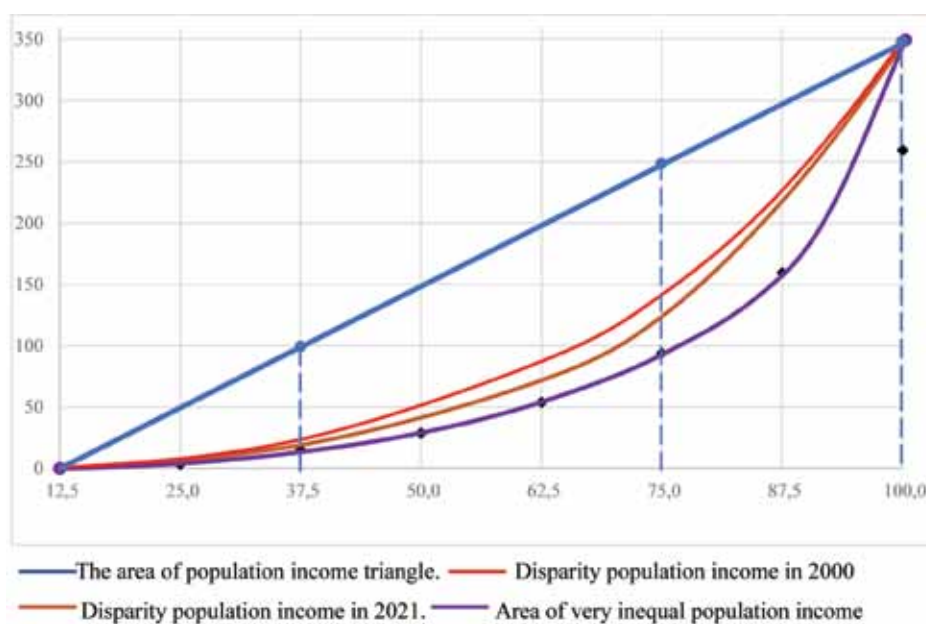
Индекс Джини социально-пространственного развития человеческого капитала в Южном федеральном округе на 2020–2021 гг.

№	p_i		q_i		$p_i \cdot q_{(i+1)}$		$p_{(i+1)} \cdot q_i$		$G = \sum_{(i=1)}^n ((p_i \cdot q_{(i+1)}) - (p_{(i+1)} \cdot q_i))$	
	1*	1**	1*	1**	1*	1**	1*	1**	1*	1**
1	0.125	0.125	0.016	0.0163	0.006	0.004	–	–		
2	0.25	0.25	0.044	0.0285	0.019	0.008	0.004	0.004		
3	0.375	0.375	0.075	0.0317	0.051	0.023	0.017	0.011		
4	0.5	0.5	0.136	0.0602	0.126	0.058	0.038	0.016		
5	0.625	0.625	0.251	0.1153	0.251	0.093	0.085	0.038		
6	0.75	0.75	0.401	0.149	0.491	0.190	0.188	0.086		
7	0.875	0.875	0.655	0.253	0.875	0.303	0.351	0.130		
8	1.000	1.000	1.000	0.346	–	–	0.655	0.253		
Σ					1.818	0.677	1.337	0.538	0.481	0.139

Note: 1* – by population; 1** – by personal income.

Compiled by the authors based on Table 3.

Составлено авторами на основе табл. 3.



Compiled by the authors based on Tables 3 and 4.

Fig. 5. Lorenz curve of the representation of indices of socio-spatial HCD in the regions of the Southern Federal District, for 2020–2021

Составлено авторами на основе табл. 3 и 4.

Рис. 5. Кривая Лоренца представления индексов социально-пространственного развития человеческого капитала в регионах Южного федерального округа, на 2020–2021 гг.

of human capital development. The GRP physical volume index in 2021 has grown, but poverty has not decreased. Some regions of the SFD are showing a relative trend in socio-spatial HCD indicators.

Based on the above, the priority directions of socio-spatial policy should be identified to ensure the effective formation and HCD in the SFD's regions:

- The most important idea is to ensure the functionality of key drivers, the socio-spatial development of human capital, and the formation of demographic foundations to improve the human development index.
- The goal is to reduce the risk of asymmetric human capital development in the regions.
- The formation, accumulation, and reproduction of a demographic fund can ensure a positive trend in GRP, resource base, and human potential.
- Narrowing the market for highly qualified labour creates a force capable of implementing innovations.
- Socio-spatial programs should be created to support labour migrants and their families.
- Institutional cooperation and support for social initiatives in external labour migration; adoption of modern territorial development strategies to meet the needs of the modern economy.

