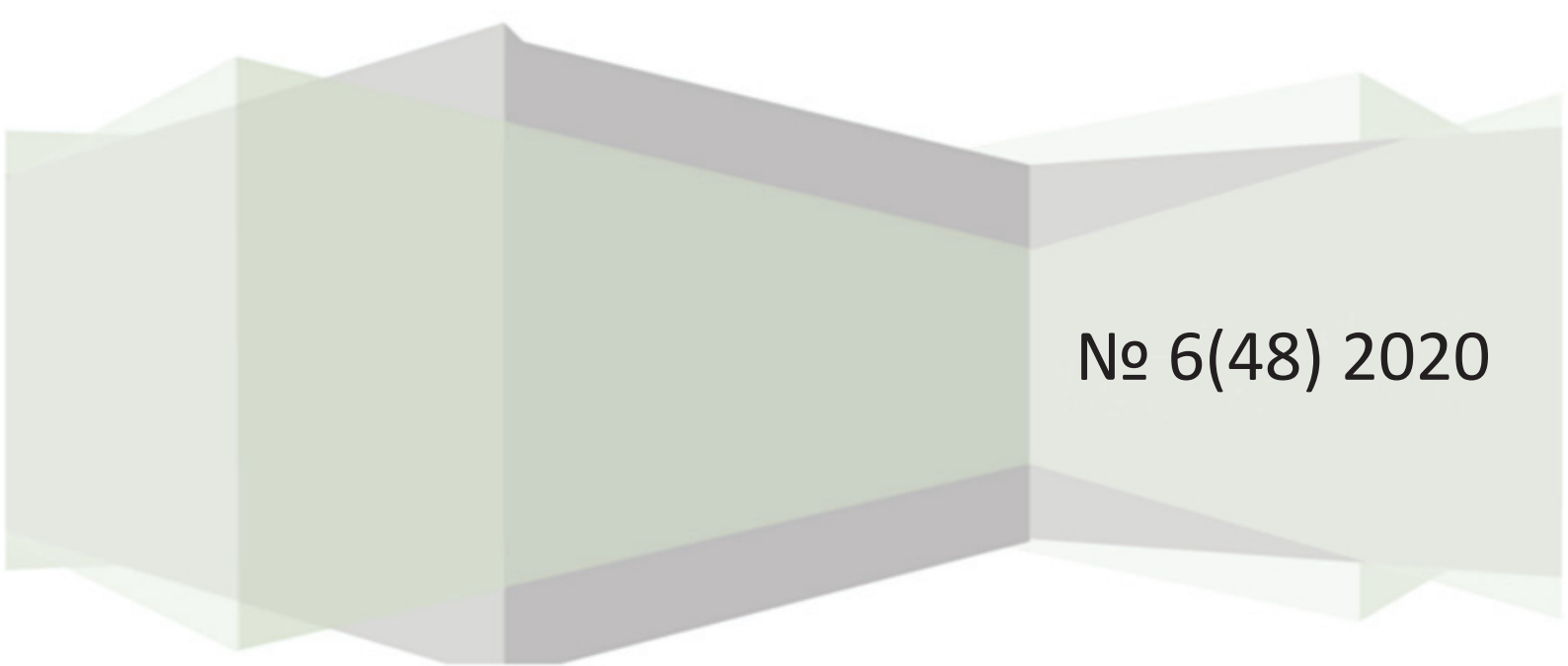


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## The Influence of Metro Operation on Architectural and Planning Solutions in St. Petersburg

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**Key words and phrases:** St. Petersburg metro; structure and schedule of work; impact on the city's life; passenger transportation schedule; urban planning; megapolis.

**Abstract.** In order to study the influence of the St. Petersburg metro as a complex and high-tech city-forming system on the architectural solutions of the city, an attempt was made to study its structure and operating mode. Using the methods of architectural review and object analysis, it was possible to identify the complex architectural structure, work schedule, and aspects of influence on the current and planned development concept of the city of St. Petersburg. As a result of studying the object, its multidimensional impact on the life of the city is revealed, which influences not only on the urban schedule of passenger transportation, but also the urban planning of the present and future megapolis.

The Saint Petersburg metro has a complex structure and schedule. Its influence on the life of the city has an influence not only on the urban schedule of passenger transportation, but also on the urban planning of the present and future megalopolis.

The Saint Petersburg metro operates almost around the clock. According to the schedule, it is closed to passengers at night, but the maintenance of the facility does not stop during night hours. In order to ensure uninterrupted movement of metro trains during the day, tens of thousands of metro employees need the same 4-5 hours at night to have time to put everything in order – to wash, paint, and repair and maintain the high-tech system in excellent order.

If the metro did not work around the clock, many works could not be carried out, and then it would be necessary to completely close the metro branches or their sections for some days, which means that there were much more disadvantages and inconveniences than there are now.

No less important is the aspect of profitability of the metro's production activities. According to statistics, 99 % of office, municipal and city organizations work during the day; this creates a large passenger flow and movement of people along the main city highways in the morning, afternoon and evening hours. The night shift is mainly used for support infrastructure, police, fire services and hospitals. As a rule, their employees work the night shift or work in the field, or move to calls on duty vehicles. Calculations show that the night passenger traffic is almost a

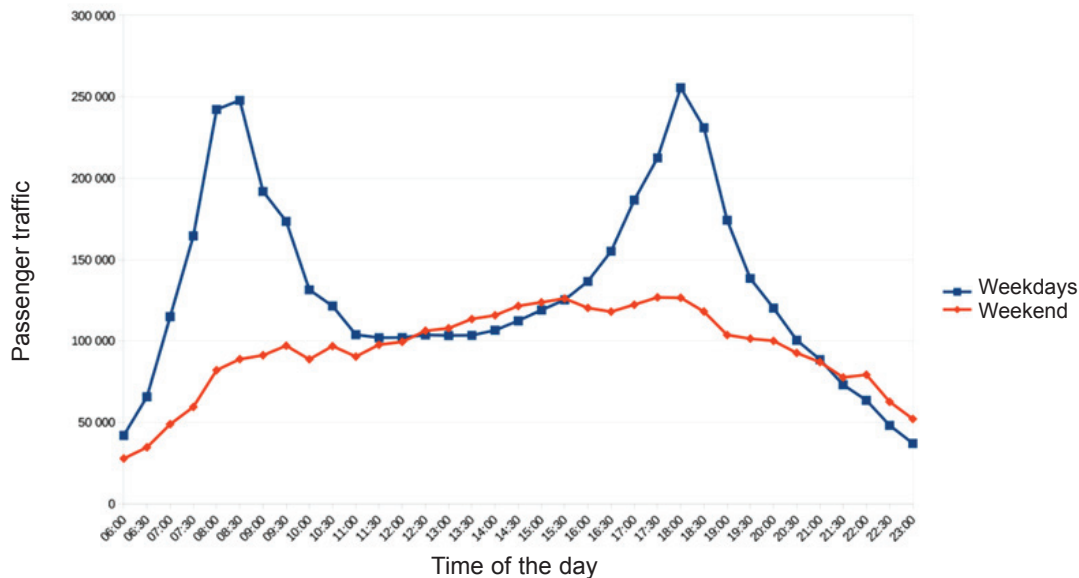


Fig. 1. Temporary passenger traffic for 2019–2020

thousand times less than the daily one.

