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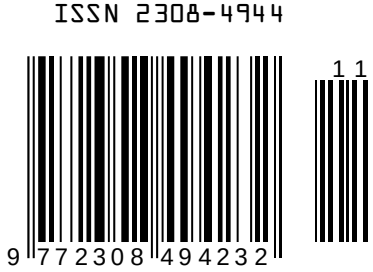

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Issue Article

Denis Chemezov
Vladimir Industrial College
M.Sc.Eng., Honorary Worker of the Education Field of the Russian Federation, Academician of International Academy of Theoretical and Applied Sciences, Lecturer, Russian Federation
https://orcid.org/0000-0002-2747-552X
vic-science@yandex.ru

Agannes Arzikyan
Vladimir Industrial College
Student, Russian Federation

Grigoriy Lushin
Vladimir Industrial College
Student, Russian Federation

Alyona Kozlova
Vladimir Industrial College
Student, Russian Federation

Ivan Proshin
Vladimir Industrial College
Student, Russian Federation

Maksim Eremtsov
Vladimir Industrial College
Student, Russian Federation

Talabsho Kamilov
Vladimir Industrial College
Student, Russian Federation

THE DEGREE OF MECHANICAL STRESS OF A METAL SPECIMEN UNDER TENSILE TESTING CONDITIONS

Abstract: *The results of local stress of cylindrical specimens during the tensile test were demonstrated in the article. It is noted that, depending on the configuration of the loaded surface, the stress value of material can increase or decrease linearly or cyclically non-linearly in different sections of the specimen.*

Key words: *specimen, tensile, von Mises stress, length.*

Language: *English*

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Introduction

The process of tensile testing of metal cylindrical specimens has been studied in a number of scientific papers [2-10]. In accordance with ISO 6892 [1], special specimens are prepared and tested for their tensile strength on a tensile testing machine. The

essence of the test is to determine the magnitude of the load leading to partial destruction of the specimen. Thus, the maximum tensile stress of material will be obtained. The loaded state of the specimen is tracked according to the dependence of the tensile test diagram. This diagram describes the stress state of material under tension in general, but the nature of the deformation (stress) of the specimen elements does not give. This gap can be filled by computer calculation of the stretching process of the specimen model. The results obtained will complement the general picture of the stress state of the specimen during stretching.

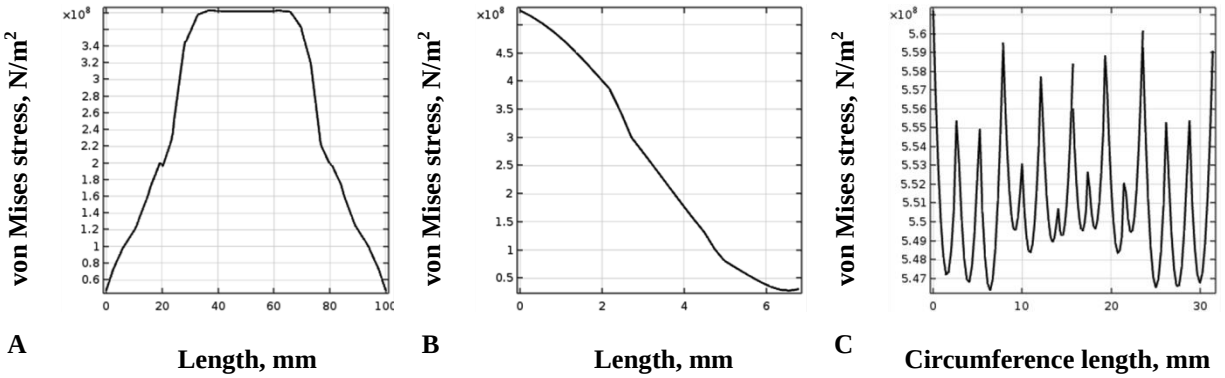
Materials and methods

A three-dimensional solid-state model of the cylindrical specimen was subjected to a tensile test. The testing was implemented in the Comsol Multiphysics computer program. The properties of steel were given to the specimen (Young's modulus and Poisson's ratio were assumed to be 210 GPa and 0.3, respectively). The initial estimated length and diameter of the specimen model were assumed to be 55 and 10 mm, respectively. A force of 30 kN was applied to the specimen model. The degree of stress of the specimen after the test was determined along the axial line, on the fillet and on the cylindrical surface.

Results and discussion

The results of the computer calculation of stress of the specimen material subjected to stretching are presented in the Fig. 1.

A mirror reflection of the stressed state of material is observed along the entire length of the specimen. This is due to the symmetrical configuration of the specimen. The maximum von Mises stress is observed at the estimated length of the specimen. At this length, the destruction of the specimen material occurs after exceeding the tensile strength. From the largest to the smallest cross sections of the specimen, the von Mises stress varies by almost 10 times. The difference in the maximum values of the von Mises stress on the axial line and the outer cylindrical surface of the specimen is observed by 1.5 times. In this case, the surface layers of the specimen cylinder are subjected to stress cyclically (values vary in ascending and descending functions). These changes do not lead to a significant jump in the stress values of the specimen material. The fillet is a smooth radius connecting two cylindrical surfaces with different cross sections. The fillet reduces the value of stress in a large range. On the section of the fillet of 6 mm, changing the von Mises stress occurs 10 times. This proves the effectiveness of performing this element to increase the strength of the specimen during tensile deformation.



A **B** **C**

Figure 1 – The von Mises stress values: A – on the total length of the axial line of the specimen; B – on the length of the fillet of the specimen; C – on the circumference length of the specimen.

Conclusion

Thus, the maximum stress of material is observed at a distance of half the estimated length of the specimen subjected to stretching. According to the highest values of the von Mises stress determined along the axial line, it is possible to make a prediction about the possible destruction of the specimen at the marked distance. The smooth radius on the specimen reduces the local stresses of material up to 10 times over a short length. The cylindrical surface is subjected to stress cyclically, but significant stress drops are not observed.

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Denis Chemezov
Vladimir Industrial College
M.Sc.Eng., Honorary Worker of the Education Field of the Russian Federation, Academician of International Academy of Theoretical and Applied Sciences, Lecturer, Russian Federation
https://orcid.org/0000-0002-2747-552X
vic-science@yandex.ru

Nikita Afanasyev
Vladimir Industrial College
Student, Russian Federation

Veronika Khlebnikova
Vladimir Industrial College
Student, Russian Federation

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Vladimir Industrial College
Student, Russian Federation

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Vladimir Industrial College
Student, Russian Federation

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Vladimir Industrial College
Student, Russian Federation

Andrey Volvyankin
Vladimir Industrial College
Student, Russian Federation

CHARACTERISTICS OF A SUPERSONIC EJECTOR

Abstract: *Some characteristics of the supersonic ejector were presented in the article. The dependences of the input and output values of temperature, velocity, pressure and total internal energy of the supersonic ejector jet flow were analyzed.*

Key words: *supersonic ejector, flow, temperature, velocity, pressure, internal energy.*

Language: *English*

Citation: Chemezov, D., et al. (2023). Characteristics of a supersonic ejector. *ISJ Theoretical & Applied Science, 11 (127)*, 4-6.