Human capital is a socio-spatial and economic phenomenon that provides theoretical and methodological foundations for component classification, system cycles, production, exchange, consumption, and the distribution of material and income values. The reproductive function of the information society development process is determined by the level of educational training of the population in the SFD.

The number of students in universities and secondary professional institutions in 2021 was 24,638 thousand, which is 99 people, or 0.3% less than the number of students in 2019. In 2021, the proportion of students studying at the bachelor's, specialist, and master's levels was 61.7%, 6.7%, and 25.9%, respectively. In 2021, the number of students enrolled in the scientific and graduate training programs, the program of secondary education, and the middle-level specialists amounted to 982 people, 246 people, and 163 people, respectively (Table 5).

Table 5

The contingent of students in the implementation of the basic educational programs in 2019–2021, person

Таблица 5

Контингент обучающихся в разрезе реализуемых основных образовательных программ в 2019–2021 гг., человек

Type of educational program	Contingent of students						2021 to 2019	
	2019		2020		2021			
	people	%	people	%	people	%	people	%
Bachelor Program	14855	60,1	15151	60,9	15210	61,7	355	102,4
Master of science Program	1453	5,9	1594	6,4	1656	6,7	203	114,0
Master's Degree program	6989	28,3	6806	27,3	6381	25,9	-608	91,3
The program of training of scientific and pedagogical personnel in graduate school	1005	4,1	1018	4,1	982	4,0	-23	97,7
The program of basic and secondary general education	118	0,5	123	0,5	246	1,0	128	208,5
Training program for mid-level specialists	282	1,1	196	0,8	163	0,7	-119	57,8
Total	24702	100	24888	100	24638	100	-64	100

Compiled by the authors based on [22].

Составлено авторами на основе [22].

If the number of students in institutions of basic and secondary general education increased by 8.5% compared to the contingent of 2019, then the number of graduate students and students in the middle-level training program decreased by 0.3% and 42.2% compared to 2019. It should be noted that, in the current conditions of economic digitalization and the need to train modern specialists, the number of graduates of state educational institutions of higher education in the field of computer science and computer engineering per 10,000 population is approximately 8 per 10,000 as of 2017.

The population's information literacy is heavily reliant on businesses willing to provide additional training in the field of information and communication technologies (ICT) to their employees. In 2018, we surveyed 235 Crimean commercial organizations as part of the program "Development of IT technologies in Crimea until 2024"; only 5.1% of the heads of organizations agreed that they were ready to train their employees" [23, 24].

An interesting point is the determination of the resource base for the implementation of innovative projects in the SFD (Table 6).

Table 6

**Resource base and effectiveness of R&D in innovative activities of human capital development
in the Southern Federal District for 2018–2021**

Таблица 6

**Ресурсная база и эффективность НИОКР в инновационной деятельности по развитию человеческого капитала
в Южном федеральном округе, за 2018–2021 гг.**

№	Indicators	2018	2019	2020	2021
1	The resource base of R&D and innovation activity				
1.1	Direct expenditures on scientific research and development, in % of GDP	1.07	1.10	1.10	1.11
1.2	The Direct costs of scientific research and development in the field of ICT	2.3	3.7	3.6	2.5
1.3	The Technological innovation costs are calculated as a percentage of the total volume of manufactured products (works and services) produced by the industry.	2.9	2.6	2.5	2.4
1.4	The number of research participants per 10.000 employed in the economy	55.1	52.5	51.4	50.1
1.5	The proportion of direct research costs aimed at economic development in total research costs.	37.8	36.7	37.8	39.8
2	Effectiveness of R&D and innovation activities				
2.1	The share of industrial enterprises and organizations that carried out technological innovations	8.8	8.3	7.3	7.5
2.2	The share of innovative products (works. services) in the total volume of industrial activity	8.7	8.4	8.5	7.2
2.3	The share of innovative products (works. services) in the total volume of export operations in the field of industry	11.9	9.4	8.7	7.5
2.4	The number of patents for inventions issued by Russian Patent services. per 1 million people. population	157.7	153.9	143.2	143.2
2.5	The share of new technologies in the total number of advanced technologies developed	11.6	12.5	12.5	13.6

Compiled by the authors based on [7, 23].