For example, in 2017, from April 30 to November 15, while navigation on the Neva was in effect, a little more than 12 thousand people used the night train from Admiralteyskaya to Sportivnaya for the entire period. And in the daytime, 2.4 million trips were made in the St. Petersburg metro every day.

In terms of the number of stations and passenger traffic (743.2 million people in 2019), the Saint Petersburg metro is the 4th in Europe (after the Moscow, Paris and London metro), the 2nd in Russia and the CIS, and the 19th in the world.

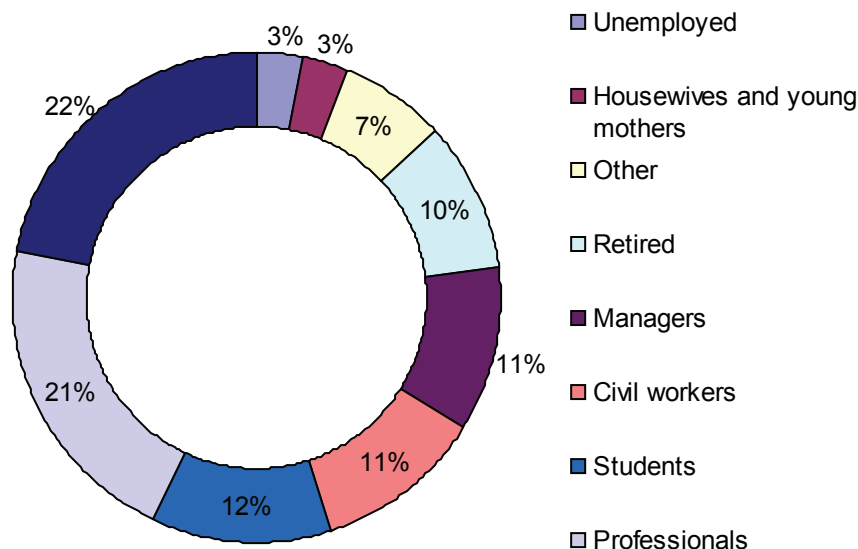
During the evening rush hour, the congestion indicator increases at the central metro stations of Saint Petersburg, especially transfer stations.

That is why the concept of reaching a new level, increasing the number of stations and working for passengers at night is emerging in relation to such a large city-forming object of the Saint Petersburg Metro.

The Saint Petersburg metro as the largest architectural urban planning system includes:

- 72 active stations;
- 62 stations with escalators;
- 7 underground passages;
- 83 ground-level lobbies;
- 5 lines of the message;
- 301 the escalator;
- 1,839 rolling stock cars;
- passenger traffic – more than 2.53 million passengers daily.

During the navigation season – from mid-April to mid-October – with the closure of the metro, the “transport issue” in Saint Petersburg becomes especially acute. After the bridges are separated, it is impossible to get from one Bank of the Neva to the other without going far away along the ring ROAD and the only permanent bridge over the Neva – the Bolshoy Obukhovskiy – and the Vasileostrovskiy district is basically cut off from the outside world.



**Fig. 2.** Social composition of the passenger traffic of the Saint Petersburg metro

Hotels located on Vasilievsky Island remind guests of this important detail on their websites and information desks.

The concept of reaching a new level of the St. Petersburg metro, increasing the number of stations and working for passengers at night will require significant changes.

There is a need to design:

- new metro stations;
- access control systems;
- security alarms, alarm systems;
- technological furniture and consoles;
- information boards at each station;
- intelligent video surveillance systems.

It is planned to develop a project for architectural lighting of metro facilities and its infrastructure at night.

Carry out design work on the reconstruction of streets and roads, design of temporary and bypass roads.

Estimate the cost of design work on the objects that will be prepared for the opening of round-the-clock trips to the metro.

The main requirements for the new project are defined. The Metro system should allow for round-the-clock operation; have diagnostic tools and indication of the current state of the system, the resources used; allow increasing the quantitative and expanding the functional characteristics of the system without interruption at night.

The concept should be based on open technologies that ensure its further modernization and development without processing, operation without interruption of the Metro. The system should be able to use scalable hardware platforms, in particular, technologically simple communication between drivers and dispatchers at night.

The system must provide sufficient accuracy to detect the congestion of a particular metro station at night, in order to evenly distribute the number of trains provided on each line of the "Metro".

The concept of the new St. Petersburg metro is aimed at providing passengers with greater convenience and comfort by operating the metro at night on a permanent basis.

In order to implement this project, you will need to rely on the following criteria:

- the need to adapt repair and maintenance work at stations and in tunnels to the new mode of operation of the “Metro”;
- increase in the night fare;
- the need to increase the travel interval, because of the very low passenger traffic at night, it is not cost-effective to move empty cars along the lines;
- additional funding from the state is required.

Thus, an increase in the metro’s operating time by 1 hour will lead to an increase in operating costs by 1.4 million rubles per day.

As part of the concept for the development of the Saint Petersburg metro, it is planned to develop a project for the architectural solution of stations, lighting of metro facilities and its infrastructure at night. It is planned to carry out design work on the reconstruction of streets and roads, the design of temporary and bypass roads and Parking areas. You should evaluate the effectiveness and cost of design work on the objects that will be prepared for the opening of round-the-clock trips to the metro. It is necessary to determine the main architectural and social requirements for the new project.

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### Влияние работы метрополитена на архитектурно-планировочные решения Санкт-Петербурга

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**Ключевые слова и фразы:** Санкт-Петербургский метрополитен; структура и график работы; влияние на жизнь города; график пассажироперевозок; градостроительные планировки; мегаполис.

**Аннотация.** С целью изучения влияния Санкт-Петербургского метрополитена как сложной и высокотехнологичной градообразующей системы на архитектурные решения города была предпринята попытка изучить его структуру и режим работы. Методами ар-



хитектурного обзора и объектного анализа удалось обозначить сложную архитектурную структуру графика работы и аспекты влияния на текущую и планируемую концепцию развития города Санкт-Петербурга. В результате изучения объекта выявлено его многоаспектное влияние на жизнь города, которое отражается не только на городском графике пассажироперевозок, но и на градостроительных планировках настоящего и будущего мегаполиса.