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Introduction

Ejectors are simple mechanical components used for a wide range of applications, including industrial refrigeration, vacuum generation, gas recirculation, and thrust augmentation in aircraft propulsion systems.

Ejectors induce a secondary flow by momentum and energy transfer from a high-velocity primary jet.

The high-energy fluid (primary flow) passes through a convergent-divergent nozzle and reaches supersonic conditions. After exiting the nozzle, it interacts with the secondary flow and is accelerated through an entrainment-induced effect. The mixing between both flows takes place along a constant-area duct called the mixing chamber where complex interactions between the mixing layer and shocks can be observed. A diffuser is usually placed before the outlet to recover pressure and bring the flow back to stagnation.

Experimental studies of supersonic ejectors are presented in a number of scientific papers [1-10]. Continuing the topic of operation of supersonic ejectors, it is proposed to consider some characteristics of these gas-dynamic devices through computer modeling.

Materials and methods

A compressible turbulent flow passing through the nozzle of the supersonic ejector was subject to simulation. For this purpose, the three-dimensional model of the supersonic ejector with the following geometry was built: diameter of the throat – 8 mm; diameter of the secondary inlet – 160 mm; diameter of the primary inlet – 16 mm; diameter of the divergent section of the nozzle – 12 mm; diameter of the diffuser – 51 mm; diameter of the mixing chamber – 24 mm; length of the mixing chamber – 240 mm; length of the diffuser – 70 mm; distance between the outlet of the nozzle and the inlet of the mixing chamber – 15 mm; length of the convergent section of the nozzle – 7 mm; length of the secondary nozzle – 90 mm; length of the divergent section of the nozzle – 23 mm; length at the inlet – 15 mm; length at the outlet – 15 mm. The output pressure is assumed to be 1 atm. The jet flow was carried out in accordance with the k-ε turbulence model. Thermal conductivity and dynamic viscosity were calculated in accordance with Sutherland's law. The Mach number and the turbulence intensity of the flow are assumed to be 0.14 and 0.05, respectively.

Results and discussion

The dependences of temperature on velocity and total internal energy on pressure of the supersonic ejector jet flow are plotted in the Fig. 1.

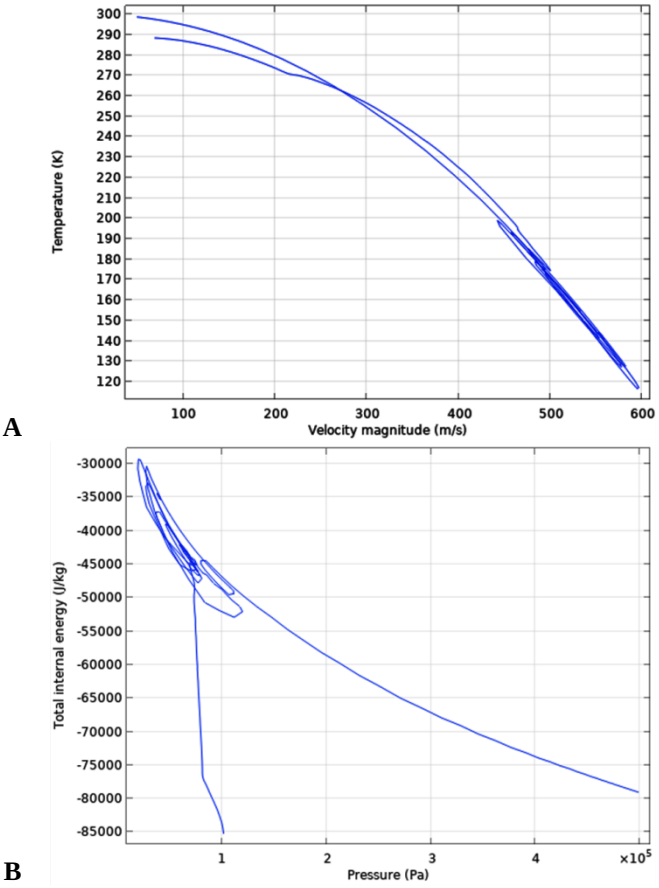

Figure 1 – The dependences of temperature on velocity (A) and total internal energy on pressure (B) of the jet flow.

The jet flow passes through the nozzle under pressure at an initial temperature of 120 K. At the same time, the flow velocity of the jet is maximum. The concentration of low temperatures is determined at the maximum flow velocities of the jet. When the jet passes up to half the length of the mixing chamber,

the flow temperature increases by 0.7 times, and the flow velocity decreases by 0.25 times. At the outlet of the mixing chamber, the temperature and flow velocity of the jet reach values of 290-300 K and 25-50 m/s, respectively.

The jet flow passing through the nozzle has a minimum internal energy characteristic of the cooling process at subzero temperatures. As the pressure decreases, the flow heats up, and the internal energy gradually increases. For the selected operating conditions of the supersonic ejector, the internal energy increases approximately three times at a pressure of less than 0.5 MPa. It is noted that at low pressures, the internal energy of the jet flow is dissipated. The maximum value of the internal energy is calculated at a jet flow pressure of 1 MPa.

Conclusion

The characteristics of the action of the supersonic ejector to create a jet flow with negative temperatures were considered. Low internal energy of the jet flow can be observed both at high overpressure and at atmospheric pressure. The temperature of the jet flow varies by 2.5 times, and the flow velocity is more than 10 times relative to the initial values in the mixing chamber.

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Issue Article

Baxodir Istamovich Xojiyev
Navoi State Pedagogical Institute
the acting associate dotsent

THE STUDY OF TRANSIENTS IN PHYSICS LESSONS

Abstract: *This article analyzes the study of the transition process in physics lessons using quantitative calculation methods. The use of electronic devices in modeling various physical processes using numbers is one of the most effective areas. This method is very convenient, especially during laboratory exercises when the results are presented in the form of tables or graphs.*

Key words: *electronic device, quasielastic force, circuit, differential, vibration amplitude, exponential law, capacitor, chain, resistor.*

Language: *Russian*

Citation: Xojiyev, B. I. (2023). The study of transients in physics lessons. *ISJ Theoretical & Applied Science, 11 (127)*, 7-9.

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ИЗУЧЕНИЕ ПЕРЕХОДНЫХ ПРОЦЕССОВ НА УРОКАХ ФИЗИКИ

Аннотация: *В данной статье анализируется изучение переходного процесса на уроках физики методами количественного расчета. Использование электронных устройств при моделировании различных физических процессов с помощью чисел является одним из наиболее эффективных направлений. Этот метод очень удобен, особенно при лабораторных занятиях, когда результаты представляются в виде таблиц или графиков.*

Ключевые слова: *электронное устройство, квазиупругая сила, цепь, дифференциал, амплитуда колебаний, показательный закон, конденсатор, цепь, резистор.*

Введение

Одним из наиболее эффективных направлений является использование экспозиции при численном моделировании различных физических процессов. Этот метод особенно удобен при представлении результатов в виде таблиц или графиков на лабораторных занятиях.