Составлено авторами на основе [7, 23].

"We must mention that by integrating into the production process the achievements of research and R&D, as well as new knowledge-intensive production capacities, there is a differentiated emergence of many new competencies that a person needs to master and move to the next level of human development; there are reproductive processes of accumulation of human capital" [7, 24].

The development of information technologies is of particular importance in the process of regenerating human capital. In the process of forming the algorithm of socio-spatial HCD, the author's justification of the main definitions of "innovative potential" is given, and their main features in the system's functioning during the implementation of the process of reproduction of human capital are analyzed. The totality of the innovation potential reflects the effectiveness of the innovative economic system of human capital reproduction [2, 24].

"It should be noted that the main and most common structural elements of the reproduction of human

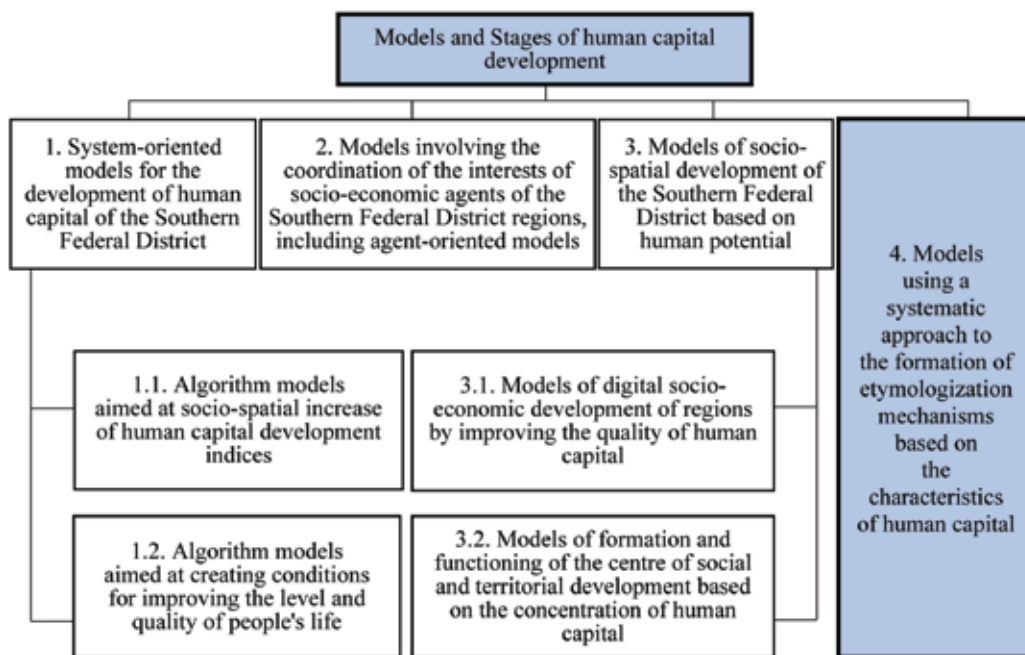
capital are embedded in the investment approach, where investments are revealed as the main factor of development, namely: investment in education; health; project activities, information technology; physical development, and much more" [2].

HCD is the process of investing in digital technologies to create and develop productive human abilities. Human capital is determined by the need to invest in the activities of individuals, educational institutions, and enterprises [27, 28].

A system-oriented approach to socio-spatial development was used to identify strategic HCD models that differ in their constituent elements and apply a sequence of stages of socio-spatial HCD (Figure 6).

These elements include the following [14, 23, 25]:

- the goals formed based on the value system of socio-spatial HCD;
- the degree to which the conditions for the implementation of procedures for coordinating



Compiled by the authors.

Fig. 6. Models and stages of the algorithm for socio-spatial of human capital development using a system-oriented approach

Составлено авторами.

Рис. 6. Модели и этапы социально-пространственного развития человеческого капитала с использованием системно-ориентированного подхода

the goals of the social and spatial development of human capital have been established;

- the human development characteristics as a criterion determinant of social and spatial development.