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## A Long-Term Farming Problem and Its Modern Solution

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**Key words and phrases:** agricultural sector of the country; food; sources of raw materials; agricultural enterprises; agricultural products; long-term farm problem; food market.

**Abstract.** In order to study the correct organization of the agricultural sector of the country, an analysis of the long-term farm problem was conducted. Using the method of theoretical economic analysis, the author described the agricultural sector as a supplier of food products and a source of raw materials for the food, textile, leather and pharmaceutical industries. The essence and impact of the long-term farm problem on the supply of large producers and consumers with milk, meat, flour, wool, leather, fats, spices and other agricultural products are revealed, which leads to industrial processing of these products, after which they are sent to more complex production processes or directly to the food market.

In fact, the properly organized agricultural sector of the country is not only a supplier of food products, but also a source of raw materials for the food, textile, leather and pharmaceutical industries. Various agricultural enterprises supply large producing consumers with milk, meat, flour, wool, leather, fats, spices and other agricultural products that are already subjected to various operations, modifications or processing under industrial conditions, and then sent to more subtle production cycles or directly to the market of food for citizens and raw materials for industry. Therefore, the developed agricultural sector can be considered a guarantee of economic security of the state [1].

Agriculture in developed countries is a classic example of a perfectly competitive industry, since agricultural production is conducted by a large number of entrepreneurs, each of whom does not have enough supply to influence prices due to the weak differentiability of products, and in addition, there are practically no barriers to entry and exit from the market. The leading position in the agricultural sector, especially in agriculture, is occupied by small and medium-sized firms with few opportunities for individual investment and limited personnel. The main reason for this is the spatial extent of land. From a single center, it is impossible to process areas that are tens of kilometers away from each other, and that is why in the agricultural sector, the dominant types of market are those where the optimal size of the enterprise is small – monopolistic competition and perfect competition.

It is important to clarify that in the agricultural sector, in contrast to other sectors of the

economy, the most common form of agricultural enterprise is a peasant farm, a family farm [2]. For this enterprise, the purpose of functioning is not limited to income from agricultural production, since the welfare of the family depends on the efficiency of the economy.

It is also necessary to understand that due to the firms operating on the market of agricultural products and the seasonal nature of production, the peculiarity of agriculture is a close connection with the banking system, or rather a strong dependence on credit. A small firm rarely has significant financial reserves, and the economy cannot start production without large monetary investments in early spring, and it can only pay off its debt obligations in late autumn. Agriculture itself can be organized in various social forms, but in modern conditions in most countries of the world, agriculture is based on market principles [4]. In this case, the interests of three different groups clash over land management:

- land owners;
- tenant entrepreneurs;
- hired workers (peasants).

As a result, on the one hand, land ownership is separated from land management. This phenomenon can be regarded as a special case of separation of capital-property from capital-function. At the same time, two types of land monopoly are formed: the monopoly of private ownership of land and the monopoly of land as an object of economy. On the other hand, there is a separation of the direct producer (in agriculture – the peasant) from the land, the main means of production, which is generally characteristic of a market economy. A typical situation is when an entrepreneur takes a piece of land for temporary use (lease) and runs a farm on market conditions i.e. using hired labor.

The final product of agricultural production and the food sector is food. A characteristic feature of agriculture is a long production cycle – the finished product can be obtained, as a rule, after a year or even longer. This is due to the fact that in most developed countries located in moderate latitudes, natural and climatic conditions allow only one crop of main crops to be harvested in a calendar year [2]. It takes even longer to grow the main types of livestock in animal husbandry. But, as a rule, low price elasticity of demand for food affects the price of agricultural products and means of production not in favor of the agricultural sector.

In itself, low demand elasticity is not a problem for the agricultural sector of the economy, if the supply is growing slowly or not at all. But the fact is that over the past century there has been significant scientific and technical progress, which has contributed to the growth of agricultural productivity, and consequently, the supply of agricultural products. At the same time, there is a decrease in the rate of population growth simultaneously with the growth of real incomes of the population, and consequently the demand of each individual family for the agricultural and food sector is reduced. As a result, the aggregate demand for agricultural products in society is growing more slowly than its supply, and thus creates a long-term farming problem.

The essence of the long-term farm problem is reflected in the unfavorable long-term dynamics of prices for their products and income from their sale - the growth rate of farm prices and income is lower than the growth rate of prices and income in the economy as a whole. Farmers sell their products at a price formed by a free competitive market at a relatively low level, and buy industrial products at a monopolistically high price. As a result, there is a significant gap in prices, which leads to a significant difference between the income of farmers and non-farm incomes [4]. The emergence of a long-term farm problem, in addition to lagging demand for agricultural products from their supply, provokes low mobility of resources. The competitive market model assumes that lower prices for agricultural products will encourage agricultural producers to leave their farms and localities to find other, more profitable jobs. A massive

outflow of resources would reduce the supply of agricultural products relative to demand, resulting in higher prices, and an increase in the income of farmers. However, this does not happen because the land on which farmers farm (except for the land that directly borders areas of large cities) usually does not find alternative uses. Farmers leave, but their land passes to other farmers, which means that it remains in the same type of economic activity, causing a relative overproduction of agricultural products.

Due to a number of reasons (such as natural conditions, seasonality, low elasticity of demand, low mobility of resources, etc.), agriculture is not the most reliable and profitable industry for capital investment, so the support and development of the agricultural sector is almost entirely the responsibility of the state.

Agriculture accounts for only 1–4 % of the gross domestic product, agricultural development remains a priority policy direction of any country, and food security depends directly on solving problems.

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### Долгосрочная фермерская проблема и ее современное решение

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**Ключевые слова и фразы:** аграрный сектор страны; продукты питания; источники сырья; сельскохозяйственные предприятия; сельскохозяйственная продукция; долгосрочная фермерская проблема; рынок продуктов питания.

**Аннотация.** С целью изучения правильной организации аграрного сектора страны проведен анализ долгосрочной фермерской проблемы. Методом теоретического экономического анализа автор описал аграрный сектор как поставщика продуктов питания и

источника сырья для пищевой, текстильной, кожевенной и фармацевтической отраслей промышленности. Выявлены сущность и влияние долгосрочной фермерской проблемы на снабжение крупных производителей и потребителей молоком, мясом, мукой, шерстью, кожей, жирами, специями и другой сельскохозяйственной продукцией, приводит к промышленной переработке этих продуктов, после чего они направляются в более сложные производственные процессы или прямо на рынок продуктов питания.

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## Organizational Potential of Investment-Construction Sector

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**Key words and phrases:** investment-construction sector; organizational potential; development; resource potential; management.