Приходится измерять изменение физической величины во времени в зависимости от различных параметров. Соответствующие параметры изменяются, эксперимент повторяется несколько раз, результаты сравниваются и делается вывод об изучаемом процессе. Тем не менее, естественно, что полученные результаты не могут достоверно отражать изучаемый процесс, поскольку точность измерительных приборов, предназначенных для учебных лабораторий, значительно ниже, а на их показания влияют различные внешние факторы.

Основная часть.

Это затрудняет формирование каких-либо физических законов из полученных результатов. По сравнению с результатами эксперимента, количественно вычисляющего закон, представляющий физический процесс, оценка результатов становится проще, и в то же время уточняются погрешности измерений. Но расчет величин, зависящих от ряда параметров, занимает довольно много времени. Если эта работа будет выполняться с помощью экспозиции, теоретические расчеты удастся повторить несколько раз для разных случаев за короткий промежуток времени. Это позволяет полностью достичь намеченной цели лабораторного обучения.

Пример 1: рассмотрим движение набора колеблющихся взаимосвязанных тел. Под влиянием среды на колебания системы

уменьшается амплитуда ее колебаний, т. е. колебания угасают. При медленном затухании колебаний и малой их амплитуде затухающие колебания можно считать периодическими, прямо пропорциональными силе сопротивления среды, скорости системы.

$$F_c = -\mu \frac{dx}{dt} = -\mu x'$$

На колеблющуюся систему также действует квазиупругая сила, равная $\boldsymbol{F_{ку} = -kx}$. Уравнение движения убывающей колеблющейся системы можно записать как:

$$mx'' = -\mu x' - kx$$

из этого мы получаем $mx'' + \mu x' + kx = 0$, делим уравнение на m и вводим обозначение $\frac{\mu}{m} = 2\beta$ и $\frac{k}{m} = \omega^2$, записывая уравнение движения системы следующим образом:

$$x'' + 2\beta x' + \omega^2 x = 0$$

где β-коэффициент затухания, ω - циклическая частота.

Это выражение называется дифференциальным уравнением убывающих колебаний. Это решение уравнений вида;

$$x = A_0 e^{-\beta t} \cos(\omega t + \varphi_0) \quad (1)$$

Выражается в виде. Здесь $A = A_0 e^{-\beta t}$ выражение представляет собой амплитуду колебаний, которая уменьшается, по экспоненциальному закону изменение координаты X происходит, на основе уравнения (1) в виде графика, представленного на рисунке.

Пример 2: рассмотрим процессы изучения явления самоиндукции. Изменение силы тока, проходящего через контур, само по себе создает ЭДС, что приводит к дополнительному току в контуре, который называется само индукционным экстра током. Направление само индукционного экстра тока основано на правиле Ленца, которое предотвращает изменение тока самовоспроизводящегося источника.

При подключении катушки индуктивности, к источнику тока образующиеся, в ней экстра токи оказывают сопротивление току источника, достигающему максимального значения. Направление генерируемых в цепи экстра токов будет противоположно направлению тока источника, который их генерирует. Рассмотрим цепь, состоящую из катушки с индуктивностью L, резистора с сопротивлением R, источника тока с ЭДС ε. Вместо резисторного сопротивления также можно получить активное сопротивление соединительных кабелей и катушки. При разрыве цепи ток в ней со временем уменьшается по закону экспоненты

$$\boldsymbol{I_1 = I_0 e^{-\frac{t}{\tau}}} \quad (2)$$

$\boldsymbol{I_0 = \frac{\varepsilon}{R}}$ -ток, образующийся в цепи. $\boldsymbol{\tau = \frac{L}{R}}$ - Время, необходимое для уменьшения силы тока в e раз. При подключении цепи сила тока увеличивается следующим образом:

$$\boldsymbol{I_2 = I_0(1 - e^{-\frac{t}{\tau}})} \quad (3)$$

$\boldsymbol{I_0}$ сила тока увеличивается от начального значения $\boldsymbol{I = 0}$ до максимального значения $\boldsymbol{I = \frac{\varepsilon}{R}}$. Скорость изменения силы тока будет зависеть от времени $\boldsymbol{\tau}$ -релаксации. Чем меньше индуктивность цепи L и чем больше сопротивление актива R, тем больше скорость изменения силы тока. Расчеты производятся по программе. В примере 2 программа вычисляет в виде таблицы значения убывания и увеличения во времени тока в катушке с известной индуктивностью для трех значений напряжения и сопротивления источника питания и на основе этой таблицы может отобразить на экране график изменения токов $\boldsymbol{I_1}$ и $\boldsymbol{I_2}$.

Пример 3: рассмотрим переходные процессы в конденсаторной цепи. Конденсатор емкостью ***C***, если $\boldsymbol{U_0}$ подключен к источнику постоянного напряжения через резистор R, как долго он будет заряжаться? При подключении конденсатора к источнику напряжение на нем увеличивается, ток в цепи уменьшается. Зарядка продолжается до тех пор, пока напряжение на конденсаторе, напряжение источника, не станет равным $\boldsymbol{U_0}$. Когда требуемый $\boldsymbol{q_0=CU_0}$ собирается в оболочках конденсатора, ток, проходящий через цепь, заканчивается, тем самым завершая процесс зарядки.

Если мы представим заряд на одной из пластин в виде ***q***, он изменится в процессе зарядки конденсатора. Скорость изменения заряда на пластине q/dt , представляющая силу тока в цепи:

$$\boldsymbol{I = \frac{dq}{dt}} \quad (4)$$

В последовательно соединенной цепи сумма напряжений $\boldsymbol{U_R}$ на резисторе и $\boldsymbol{U_C}$ на конденсаторе равна напряжению $\boldsymbol{U_0}$ источника. Отсюда следует, что напряжение на резисторе равно произведению тока на сопротивление

$$\boldsymbol{IR+U_C=U_0}$$

Учитывая, что сила тока (4) зависит от скорости изменения заряда, а напряжение $\boldsymbol{U_C}$ на конденсаторе, $\boldsymbol{q/C}$ в произвольный момент времени, мы получаем:

$$\boldsymbol{R\frac{dq}{dt} + \frac{q}{C} = U_0}$$

Это дифференциальное уравнение, зависящая от времени функция $\boldsymbol{q(t)}$ заряда конденсатора. Учитывая $\boldsymbol{U_0}$ напряжение, результирующий заряд конденсатора равен отношению $\boldsymbol{q_0}$ к емкости: $\boldsymbol{U_0=q_0/C}$.

$$\frac{dq}{dt} = \frac{(q_0 - q)}{RC}$$

Если мы представим заряд ***q*** на пластине с новой величиной ***Q***, это уравнение можно легко преобразовать в другое представление: мы возьмем $\boldsymbol{Q=q_0-q}$ и дифференцируем его,

формируем $\frac{dq}{dt} = -\frac{dQ}{dt}$. Учитывая это, (4) можно записать следующим образом.

$$\frac{dQ}{dt} = -\frac{Q}{RC}$$

Решение этого уравнения

$$Q(t) = CU_0 e^{-\frac{t}{RC}} \qquad (5)$$

Учитывая это $Q = q_0 - q$

$$q(t) = CU_0 \left\{1 - e^{-\frac{t}{RC}}\right\} \qquad (6)$$

Заключение.