The application of a system-oriented approach to the identification of directions of socio-spatial development of human capital allowed us to propose, in the form of an algorithm, a model of its strategic development [12, 21]. To accomplish the aim of socio-spatial HCD in the SFD, within the framework of the previously indicated algorithm, a method to evaluate the degree of sustainable and balanced regional development centred on enhancing population quality of life is required [23, 27]. The methodological support of the socio-spatial HCD within the framework of the system-oriented approach algorithm is presented in Table 7.

This proposed algorithm is based on the needs (physiological, demographic, self-realization, etc.) of the regions of the SFD in terms of human potential, which are interpreted as objective characteristics of the socio-spatial attractiveness of the regions.

The spatial and economic components of human capital development should reflect the level of

satisfaction with the physiological, economic, and other needs of the population. The social and spatial components of human capital development are achieved under the conditions of systematic provision of favourable conditions for successful human activity and the formation of a basis for the development and satisfaction of needs in communication and information systems [29].

Thus, in modern conditions of demographic risk and economic implementation of digital trends, the phenomenon of reproduction of the SFD's human capital as a set of an individual's skills, knowledge, and abilities used to meet the person's and the SFD's socio-spatial expectations should play an important role. The socio-spatial HCD in modern conditions is a process of creating, using, and accumulating all the components of human potential through both direct and indirect investment in the activities of the person himself, an educational institution, an enterprise, etc.

To develop stratagems for human capital development in the region, it is necessary to accept it as human knowledge, skills, abilities, and physical capabilities involved in the regional socio-economic system, while also taking into account its potential, which can be involved in the socio-spatial system of the region.

Table 7

Components of the algorithm for ensuring the socio-spatial development of human capital

Таблица 7

Компоненты алгоритма обеспечения социально-пространственного развития человеческого капитала

№	Author's methods	Algorithm models	Goals of socio-spatial development of human capital	Achieved parameters for 2010–2021
1	Scientific search in the application of a system-oriented approach to the identification of directions of socio-spatial development – a model of the strategy of HCD	1.2. Ensuring sustainable socio-spatial development of human capital aimed at eliminating differences in the level and quality of life of the population in certain regions	No less than the achieved optimal HDI	$HDI_{max} = 1.336$ $HDI_{min} = 0.783$
2	It is necessary to propose an approach to the formation of models of the algorithm of human development in the regions, depending on the characteristics of its spatial attractiveness	3.1 and 3.2. Accelerating the pace of socio-spatial development based on human development	No less than the achieved optimal HDI	$0.706 \leq x_{HDI} \leq 0.829$
3	Algorithm models using a systematic approach in the formation of etymologization mechanisms of the Southern Federal District regions according to the characteristics of human capital	3.2. Development: – promising centres of social and territorial growth based on the concentration of human capital; – geostrategic space of the Southern Federal District. 4. The formation of meso-spaces for the coordination of work on the abolition of differences between regions, the implementation of large-scale infrastructure projects for the development of human capital, the formation of a common socio-spatial base of human development of the Southern Federal District	Ensuring an adequate resource base for long-term human development and HCD	$0.139 \leq G \leq 0.481$

Compiled by the authors based on [9, 28].

Составлено авторами на основе [9, 28].

Stratagems serve as effective tools for analyzing the dynamics and territorial distribution of human capital with the components of the algorithm for ensuring the socio-spatial development of human capital (Table 7). They make it possible to make scenario forecasts of the spatial distribution of human capital, taking into account the indicators of the effectiveness of the use of the labour factor in the region (capital strength, labour intensity).