**Abstract.** The paper explores relevant questions of using resource-based approach for investment-construction sector development. The research objective is description of essence of organizational potential of investment-construction sector. The mentioned objective is achieved by means of implementing the appropriate tasks (to research approaches to describing components of resource potential; to clarify components forming composition of this potential; to describe the organizational potential of investment-construction sector). Within the framework of the research hypothesis, development is considered as the managed process which is accomplished on the basis of interaction between components of resource potential. During the research process abstraction method, classification method, analysis, and synthesis were used. As a result of the research, the components of resource potential of investment-construction sector were clarified, description of its organizational potential was provided.

The study of the organizational potential of the investment and construction complex (ICS) [2], its resource potential becomes especially relevant when it is necessary to increase the volume of construction, increase the level of housing provision for the population [21]. In addition, the question of the composition of the resource potential is very relevant, since there are various ways to interpret its components (table 1). This situation is due to the fact that scientists study the resource components of objects belonging to different levels, spheres (agriculture, construction, etc.). The author is also interested in various aspects of the management object.

According to the data shown in table 1, the resource potential, along with labor, material, information and other components, may include production potential, investment potential, and innovation potential. However, it should be noted that the production potential also includes labor and material components [8, p. 29; 16, p. 409; 29, p. 90].

Moreover, the investment potential may include labor potential, innovation potential, institutional potential, infrastructure potential, production potential, and other potentials [10, p. 18; 12, p. 138; 23, p. 228]. Innovation potential includes material, labor, information, financial and

**Table 1.** Composition of resource potential

Authors	Resource potential components
A.G. Fonotov [26, p. 27]	Natural, material, financial, information resources, population
L.G. Okorokova [14, p. 83]	Production and technological, scientific and technical, personnel, financial and economic, innovation, managerial, institutional, investment potentials
N.D. Kulikov [9, p. 6]	Natural, labor, material means
A.M. Babashkina [25, p. 100]	Natural, material, energy, informational means, workers, entrepreneurial abilities of people
M.Yu. Rezepov [17, p. 9]	Material, energy sources, means, reserves, experience, knowledge, spiritual qualities of people, forms of organization and interaction of workers in the reproduction process, technological processes
G.V. Vedeshina [4, p. 10]	Land, economic, labor, energy, material, financial, innovative, informational, technical, bioclimatic, infrastructural, institutional, technological potential
N.N. Chepeleva [28, p. 26–28]	Material, intangible, labor resources and the possibility of their use, development
V. V. Shlychkov, S.M. Kulish, R.A. Timofeev [30, p. 54]	Personnel, financial and economic, production, marketing, information, innovation, environmental potential
S.Yu. Steksova [20, p. 9]	Property, financial, organizational and technical, human resources
S. N. Lykasova, T.I. Nikolaeva [13, p. 123]	Personnel, informational, technological, financial and investment, organizational potential
L.F. Berdnikova [3, p. 203]	Production resources (human resources, fixed assets, material resources), financial resources, innovation resources
O.M. Fedorova, I.A. Maksimenko, A.S. Danilova [24, p. 252]	Financial and property potential, human resources, information and communication potential, organizational and entrepreneurial potential
L.B. Vinnichuk, O.A. Zyablikova, G.V. Terzova [5, p. 10]	Natural, logistical, financial, informational, human, managerial resources and capabilities

other components [1, p. 18; 6, p. 137; 7, p. 24; 11, p. 47].

In this case, it turns out that the resource potential has in its composition potentials that are repeatedly duplicated due to the consideration of derived potentials as components of the resource potential. This situation is undesirable for two reasons. First, there is some terminological confusion that prevents a clear interpretation of the nature of the resource potential. Secondly, this situation complicates the process of conducting an analysis of the resource potential and its assessment.

In order to clarify this situation, in our opinion, the various potentials considered in the works on resource potential should be divided into two groups.

The first group includes potentials that do not contain other potentials. It is proposed to call such potentials the main ones. The second group includes derivative potentials, that is, potentials consisting of other potentials. The composition of the resource potential should include only the main potentials, among which we propose to highlight the labor potential, organizational potential, property potential, financial potential, natural potential, energy potential, information potential (Fig. 1). Derivative potentials can be represented by production, investment, innovation and other potentials, but the list of derivative potentials remains open.

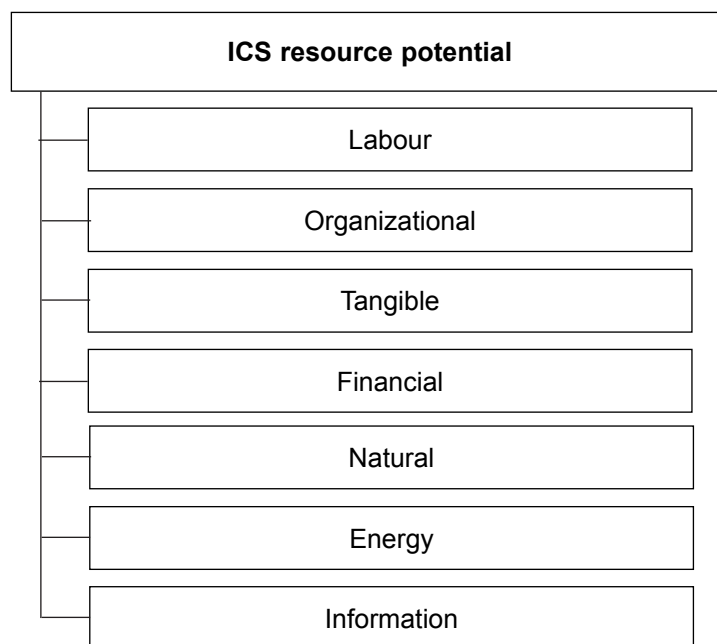


Fig. 1. The composition of the ICS resource potential

Secondary potential	Production potential	Investment potential	Innovation potential
Main potential			
Labour			
Organizational			
Tangible			
Financial			
Natural			
Energy			
Information			

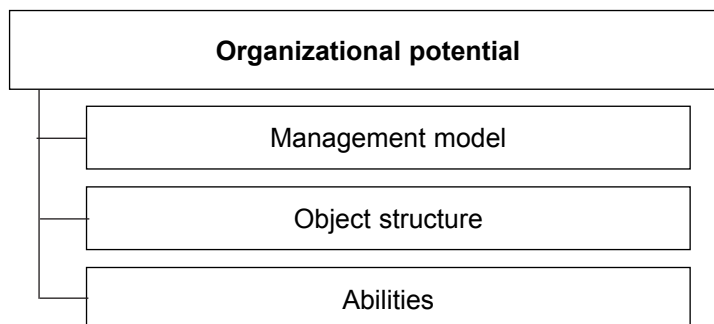
Fig. 2. Resource potential matrix

Of course, derived potentials are very important, since their study allows us to apply a resource approach in the context of specific activities (production, investment, innovation, etc.). In this regard, it is proposed to use a matrix of basic and derived potentials, which will ensure their differentiation and help to reflect the corresponding relationships (Fig. 2). This matrix can be used for analysis and evaluation of derivative potentials, since its application opens up opportunities for a detailed description of the characteristics of the main potentials, identifying those of them that are strengths, as well as those that act as weaknesses and require improvement.