В данной работе предлагается количественное исследование переходного процесса. Расчеты выполняются по программе, написанной для формул (5) и (6). В примере программа вычисляет значения уменьшения и увеличения заряда конденсатора определенной емкости C для трех значений напряжения U_0 источника питания и сопротивления во времени, и на основании этой таблицы, может вывести на экран график изменения зарядов q_1 и q_2 (рис. 3). В данной работе предлагается количественное исследование переходного процесса. Программа может быть использована для организации лабораторных работ в электрических и электротехнических курсах.

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Issue **Article**

Feruza Bobirovna Kholbutaeva
Andijan State Institute of Foreign Languages
teacher
Andijan, Uzbekistan
xabibullaevaferuz@gmail.com

SEMASIOLOGY AND ONOMASIOLOGY AS TWO APPROACHES TO THE CONSIDERATION OF LINGUISTIC UNITS

Abstract: *This article provides ways to consider linguistic and lexical units using onomasiology and semasiology, as two aspects of semantics. And the various ways of their existence and functioning in language are illustrated within the framework of a single theory - lexical semantics.*

Key words: *semasiology, onomasiology, act of communication, lexeme, meaning, sign, dictionary F. Dornseif.*

Language: *Russian*

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СЕМАСИОЛОГИЯ И ОНОМАСИОЛОГИЯ КАК ДВА ПОДХОДА К РАССМОТРЕНИЮ ЯЗЫКОВЫХ ЕДИНИЦ

Аннотация: *В данной статье даются пути рассмотрения языковых и лексических единиц с помощью ономасиологии и семасиологии, как два аспекта семантики. И иллюстрируются различные способы их существования и функционирования в языке в рамках единой теории – лексической семантики.*

Ключевые слова: *семасиология, ономасиология, акт коммуникации, лексема, значение, знак, словарь Ф. Дорнзайфа, семасиология, ономасиология.*

Введение

Рассматривая акт коммуникации, мы видели, что один из коммуникантов (говорящий – А) кодирует информацию по действующим, в данном языке законам связи значений и знаков, т.е. осуществляет переход типа S → s → z → Z, или более упрощенно: «значение» → «знак». Другой участник коммуникации (слушающий – В), напротив, декодирует информацию по тем же законам языка, т.е. совершает как бы обратный переход типа Z → z → s → S, или проще: «знак» → «значение». Диалог между А и В предполагает перемену ролей.

В лингвистике значительно больше разработан второй аспект – изучение того, что значат те или иные слова (знаки), как они декодируются, и гораздо меньше – первый, т.е. какие существуют наличные средства для кодирования мысли. Традиционную науку о значении, которая возникла как историческая лингвистическая дисциплина, интересовал главным образом вопрос о том, что значат те или иные отдельные слова и как они изменяют свои значения. Вокруг этой проблемы и группировалась прежняя семантическая (семасиологическая) проблематика. Своеобразной реакцией на атомарность семасиологии и односторонность рассмотрения языковых единиц явилась статья известного немецкого лингвиста Л. Вайсгербера «Семасиология – ложный путь языкознания?» («Die Bedeutungslehre – ein Irrweg

der Sprachwissenschaft?»)[1]. Л. Вайсгербер предложил заменить традиционную теорию значения рассмотрением языка как системы (сетки) понятий; при этом имелись в виду не «искусственные» логические, а языковые понятия (Popularbegriffe, «наивные понятия»), обусловленные субъективными, эмоциональными факторами[2]. Главное внимание науки о смысловой стороне языка перемещалось при таком подходе с атомарного рассмотрения изменения значений слов на систему значимых единиц, т.е. на определение их содержания и «значимости» внутри единого целого (понятийной сферы, «наивной» картины мира). Работы Л. Вайсгербера (так же, как и его предшественников, и прежде всего – Й. Трира[3]), если оставить в стороне их вполне понятную «антисемасиологическую» направленность, а значит, тоже в известной мере односторонность, объективно способствовали развитию методов разностороннего семантического анализа, выдвигая наряду с существующей теорией значения (или ошибочно – вместо нее) теорию обозначения, опирающуюся на систему языковых понятий, выражаемых средствами определенного языка.

Наиболее полное, ясное и вместе с тем свободное от крайностей определение двух взаимосвязанных аспектов теории значения впервые находим у Ф. Дорнзайфа во введении к его идеографическому словарю немецкого языка «Der deutsche Wortschatz nach Sachgruppen»[4], в котором предпринята попытка представить словарный состав языка как организованный по понятийным группам (nach Sachgruppen).

Используемые в словаре понятия, единицы, классификационные категории основывались на теории обозначения (Bezeichnungslehre, Ononiasiologie). Ф. Дорнзайф отчетливо различал два направления (аспекта) изучения значения: 1) «от звучания к содержанию»: «Что значит данное слово, сочетание слов?» и 2) «от содержания к выражению»: «Какие существуют слова, сочетания слов для выражения определенного содержания?». Эти аспекты он предложил называть соответственно семасиологией (Bedeutungslehre) и ономасиологией (Bezeichnungslehre)[5]. Семасиология и ономасиология, теория значения и теория обозначения, являются в их современном понимании двумя методами в рамках одной общей науки, исследующими один и тот же предмет с различных сторон, в различных, противоположных направлениях.

Если термин понимать как общее название науки о языковом значении, то ее аспектизация применительно к лексической системе языка примет следующий вид:

Таблица 1.

Лексическая семантика	**семасиология** (аспект семантики, изучающий лексическое значение в направлении: знак → значение)
	Ономасиология (аспект семантики, изучающий лексическое значение в направлении: значение → знак).

Выделение противоположно направленных аспектов значения в пределах семантики позволяет полнее, всестороннее, с различных точек зрения представить разные способы существования элементарных языковых единиц (материально выраженных «слов-понятий», идеальных монем), получить полную картину различной организации таких единиц в лексические категории на основе достаточно различных по природе типов связи, в зависимости от роли коммуниканта в акте общения (говорящий – слушающий), от самого направления использования единиц лексико-семантической системы как коллективного отражения объективного мира в нашем сознании, языке.