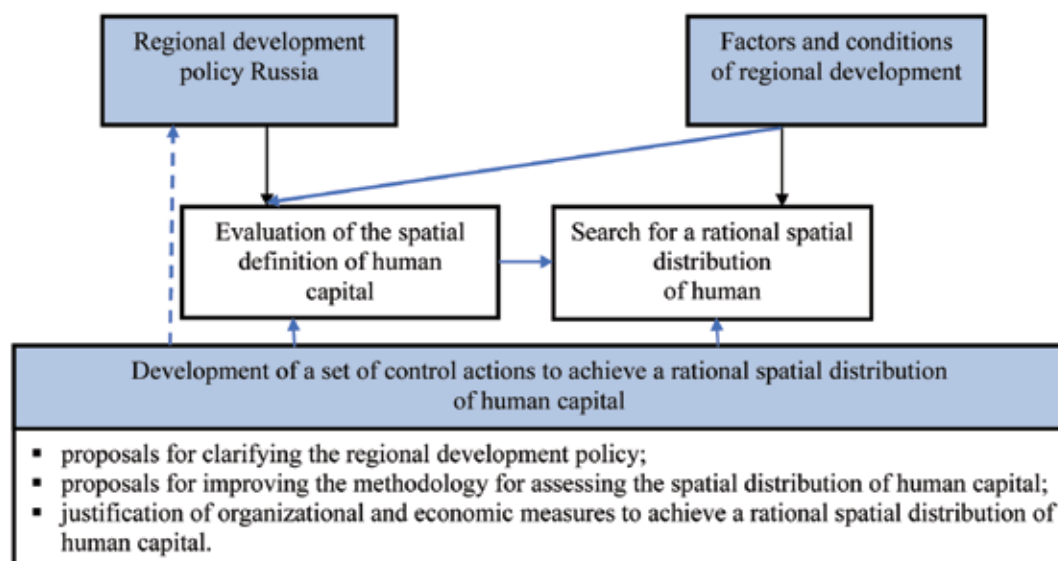
Conclusions and Relevance

The primary findings of the work allowed us to make many conclusions and recommendations. The importance of studying the evolution of spatial forms of organization based on modern human capital requirements is that their rational existence leads to economic growth activation and the consolidation of socioeconomic space. This is only attainable if suitable conditions are created for the implementation of competitive advantages of human capital components in a specific localization.

1. The growth of the notion of "human capital of the SFD" and related phrases allowed us to show that the term "human capital" is the consequence of ideas about the role of labour resources and labour relations in the theory and practice of society's demographic and economic life. Human capital should be related to more than just income-generating activities; it should also be associated with a complex socio-spatial and economic system, such as the Russian Federation.

2. The human development strategy in the region is hindering the effective implementation of the role of human capital in regional socio-economic systems:

- the prevailing significant unevenness in the spatial formation, use and accumulation of human capital at the regional level;
- the tendency to increase unevenness in the spatial formation and distribution of human capital between regions with different levels of socio-economic development, due to negative migration growth in many regions of the SFD.



Compiled by the authors.

Fig. 7. The mechanism of the stratagem of socio-spatial formation and distribution of human capital

Составлено авторами.

Рис. 7. Механизм стратагемы социально-пространственного формирования и распределения человеческого капитала

3. The author's approach to the effective measurement of the socio-spatial development of human capital includes the use of publicly available information from state statistics on wages and ages of employees; the calculation of the value of the human capital of the regions as the product of the expected annual income and the average value of the multipliers prenumerando and postnumerando; and the priority of residual value in assessing the value of human capital.

4. The socio-spatial human capital development was examined during the periods of 2010 to 2018 and 2021 to 2021. The human development index increased from 0.679 to 0.831 and subsequently from 0.831 to 0.852, suggesting an increase in the differentiation of the value of absolute human capital and its concentration in specific areas in the SFD.

5. Comparative investigation has revealed that the variance of the population's income is more than 1.59 times higher than the interregional asymmetry in many indices of the growth of the SFD (for example, 41944 rubles in the Krasnodar Territory, 26371 rubles in Crimea, or 21250 rubles in the Republic of Kalmykia). A significant gap between areas in terms of the number of students, the quality of the resource base, and the level of remuneration,

which is one of the major needs for the deployment of human capital, threatens the sustainable growth of a significant section of the regions. Low regional wages, which cause migrant outflows, should be seen as an indication of inefficient socioeconomic policy.

6. Human capital employed in the production of GRP, the physical volume index, which during this period reached 98.0% (in 2015), 102.8% in 2018, 97.3% in 2020, and 104.7% in 2021, represented the highest part in the economy of the SFD in 2018–2021. The Gini index was 0.481 at the time.

7. An information block, basic assessment indicators, and analytical indicators are included in the proposed technique to evaluate the socio-spatial development of human capital. Human capital is much higher than fixed assets in the SFD, indicating the importance of human capital. The excess in regions is 3.18-4.68 times and 1.59-2.56 times in full value.

The primary components of the SFD's socio-spatial human capital development stratagems are tracking the dynamics of changes in the residual value of human capital, comparing rates of change across regions, and ensuring an absolute rise in the residual value of human capital.

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