The essence of each of these main potentials, in addition to the organizational potential, has already been studied and disclosed earlier [31], so in this paper we will pay attention to the content of organizational potential.

The implementation of organizational potential involves the ordering of other components of





**Fig. 3.** Elements of organizational potential

the resource potential in space and time, and also ensures their involvement in the activities of the management object [15, p. 11]. In addition, organizational capacity is characterized by ways to define tasks (their detail to a greater or lesser extent), ways to ensure the relationship of tasks, organizational culture, as well as the structure of authority and methods of their implementation.

Organizational potential can be considered as a set of components and mechanisms that allow you to organize and successfully apply the resource potential of the management object to implement the goals of its functioning [19, p. 10]. Investigating the organizational potential at the micro level, it is interpreted as the ability to adapt to changes in the external environment, develop appropriate management decisions in advance and implement them through the combination and use of resources of the management object [22, p. 71]. At the meso-level, organizational potential is defined as a set of organizational capabilities of the relevant authorities within the boundaries of a certain territory for the implementation of managerial activities [18, p. 75].

The composition of the organizational potential can be represented by the organizational structure, organizational culture, personnel policy, as well as other elements [15, p. 15; 19, p. 11]. However, this paper suggests a slightly different version of the composition of organizational capacity. In our view, the organizational potential of the ICS is a combination of the management model, the structure of the object under consideration and its capabilities (Fig. 3).

The management model serves as the basis for the ICS functioning and includes values, principles, goals, appropriate ways and mechanisms for implementing the principles and achieving the goals [27]. The structure of the ICS is characterized by the participants who are part of it, the relationships of these participants, as well as their interaction with each other and with the external environment. By abilities in this case we mean certain routines [32, p. 142], that is, structured habitual reactions that connect the elements of the internal environment of the control object with each other, as well as the control object with its external environment. Abilities characterize the ability of an organization to use resources efficiently and can contribute to improving the effectiveness of its functioning.

Thus, in the course of the study, the components of the resource potential of the ICS were clarified, which includes labor, organizational, property, financial, as well as natural, energy and information potentials. It also described the organizational potential of the ICS, which combines the management model, the structure of the ICS, and capabilities. The indicated research results can be applied in order to ensure the development of the ICS based on the resource approach.

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## Организационный потенциал инвестиционно-строительного комплекса

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**Ключевые слова и фразы:** инвестиционно-строительный комплекс; организационный потенциал; развитие; ресурсный потенциал; управление.

**Аннотация.** Рассматриваются актуальные вопросы использования ресурсного подхода для совершенствования функционирования инвестиционно-строительного комплекса

**(ИСК)**. В качестве цели исследования выступает раскрытие сущности организационного потенциала ИСК. Достижение обозначенной цели обеспечивалось посредством выполнения соответствующих задач (исследовать подходы к определению компонентов ресурсного потенциала; уточнить компоненты, формирующие состав этого потенциала; изложить содержание организационного потенциала ИСК). В рамках гипотезы исследования процесс развития рассматривается как управляемый и осуществляемый через взаимодействие компонентов ресурсного потенциала. В ходе исследования применялись методы абстрагирования, классификации, а также анализа, синтеза. Итоги исследования представлены уточнением компонентов ресурсного потенциала ИСК, описанием его организационного потенциала.

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UDK 337

## Russia's Policy in the Area of Food Security

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**Key words and phrases:** agricultural sector of the country; food security; food; raw materials sources; agricultural enterprises; agricultural products; food market.

**Abstract.** In order to study the directions of solving the problem of food security of the Russian Federation, the analysis of the agricultural sector of the country is carried out. Using statistical and economic analysis methods, the author gives a description and structure of the agricultural sector as a supplier of food products and a source of raw materials for the food, textile, leather and pharmaceutical industries. The directions of solving the problems of food security in Russia and providing it with agricultural products are identified.

The agro-industrial complex of Russia is a priority sector of the economy and a strategic direction of domestic policy. Having a significant agricultural potential, and by increasing the pace of agro-industrial production, Russia has provided a sufficient level of the daily diet of the country's population. The meat and dairy industries are showing steady growth. The technological part of agro-industrial production is actively developing. Gradually, the process of import substitution is taking place.

Currently, the Russian agricultural sector requires the development of a scientific base: breeding laboratories throughout Russia are to increase the rate of development of new varieties of plants that are more resistant to our natural conditions, and new educational institutions that can train the necessary specialists are required, since an acute shortage of qualified personnel hinders the development of the agricultural sector.

In addition to the scientific base, the dairy and meat industries require attention, since the quality of products is very low, and in some cases the products are even dangerous to human health. Therefore, the state needs to take measures to more thoroughly check the products of the dairy and meat industries, as well as to encourage the development of these producers through subsidies.

There is also the issue of outflow of rural population. To stop this process, it is necessary to improve the housing conditions of workers in the agro-industrial complex, provide them with medical care (to do this, you need to organize medical aid points, build clinics and hospitals) and improve communication with major cities.

In general, despite some difficulties, the development of agriculture is proceeding harmoniously. Stable growth indicators in the industry indicate a competent government policy in this area. It is important to reduce the impact of restraining factors on the industry and ensure normal conditions for the development of the agro-industrial complex.

The level of development of agriculture in the Russian Federation depends entirely on a

**Table 1.** Livestock and poultry (million heads)

	2017	2018	2019
Cattle	18.3	18.3	18.1
Pigs	21.9	23.1	23.7
Sheep and goats	24.7	24.3	23.1
Horses	1.2	1.2	1.2
Reindeer	1.7	1.8	1.7
Chickens and roosters	128	131	132
Geese	0.2	0.2	0.3

competent state policy in this area. The forecast of growth of indicators of the agro-industrial complex indicates a slight decrease in this indicator in the future. In the past few years, Russian agriculture has reached a high level of development. It will take several years to exceed this level. In recent years, the climate has contributed to a plentiful harvest. This made it possible to export a large number of agricultural products and to meet domestic needs to a large extent. We will be able to provide the domestic market with our own products gradually. In 1–2 years, the demand for meat (pork, chicken, beef) will be fully met at the expense of its own resources. The market will be fully supplied with its own dairy products in 6–9 years. Russian consumers will be fully provided with domestic vegetables and fruits in 2–4 years.