Представим лексическую систему в виде множества элементарных «клеточек» («слов-понятий», по Л.В. Щербе). Возьмем фрагмент системы – элементарные единицы, представляющие собой качественные обозначения одной из характеристик внешнего вида человека (даются в алфавитном порядке): жирный, костлявый, полный, пухлый, *толстый, тощий, худой... полнее – худее* (при сравнении) и под. Эти единицы (вместе с другими подобными или как-то соотносительными с ними) образуют своеобразную «сетку», «шкалу», сквозь которую

[1] Weisgerber L. Die Bedeutungslehre ein Irrweg der Sprachwissenschaft? // Germanisch-romanische Monatsschrift 15, 1927. – S. 161-183.
[2] Kronasser H. Handbuch der Semasiologie, Heidelberg, 1952. – C. 62.
[3] Trier J. Der deutsche Wortschatz im Sinnbezirk des Verstandes. Von den Anfangen bis zum Beginn des 13. Jahrhunderts. Heidelberg, Carl Winter Universitatsverlag, 1932, 1973. – 347 s.
[4] Dornseiff F. Der deutsche Wortschatz nach Sachgruppen. Berlin – N. Y.: Walter de Gruyter, 2004. – 933 s.
[5] Dornseiff F. Sprache und Sprechender. Kleine Schriften II. Leipzig, 1964. – C. 90.

воспринимается действительность, тот или иной ее «сегмент», т.е. в известном смысле «промежуточный мир».

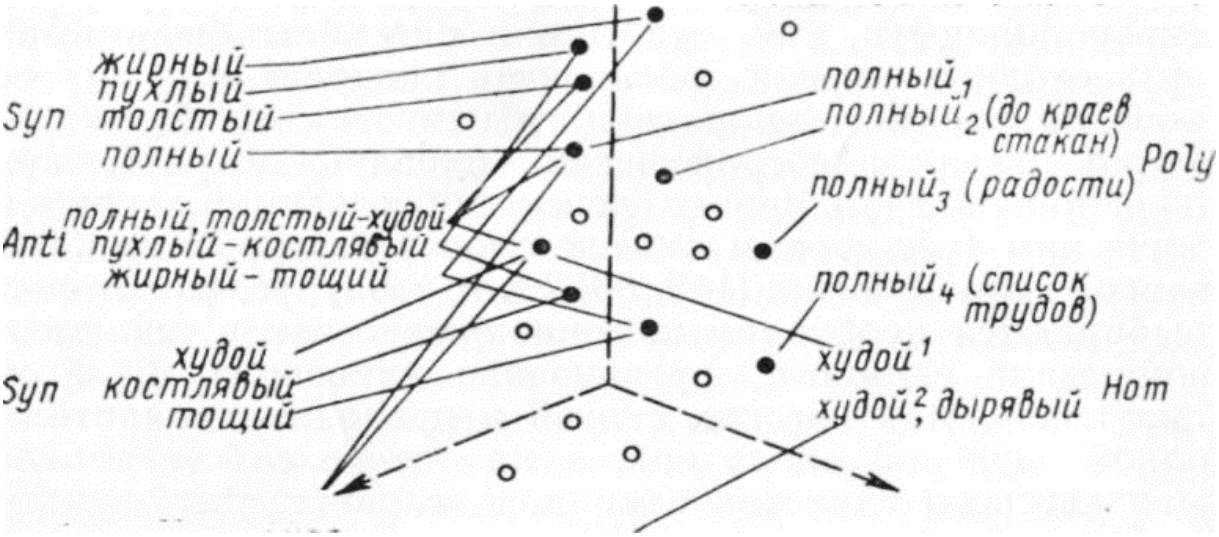
В зависимости от той или иной коммуникативной роли и задачи единицы лексико-семантической системы, существующие в языковом сознании, объединяются, группируются по-разному. Если коммуникант выступает в роли слушающего (читающего), он производит анализ значения в направлении «знак-означение», т.е. в семасиологическом аспекте, решая вопрос «Что значит это слово (сочетание слов), например прилагательное *полный*?». В этом случае он «держит в поле зрения» все единицы (варианты единиц), имеющие звуковую (графическую) оболочку этого слова, связывая их между собой в полисемантическое, многозначное слово (Poly – полисемия) и определяя по контексту соответствующее значение единицы, например «толстый» *(полный*$_1$ *мужчина)* это значение уточняется путем сравнения с другими вариантами этого многозначного слова (ср. *полный*$_2$ *стакан вина, полный*$_3$ *радости, полный*$_4$ *список трудов* и др.). В основе такой систематизации, при которой единицы объединяются в многозначное слово, лежат, как видно, ассоциативно-семантические связи тематически достаточно разнородных оязыковленных содержаний. При восприятии одних единиц легко обнаруживается их взаимная связь (семантическая мотивированность), основанная на общности внутренних форм, например у вариантов 1-4 и др. прилагательного *полный* (*наполнять, полнить – полный*: «вмещающий в себя, сколько можно, наполненный до краев, весь проникнутый чем-либо, содержащий в себе все необходимые части, составляющие, объемистый, тучный» и др.). Напротив, при восприятии других единиц, например *худой*[1] – «тощий, не упитанный» и *худой*[2] – «дырявый, ветхий», внешне аналогичных предшествующим, такой связи не обнаруживается. Такие единицы семантически разобщены для воспринимающего их и выступают как омонимы (Hom – омонимия).

Если коммуникант выступает в роли говорящего (пишущего), он ассоциирует определенные значения с соответствующими знаками, осуществляет переход «значение → знак» в ономасиологическом аспекте семантики, решая задачу: «Какими словами (знаками) или сочетаниями выражается то или иное содержание или оценка, например, оценка внешности человека в таком-то отношении?»[6]. И тогда семантические единицы группируются иначе: по их сходству, смысловому «соположению», противоположности, так, чтобы они способны были выразить сходное понятие, обозначить контраст, т.е. на основе их предметно-понятийного единства. Ф. Дорнзайф метко назвал идеографический словарь, отражающий понятийную группировку лексических единиц, «синонимическим (в широком смысле слова) тезаурусом» The saurus synonyinorum[7]. Этот тезаурус, из которого выбираются необходимые синонимические в широком понимании единицы, организован на основе не ассоциативно-семантических связей в пределах вариантов с одной звуковой оболочкой, а на основе собственно семантического единства единиц, т.е. понятийной, содержательной общности внутри того или иного поля, микро-поля. Единицы лексико-семантической системы само-организуются в этом случае таким образом, что в «поле зрения» говорящего (пишущего) оказываются синонимические ряды, парадигмы (Syn – синонимия: *полный, толстый, пухлый, жирный...*, *худой, костлявый, тощий...*), антонимические противопоставления (Anti – антонимия: *полный, толстый – худой, пухлый – костлявый, жирный – тощий...*), конверсивы (Conv – конверсия: *Сын полнее отца – Отец худее сына* и т.д.), вообще понятийно (тематически) близкие единицы[8].

Семасиологический и ономасиологический принципы связи и объединения в категории единиц лексико-семантической системы иллюстрируют различные способы их существования и функционирования в языке в рамках единой теории – лексической семантики. Противопоставление семасиологии и ономасиологии как двух взаимно дополняющих методов изучения семантики не является абсолютным: одно пронизывает другое. И тем не менее можно в принципе говорить об одних явлениях и категориях как «преимущественно семасиологических» (ассоциативно-семантическая связь: полисемия, омонимия и др.), а о других – как о явлениях и категориях преимущественно ономасиологических («понятийная», содержательно-семантическая связь; синонимия, гипонимия, антонимия, конверсия и др.). Изложение может быть представлено в виде следующей схемы[9]:

[6] Новиков Л.А. Семантика русского языка. – М.: Высшая школа, 1982. – С. 82.
[7] Dornseiff F. Sprache und Sprechender. Kleine Schriften II. Leipzig, 1964. – С. 89.
[8] Новиков Л.А. Семантика русского языка. – М.: Высшая школа, 1982. – С. 83.
[9] Там же. – С. 84.

Лексическая семантика



Ономасиологические связи единиц и категории **Семасиологические связи единиц и категории**

Рисунок 1.

Разграничение семасиологии и ономасиологии как двух подходов к изучению лексико-семантической системы языка имеет важное методологическое значение не только для раскрытия природы и принципов организации языковых единиц в категории в зависимости от характера ее использования участниками коммуникации, но и для раскрытия характера основных лексических категорий, тяготеющих в своей основе то к семасиологической (моносемия, полисемия, омонимия), то к ономасиологической организации (синонимия, антонимия, конверсия; семантические поля) и к соответствующим видам их использования, реализации в языке. Вместе с тем семасиология и ономасиология неразрывны, неотделимы друг от друга как два аспекта и метода одной научной дисциплины – семантики. Эти разнонаправленные аспекты пронизывают все семантические единицы в направлении «план выражения» → «план содержания», и наоборот.

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Issue Article

Alevtina Grigoryevna Kozhevnikova
Tashkent State Agrarian University
Doctor of Biological Sciences,
Professor of the Department «Plant Protection and Quarantine»
gnadezhda03@gmail.com

INNOVATIVE STUDIES OF CICADAS (CICADIDAE) IN THE CONDITIONS OF UZBEKISTAN

Abstract: *The article presents the results of the study of cicada pests Chloropsalta ochreata (Mell.), Cicadatra querula (Pall.), Cicadatra alhageos (Kol.), Cicadatra hyaline (F) of the family Cicadidae in Uzbekistan, their morphological and biological features, systematic position, distribution, harmfulness, nutritional relationships, features of their diagnosis and their entomophages, modern control measures are recommended.*

Key words: *Pests, cicadas, species, species composition, family, Cicadidae, diagnostics, entomophages, harmfulness, significance, modern methods, control measures.*

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ИННОВАЦИОННЫЕ ИССЛЕДОВАНИЯ ЦИКАДИД (CICADIDAE) В УСЛОВИЯХ УЗБЕКИСТАНА

Аннотация: *В статье представлены результаты изучения вредителей цикад Chloropsalta ochreata (Mell.), Cicadatra querula (Pall.), Cicadatra alhageos (Kol.), Cicadatra hyaline (F) семейства Cicadidae в условиях Узбекистана, их морфологические и биологические особенности, систематическое положение, распространение, вредоносность, пищевые связи, особенности их диагностики и их энтомофаги, рекомендованы современные меры борьбы.*

Ключевые слова: *Вредители, цикады, вид, видовой состав, семейство, Cicadidae, диагностика, энтомофаги, вредоносность, значение, современные методы, меры борьбы.*

Введение

УДК:632.7.

Представители семейства Cicadidae давно привлекают внимание ученых. Это необычные по своим морфологическим, биоэкологическим и другим особенностям насекомые.

Цикадовые этого семейства исключительно растительноядные, по крайней мере, как нами обнаружено, в условиях Узбекистана. Многие виды полифаги, но имеются и олигофаги. Многочисленные в природе Узбекистана дикие растения, как правило, имеют специфические виды цикад.

Автор данной статьи наблюдая этих насекомых обращает внимание на то, что вредители из семейства Cicadidae высасывают питательные соки из хлопчатника, зернобобовых, овощных, бахчевых и других сельскохозяйственных культур.

Эти насекомые наносят повреждения растениям как обычные сосущие вредители и как переносчики фитопатогенных вирусов, кроме того, опасны еще тем, что наносят яйцекладом ранки на вегетативных частях растений в период яйцекладки.

Число выявленных видов, переносящие тяжелые вирусные заболевания с каждым годом увеличивается.

Некоторые виды этого семейства, являются специфическими переносчиками вирусных болезней растений [1].

Среди них имеются виды, повреждающие сельскохозяйственные культуры, декоративные насаждения, пастбищные и сенокосные угодья.

Однако давно известно, что борьба с вредными насекомыми эффективна лишь при точном знании и диагностике их видового состава, биологии, распространении, численности и т.п.

Без глубокого познания фауны и разработки систематики насекомых, как и других групп животного мира и растительности, невозможно решить дальнейшие проблемы охраны и рационального использования полезных форм, а также организации защиты растений [2].

Современная классификация насекомых это итог исследований многих поколений учёных, высказавших ряд важный идей или сделавших крупные обобщения [3].

Фауна цикадовых Средней Азии и сопредельных районов еще полностью не выявлена.

Работами А.Ф. Емельянова, И.Д. Митяева и их учеников много сделано в исследовании фауны цикадовых Казахстана. Но и из этого региона всё ещё продолжается описание новых для науки видов.

По данным И.Д. Митяева только в Южной части Казахстана найдено 703 вида цикадовых, относящихся к 214 родам и 12 семействам [4].

И.Д. Митяев сообщает, что по семействам они распределяются следующим образом: Dictyopharidae – 34, Derbidae – 2, Meenoplidae – 1, Cixiidae – 29, Delphacidae – 66, Issidae – 22, Flatidae – 1, Tettigometridae – 18, Cicadidae – 9, Aphrophoridae – 10, Memracidae – 2, Cicadellidae – 509 [5].

В Средней Азии ревизия фауны цикадовых еще не проведена, но по мнению Г.К. Дубовского здесь встречается около 1000 видов цикад [6].

В настоящее время в обеспечении высоких и устойчивых урожаев сельскохозяйственных культур, возрастает роль и значение защиты растений от вредителей [7].

Антропогенное воздействие и, в частности, бессистемное применение химических средств защиты растений против вредителей, привело к нарушению естественного баланса в биоценозах и определило тенденции массового размножения многих насекомых [8].

В связи с этим задачами исследований в области защиты растений, является разработка методов экспресс диагностики вредителей и их мониторинг [9].

Полное выявления вредной фауны культурных растений, детальное изучение их особенностей, вредоносности, облегчит разработку и совершенствование современных мероприятий по борьбе с ними.

С этой точки зрения изучение сосущих вредителей сельскохозяйственных культур семейства Cicadidae актуально.

В задачи наших исследований входило выявление и определение видового состава цикадовых, выявление наиболее вредоносных видов, изучение энтомофагов и рекомендация наиболее удобных для применения.