The priority was to replace imported products with products of their own production. This is the key and most important direction of agricultural development in the Russian Federation. After the introduction of sanctions by a number of countries, Russia has reduced the import of pork, cattle meat, and poultry to the territory of the country. Supplies of salted, smoked, dried meat and fish, crustaceans, shellfish, as well as dairy products (cheese, cottage cheese, milk, etc.) were also significantly reduced; imports of vegetables, fruits, and nuts were reduced. As a result, the financing was directed to the development of sectors that would fill the need for products that were not allowed on the domestic market. Constructive measures in the accelerated development of animal husbandry have significantly increased the indicators of production growth in such areas as poultry and pig farming (Table 1). The situation in cattle and cattle breeding remains tense, but recovery measures in this sector allow us to hope for an increase in productivity (Table 1). For this purpose, reconstructive measures are organized to purchase breeding cattle with high indicators of efficient production. Measures are being introduced to increase the profitability of milk and meat production as the main valuable food products. As a result, today the products of foreign production on the shelves of our stores are only 20 % of the total number.

To increase the volume of production and the competitiveness of the domestic fruit production for domestic and foreign markets also need a speedy update of technological and material base of the subsector, including a significant increase in the share of gardens of intensive type with transition producers to a system of drip irrigation, use of mechanized and robotic technologies of soil processing, the formation of the trees, harvesting and transporting the fruit, improving the storage, processing and sales. In the machine-building industry and the agricultural industry, measures are being introduced to promote leasing programs for the purchase of equipment with long loan terms and favorable interest rates [2].

A promising direction for the development of the agro-industrial complex is to review the entire financing system in order to provide business owners with the means to purchase mineral fertilizers, fuel and lubricants, materials, and high-quality feed in the volumes necessary for efficient production. Such topical issues as increasing wages for agricultural workers also require attention, which makes it possible to attract specialists to the village and, thus, solve the problem of the shortage of qualified personnel.

Development priorities are the restoration and development of industrial science, the formation of a regional system of selection and seed growing, providing short term cartoony and renovation on the basis of domestic varieties and hybrids of agricultural crops, improving the efficiency of land use and level of technological development of production, improvement of sub-sectors of beef and dairy cattle, horticulture, viticulture and vegetable growing of the protected ground, the development of small forms of managing, improving the system of state support for agricultural producers [2]. Agroeconomics of the Russian Federation has a high scientific and technical potential, and the implementation of this potential in practice requires deeper integration of capital, science, education and production, which will allow creating innovative products with the involvement of private investors, developers, specialists of agricultural organizations, providing scientific and industrial activities with highly qualified personnel with deep innovative thinking.

The new task of agricultural educational institutions should be not only to train specialists for large and medium-sized producers of agricultural products, but also to provide personnel for the entire value chain in agriculture – from researchers and geneticists to specialists in the field of logistics, storage and marketing of products. Today, we need people who understand the entire process of functioning of the agro-industrial complex. In these conditions, the availability of specialized programs on management, Economics and logistics in the agricultural sector becomes crucial.

An important area of development is the improvement of the entire complex of land relations, improving the state and increasing the efficiency of agricultural land use. For the country as a whole, the problem of reducing acreage, which occurred in the post-reform period, is acute. So, in the last decade, Russia has not used about 35–40 million hectares of arable land, which is a large reserve for the growth of production volumes and the implementation of the strategy of import substitution of agricultural raw materials and food in the country. This requires improving the system of state regulation of land relations aimed at restoring and subsequently involving unused agricultural land in economic turnover. In the Krasnodar territory, as in other agricultural regions of the country, the state of agricultural land continues to deteriorate [8]. This is mainly due to the low level of application of mineral and organic fertilizers, which is 4–5 times lower than in the economically developed countries of the West. It is worth noting that this is happening in a country that is a major global producer of mineral fertilizers and plant protection chemicals, of which more than 80 % is exported.

At the same time, the relatively low level of chemicalization of domestic crop production creates some competitive advantages when organizing the production of organic agricultural products with noticeably higher sales prices, which should also be taken into account when strategic planning the development of the industry [2].

Due to a number of reasons (such as natural conditions, seasonality, low elasticity of demand, low mobility of resources, etc.), agriculture is not the most reliable and profitable industry for capital investment, so the support and development of the agricultural sector is almost entirely the responsibility of the state. At the moment, there are nine major programs

within the framework of state support for the agricultural sector that help producers reduce the cost of agricultural equipment (support is generally aimed at improving the level of technical and technological development, including the use of precision farming technologies), transportation of products, creation and modernization of agricultural facilities, as well as stimulating and supporting subsidies and soft loans.

Agriculture accounts for only 4 % of the gross domestic product, the development of agriculture remains a priority of our country's policy, and Russia's food security depends directly on solving problems.

Currently, the development of domestic agriculture is carried out mainly on the basis of the introduction of foreign technologies and equipment into production, which is innovative, as a rule, only for our country. To move to a faster pace of development of agro-economics based on its own world-class scientific products, it is necessary to restore competitive sectors of fundamental and applied branch science with the deepening of its integration with higher agricultural and economic education, production and capital due to a multiple increase in the volume of its state funding, the level of remuneration and prestige of the scientific profession, improving the mechanism of commercialization and dissemination of the obtained scientific results. An important area of ensuring food security and independence of the country is the implementation of import substitution in the seed markets. Major investments are needed in the creation of new high-yielding varieties of crops of domestic selection, adapted to the soil and climatic conditions of the region, the formation and development of a highly effective seed system that provides short-term variety changes and variety renewal on the basis of created varieties and hybrids of agricultural crops, the organization of large breeding and seed complexes with a full production cycle [2].

The results show that currently the most effective direction of state support for agricultural producers is to subsidize part of the interest rates on long-term investment loans aimed at updating and replenishing their fixed assets.

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## Политика России в области продовольственной безопасности

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**Ключевые слова и фразы:** аграрный сектор страны; источники сырья; продовольственная безопасность; продукты питания; рынок продуктов питания; сельскохозяйственная продукция; сельскохозяйственные предприятия.

**Аннотация.** С целью изучения направлений решения проблемы продовольственной безопасности РФ проводится анализ аграрного сектора страны. Методами статистического и экономического анализа автор дает описание и структуру аграрного сектора как поставщика продуктов питания и источника сырья для пищевой, текстильной, кожевенной и фармацевтической отраслей промышленности. Выявлены направления решения проблем продовольственной безопасности России и обеспечения ее сельскохозяйственной продукцией.