МЕТОДИКА И МАТЕРИАЛЫ ИССЛЕДОВАНИЙ:

Материалом для настоящей работы явились 10 летние исследования цикадовых в условиях Узбекистана. Использовались общепринятые в энтомологии и специальные методики.

РЕЗУЛЬТАТЫ ИССЛЕДОВАНИЙ:

Цикадовые относятся к насекомым отдела Hemimetabola, которые проходят в течение жизни три фазы развития: яйцо, личинка, имаго [10].

В отдельных естественно-исторических зонах возделывания культурных растений фауна цикадовых выявлена довольно полно.

В Ферганской долине Г.К. Дубовским найдено 342 вида, относящихся к 12 семействам.

В Северном Узбекистане согласно нашим сборам найдено 208 видов цикад, относящихся к 11 семействам.

Видовой состав цикадовых распределяется следующим образом: Cixiidae – 10, Delphacidae – 16, Derbidae – 1, Dictyopharidae – 7, Tropiduchidae – 1, Tettigometridae – 4, Issidae – 11, Cicadidae – 4, Cercopidae -7, Memracidae – 1, Cicadellidae – 147.

Замечено, что опасными являются виды из семейства Cicadidae, они более крупные, но и другие по размеру виды этого семейства тоже травмируют растения и создают ворота для проникновения инфекции.

Процесс определения цикад довольно сложен, цикад часто путают с другими насекомыми, принимая за других вредителей.

Определение мы проводим по особенностям строения генитального аппарата самца, так как по этому признаку отличаются многие роды и виды. Безусловно учитываются морфологические признаки, но строение генитального аппарата самца, согласно последним требованиям систематики, является решающим.

Цикады семейства Cicadidae сосущие вредители, ротовой аппарат у них колюще-сосущий и при его помощи они высасывают из сосудистых пучков корней, стеблей, побегов, почек, черешков и жилок листьев растений питательные соки. Много видов относятся к вредителям.

Они повреждают растения, нанося своим острым яйцекладом ранки в период размножения,

это очень характерно для крупных видов, обитающих в Узбекистане и имеющих размеры до 4-6 см, из семейства Cicadidae.

Цикл развития у представителей этого семейства в Узбекистане относительно длительный, у некоторых видов продолжается 4 года. Личинки этих видов долгое время живут в почве и имеют на её особенности прямое воздействие. Из-за особенностей личинок, скрыто жить в почве и высасывать растения, цикады плохо известны.

По нашим исследованиям в Узбекистане встречаются 4 вида: *Chloropsalta ochreata* (Mell.), *Cicadatra querula* (Pall.), *Cicadatra alhageos* (Kol.), *Cicadatra hyaline* (F).

Более вредоносным и распространенным видом, является *Cicadatra querula* (Pall.).

Этот вид особенно вредоносен в предгорьях, где наблюдается высокая численность.

При массовых размножениях вид *Cicadatra querula* (Pall.) может питаться на посевах хлопчатника и других сельскохозяйственных растений и повреждать их.

Безусловно, специалисты не допускают потерь, которые может наносить вредитель (10-12%) однако за *Cicadatra querula* (Pall.) контроль необходим.

Семейство Cicadidae Leach характеризуется тем, что включает в себя крупных и средних размеров цикад.

Виды из этого семейства имеют передние и задние крылья одинаковой консистенции, прозрачные и перепончатые. Бёдра передних ног вздутые с 2-3 зубцами снизу, задние ноги ходильные. У самцов в основании брюшка сильно развитый звуковой аппарат. Личинки с копательными передними ногами, живут под землёй несколько лет, сосут корни растений.

В Южном Узбекистане требуют внимания виды *Chloropsalta ochreata* (Mell.) и *Cicadatra querula* (Pall.), ареал распространения, которых довольно широк.

Вредоносные виды из семейства Cicadidae, изученные нами повреждают различные культуры, такие как плодовые, хлопчатник и другие. Наиболее опасно то, что взрослые особи питаются соками надземной части растения, а личинки, живут под землей, питаясь соками подземной части. Самки, при откладке яиц в верхнюю часть растения, надпиливают её и выше откладки яиц растение угнетается или высыхает.

Обнаружено, что вид *Cicadatra querula* (Pall.) для размещения яиц, при яйцекладке делает надрезы на стеблях длиной 4-5 мм, которые размочаливает и прикрывает. В надрезе образовываются две полости, в каждую из которых самка помещает 10-15 яиц, всего 25-30 шт. В цепочке надрезов, расположенных через 2 мм, бывает большое количество яиц *Cicadatra querula* (Pall.). Это наблюдалось в Южном Узбекистане.

Численности цикад можно определить по количеству выходных отверстий личинок в почве. В последние годы их насчитывалось нами в Южном Узбекистане от 10 до 15 шт. на 1 м^2.

Chloropsalta ochreata (Mell.) к юго-западу от Каршинской степи в большом количестве заселяла *Populus deversifolia*. Ранним утром, в период их активного движения, на одной ветке насчитывалось до 30 и более особей. Отмечалось повреждение кунжута, картофеля, дынь, виноградной лозы и шелковицы.

Для разведения энтомофагов в лабораторных условиях более перспективными энтомофагами являются паразитические виды из семейства Dryinidae, заражение которыми в природе Узбекистана варьирует от 16до18%.

В Узбекистане научные исследования в области изучения цикадовых продолжаются учениками известного цикадолога Г.К. Дубовского - Х.А. Сулаймановым, З.М. Муминовой, У. Расуловым, А.З. Закировым, Н.Н. Назаровым, Ш.И. Тураевой, Г.А. Пулатовой, Э.Г. Номозовым, Ш.С. Юсуповым и другими талантливыми научными исследователями.

ВЫВОДЫ:

В результате изучения цикадовых из семейства Cicadidae можно сделать вывод, что для культурных растениях в условиях Узбекистана, встречаются виды: *Chloropsalta ochreata* (Mell.), *Cicadatra querula* (Pall.), *Cicadatra alhageos* (Kol.), *Cicadatra hyaline* (F).

Для ведения успешной современной борьбы с вредными видами необходимо выявить видовой состав, определить наиболее опасные виды, изучить их особенности, определить перспективных хищников и паразитов, и рекомендовать для разведения.

Исследование вредителей из семейства Cicadidae в условиях Узбекистана показало, что их уничтожают хищные насекомые *Mantis religiosa, Nabis pallifer, Orius niger, Coccinella septempunctata*, виды рода *Chrisopa*.

Для разведения энтомофагов в лабораторных условиях более перспективными энтомофагами являются паразитические виды из семейства Dryinidae, заражение которыми в природе Узбекистана варьирует от 16до18%.