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## A Comparative Analysis of the Frequency of Kariological Indicators of Different Age Groups

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**Key words and phrases:** biomarkers; chromatin; karyolysis; karyorexis; nuclear aberration; protrusion.

**Abstract.** This article analyzes the concept of “micronucleus”. Nuclear phenomena that can occur not only during physiological cell differentiation, but also during the death of cells with DNA damage, are described. The analysis of buccal epithelocyte micronuclei widely used throughout the world and widely used in the last decade is given. It is noted that most of the changes in the tumor cell occur in the nuclei, and the modifications vary in size, density and distribution of chromatin, such violations can be distinguished between normal cells and the diseased.

The micronuclear test in buccal epithelium of the oral cavity appeared relatively recently (in the 80s of the twentieth century (Sarto, 1987)) and quickly became one of the most widely used for assessing the body’s genetic homeostasis, screening for chemical compounds and physical factors for genotoxicity (Kalayev, 2004; Yurchenko, 2005).

A number of studies have postulated the effect of age on the frequency of nuclear aberrations in human epithelial cells, but there is no consensus on this issue. In some works, the authors conclude that age does not affect the vital processes of cells [P.V. Rekhadevi, 2009]. Other scientists, on the contrary, confirm the effect of age on cytogenetic status. The research results are inconsistent.

In connection with the foregoing, the aim of our work was to assess the cytogenetic status of individuals of different age groups, taking into account the kariological parameters of the micronuclear test.

To achieve the goal, we set the following tasks:

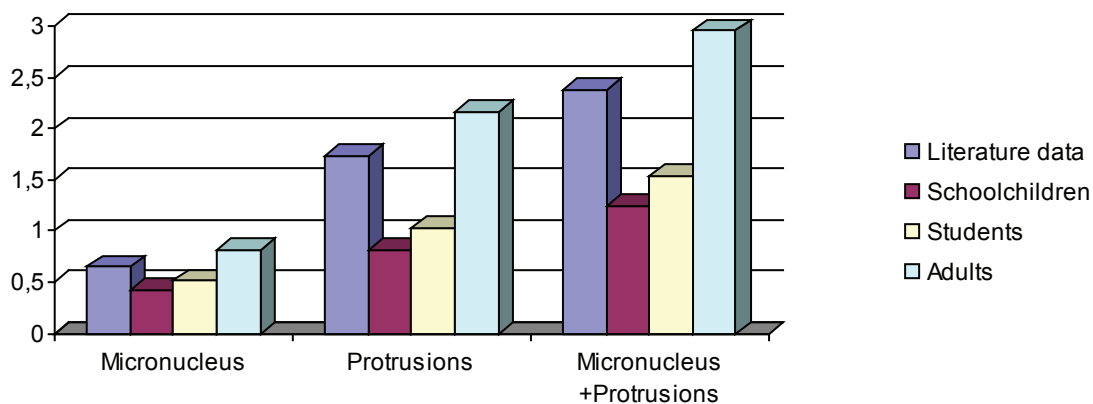
- 1) to assess the cytogenetic status of schoolchildren;
- 2) to assess the cytogenetic status of students of the Chechen State University;
- 3) to assess the cytogenetic status of individuals of the older age group (45–50 years);
- 4) conduct a correlation analysis of the data.

In the studied groups, a kariological analysis of buccal epithelium was performed. To study cytogenetic disorders in buccal epithelial cells, an extended micronuclear test protocol was used. In our study, we were guided by the classification of L.P. Sycheva (2007), according to which kariological parameters are divided into 4 groups: cytogenetic, proliferation, early and late nuclear destruction.

**Table 1.** Frequency distribution of micronuclei and protrusions in the studied groups

Cytogenetic indicators	Cell Frequency (‰)			
	Literature data* (n = 51)	Schoolboy (n = 21)	Students (n = 20)	Adults (n = 18)
Micronuclei	0.65 ± 0.12	0.43 ± 0.07	0.51 ± 0.06	0.81 ± 0.12
Protrusions	1.73 ± 0.28	0.82 ± 0.23	1.03 ± 0.23	2.16 ± 0.87
Total	2.38 ± 0.26	1.25 ± 0.12	1.54 ± 0.13	2.96 ± 0.99

\*According to the data of L.P. Sycheva (2009).



**Fig. 1.** The distribution of the number of cells with cytotenetic disorders (PR) in the studied groups

The results of the study of the frequency of cytotenetic disorders of karyological analysis in the studied groups are presented in Table 1.

As we see, according to the data in Table 1, the lowest frequency of cells with micronuclei was detected in schoolchildren ( $0.43 \pm 0.07 \text{ ‰}$ ) in comparison with a group of students ( $0.51 \pm 0.06 \text{ ‰}$ ) and adults ( $0.81 \pm 0.12 \text{ ‰}$ ). However, all results have no statistical significance of differences.

*Protrusion.* Protrusions are cytotenetic indicators, also contain DNA and have a cytoplasmic membrane. They are the result of unrepaired violations of protein functions and the structure of the spindle division [Sycheva, 2007; Tolbert et al., 1992]. So, in schoolchildren, the proportion of cells with protrusions was  $0.82 \pm 0.23 \text{ ‰}$ , in students, the frequency of this indicator was higher by 0.23 ( $1.03 \pm 0.23 \text{ ‰}$ ).

Of course, this effect is associated with the lifestyle of the adult population (working conditions, stress, using cars, smoking, treatment, etc.) (Table 2, Fig. 2).

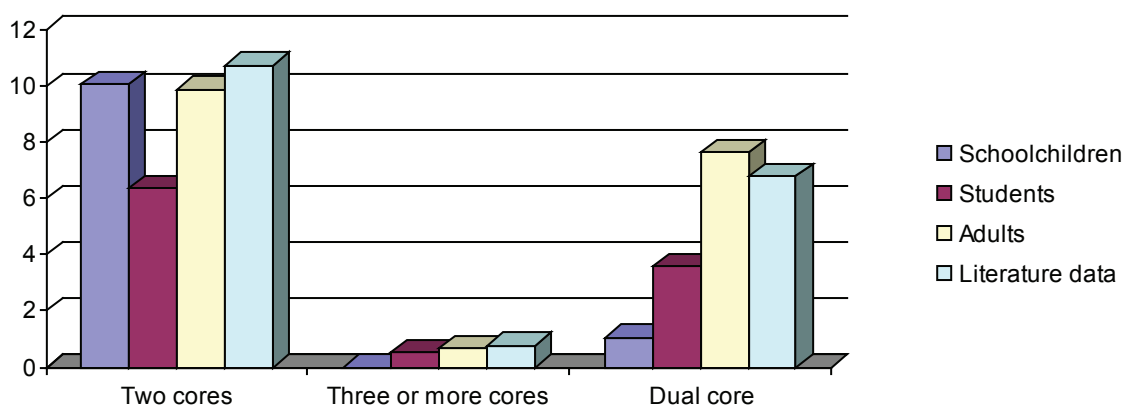
### Indicators of proliferation

In case of disturbances in the course of mitotic cell division, acytokinetic cell division often occurs [1; 2]. The proliferative activity of buccal epithelial cells in the studied groups is presented

**Table 2.** The distribution of cell frequency in proliferation among the studied groups

The proportion of cells with	Buccal Epithelial Cell Frequency (‰)			
	Literature data * (N = 51)	Schoolboy (N = 21)	Students (N = 20)	Adults (N = 18)
Two cores	10.73 ± 0.83	10.03 ± 2.85	6.33 ± 0.62	9.17 ± 3.2
Three or more cores	0.78 ± 0.14	0.00 ± 0.0	0.51 ± 0.18	0.64 ± 0.12
Dual core	6.78 ± 0.77	1.06 ± 0.52	3.58 ± 0.34*	3.42 ± 1.88*
Total proliferation	20.73 ± 1.40	8.31 ± 1.12	10.22 ± 1.07	13.23 ± 2.53

\*  $p < 0,005$ .

**Fig. 2.** The distribution of the number of cells with two or more nuclei (PN) for the studied groups

in Table 2 and in Fig. 2.

According to table 2, in the group of schoolchildren, the frequency of cells with dual nuclei ( $1.06 \pm 0.52$ ) is significantly significantly ( $p < 0.005$ ) lower in comparison with the group of students ( $3.58 \pm 0.34$ ), and with a group of adults ( $7.62 \pm 1.88$ ). The appearance of such cells is associated with a cytogenetic violation of the structure of chromatin or spindle filaments, which blocks the normal process of nucleus separation after mitosis. It is an indicator of mutagenic or cytogenetic effects of environmental factors. In our opinion, a group of schoolchildren is less susceptible to mutagenic factors than adults.

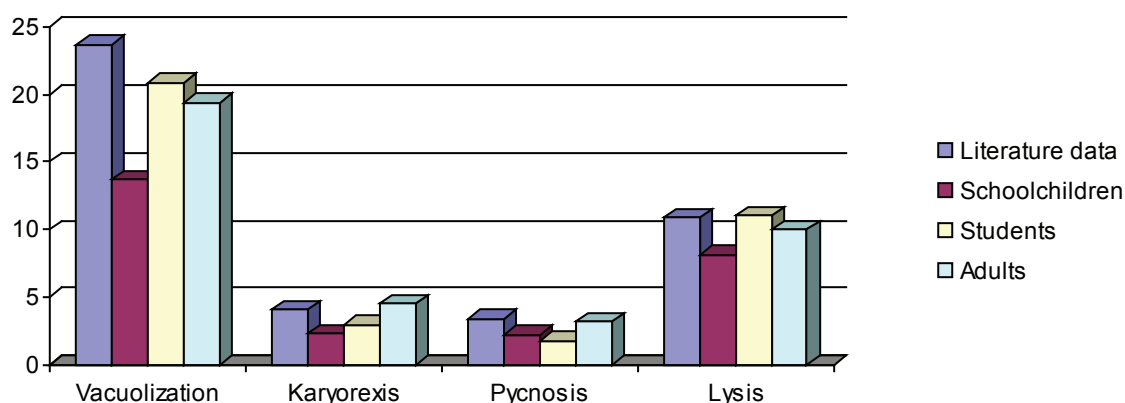
### The destruction of the nucleus

This group of indicators has a highly variable ability, that is, they vary over a wide range when exposed to various exogenous or endogenous factors and are indicators of the destruction of epithelial cells during their exposure. The indicators of early nuclear destruction were studied: with chromatin condensation, vacuolization, and the onset of karyolysis.

The results of the study of the frequency of destructive cells in the studied groups are presented in Table 3 and Fig. 3.

**Table 3.** Indicators of early destruction of the nucleus of the cells of the oral cavity in the studied groups

Destruction indicators	The frequency of cells with nuclear destruction (%)			
	Literature data (n = 51)	Schoolboy (n = 21)	Students (n = 20)	Adults (n = 18)
Indicators of early nuclear destruction				
Vacuolization	23,75 ± 3,86	13,66 ± 2,27	20,89 ± 2,62	19,44 ± 2,85
Karyorexis	4,02 ± 1,13	2,26 ± 0,22	2,93 ± 0,60	4,50 ± 1,19
Karyopiches	3,35 ± 0,78	2,16 ± 0,48	1,75 ± 0,52	3,14 ± 0,91
Karyolysis	10,85 ± 2,54	8,16 ± 2,13	11,02 ± 1,89	9,96 ± 1,79
Total	12,64 ± 0,63	11,20 ± 2,63	9,33 ± 0,92	12,38 ± 0,97



**Fig. 3.** Distribution of indicators of nuclear destruction in the studied groups and according to literature [1]

As you can see, in the frequency of cells with the studied indicators of nuclear destruction, there are no significant differences between the studied groups and the literature data.

The proportion of cells with vacuolization of the nucleus, karyorexis, and complete karyolysis is not significantly lower for a group of students compared to a group of students and adults, which may reflect lifestyle and environmental factors.

According to the data obtained (Table 3 and Fig. 3), the indicator – the proportion of all cells in apoptosis in the studied groups does not exceed the indicator presented in the literature.

### Conclusions

1. The frequency of cells with karyological parameters is within the values characteristic of most populations outside the production sphere.
2. There is an increase in apoptosis in response to nuclear structural abnormalities in epithelial cells in order to accelerate the elimination of cells with cytogenetic disturbances in the structure of the nucleus.
3. The conjugation of cytogenetic indices and apoptosis indices of buccal epithelial cells is

due to their dependence on age.

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### Сравнительный анализ частоты кариологических показателей разных возрастных групп

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**Ключевые слова и фразы:** биомаркеры; кариолизис; кариорексис; протрузии; хроматин; ядерные абберации.

**Аннотация.** В данной статье анализируется понятие микроядра. Описаны ядерные явления, которые могут происходить не только во время физиологической клеточной дифференцировки, но и во время гибели клеток с повреждением ДНК. Приведен анализ широко применяющихся во всем мире и используемых в последнее десятилетие микроядер букальных эпителиоцитов. Отмечается, что большинство изменений в опухолевой клетке происходят в ядрах, а модификации меняются по размеру, плотности и распределению хроматина, такие нарушения могут быть различимы между нормальными клетками и пораженными.

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