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Issue Article

Annaguly Rejepovich Deryaev
Scientific Research Institute of Natural Gas of the State Concern „Turkmengas”
Doctor of Technical Sciences, Principal researcher,
Corresponding Member of International Academy of Theoretical and Applied Sciences,
Ashgabat, Turkmenistan
annagulyderyayew@gmail.com

THE TECHNOLOGY OF DRILLING DEEP AND DIRECTIONAL WELLS WITH ELECTRIC DRILLS IN THE AREAS OF THE WESTERN PART OF TURKMENISTAN

Abstract*: The article discusses the technology of drilling deep vertical and directional wells with electric drills on the Goturdepe area. The analysis of geological and technical conditions of hole drilling, changes depending on the depth of reservoir temperatures and pressures, as well as the choice of well design and parameters of the operating mode of electric drills at depth intervals in order to successfully complete the projected wells with complex mining and geological conditions for drilling.*

To analyze the choice of technology for drilling deep vertical and directional wells with electric drills on the Goturdepe area, materials of previously operated wells, geological and operational characteristics of fields and the guidance document "Technology of drilling oil and gas wells", as well as safety rules in the oil and gas industry were used. This paper provides a detailed analysis of the complexity of drilling deep vertical and directional oil and gas wells and their specific causes, as well as recommendations for choosing the design of wells and parameters of the operating mode of electric drills for depth intervals.

Such work can be used to perform the assigned tasks when drilling oil and gas wells by electric drilling in fields with complex mining and geological characteristics.

Key words*: electric drill, telemetry system, curvature mechanism, formation, thickness, incision, strength, abrasiveness, power.*

Language*: English*

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Introduction

The technology is designed for drilling deep and directional wells with electric drills E290, E240, E215, E190 (E185), 164 bits in diameter, respectively, 490; 394; 295,3; 269,9; 144,5; 215,9; 190,5 mm with the use of gearboxes-inserts, curvature mechanisms, telemetry systems and layouts of the bottom hole assembly (BHA) with stabilizers, centralizers and calibrators.

The technology includes drilling of exploration, production and directional wells in compliance with the requirements, techniques and operations for their hole drilling and consists of the following main processes [1, 2]:

- drilling for a conductor;
- drilling for two intermediate columns;
-drilling for the production column, including the opening of productive horizons in the Koturdepinsky formation of the lower section of the red-colored strata;
-opening and sinking of the drained horizons of the Absheron-Akchagyl and Upper red-colored deposits.

Geological and technical conditions of the hole drilling.

a) Lithological and stratigraphic characteristics of the section being opened.

b) In the lower part of the Absheron tier there are two packs of high-grade colloidal soda clays “black clays” spread with siltstone lintel, with a total capacity of 150 to 250 m. Their Schreiner hardness does not exceed 100-300 MPa.

c) Up to the depth of the “black clays”, 75% of the section is composed of rocks whose strength exceeds 500 MPa according to Schreiner, and 25% have a strength of 800 MPa. The part of the section lying below the “black clays” is composed of rocks with a Schreiner hardness of 200-1500 MPa [3, 4].

d) The strength and abrasiveness of rocks correspond to the use of chisels of types M, MS, S at loads per unit length of the diameter of the bits from 2 to 10 kN / cm.

Changes in reservoir pressures and temperatures with depth:

a) Up to the roof of the “black clays” reservoir pressures are normal. Formation pressure gradients do not exceed 0.0115 MPa/m;

b) in the interval of occurrence of “black clays”, the gradients of pore pressures, according to geophysics, do not exceed 0.0115 – 0.014 MPa/m. At this stage of drilling operations, drilling fluids with a density of 1.45 – 1.50 g/cm^3 are used for opening and sinking these intervals [5, 6]. The stability of the borehole is not provided with a lower density of drilling mud.;

c) the pressure of reservoir fluids in sediments lying below the “black clays” is abnormally high, the gradients of reservoir pressures vary from 0.0120 - 0.0130 MPa/m to 0.2 – 0.23 MPa/m in the sole of the red–colored thickness in the roof of the underlying red-colored thickness of sediments [7, 8];

d) the main productive objects in the area (in the supracolor and upper red-colored deposits) are drained. Low gradients of reservoir pressures in them (0.006 MPa/m) cause complexity of the design and technological process [9, 10];

e) reservoir temperatures in wells up to 5000 m deep reach 110 C.

To the drained horizons of the Absheron-Akchagyl and Upper red–colored deposits, the temperature gradient is 0.031 - 0.021 S/m.

Well construction

Technical projects should provide for the following typical well designs:

a) for drilling exploration wells in the eastern section of the Goturdepe area: a conductor with a diameter of 426 mm, 1 intermediate column with a diameter of 324 mm, an intermediate column with a diameter of 245 mm, an operational column with a diameter of 140 x 168 mm -5200 m; - for drilling production wells in the eastern section of the Goturdepe area: a conductor with a diameter of 426 mm - 100 m - 600 m, 1 intermediate column with a diameter of 324 mm - 1500 m - 2500 m, II intermediate column with a diameter of 245 mm - 3500 m - 3900 m, an operational column with a diameter of 168 mm - 4250 m - 4400 m, direction with a diameter of 324 mm - 30 m, conductor with a diameter of 245 mm - 600 - 800 m, operational column 140 mm - 2700 m .wells with a depth of 2700 m in the eastern part of the area and 1700 m in the western part are drilled both vertically and obliquely directed [11, 12, 13].

b) For drilling production wells in the western section of the Goturdepe area: conductor with a diameter of 324 mm – 600-800m, intermediate column with a diameter of 245 mm - 2200-3200 m, production column with a diameter of 140 mm - 3200-3800 m, direction with a diameter of 426 mm - 30 m, conductor with a diameter of 299 mm - 60 m, "shank" with a diameter of 219 mm - 500- -1500 m, an operational column with a diameter of 140 mm -1700 m [14, 15].

Electric drill testing mode

To ensure the implementation of the established work program, it is necessary to install such a power supply mode for the electric drill motor, which would ensure its operation in the nominal mode, if there are no restrictions related to the strength of the gearbox insert. These restrictions are carried out by reducing the value of the supply voltage. It is also allowed to slightly reduce the voltage against the nominal voltage and in the case when an electric drill with a gear-insert provides a preset mode of operation of the bit at this reduced voltage, see Table 1.

The choice of voltage at the terminals of the secondary winding of the TMTE-560/6 transformer for powering the electric drills used, depending on the drilling depth, should be made in accordance with the table in which the no-load currents of the electric drill corresponding to these voltages and depths are also given [16, 17].

Table 1. Parameters of operation of electric drills by depth intervals

Drilling interval, m	Type of electric drill	Voltage on the transformer, V	Idle current, A	Inrush current, A
0		1700	80	277
1000	3290 – 12r (i =3,15)	1700	78	260
2000		1800	90	260
2800		2000	98	268
0		1500	78	312
1000	3240 – 8r (i =3)	1550	80	303
2000		1700	90	309
3000		1850	100	302
4000			98	274
below		2000	110	280
600		1350	65	279
1500	3215 – 8r (i = 3)	1500	76	283
100		1350	65	279
1000		1500	76	283
2000	3190 – 8r (i =2,92)	1750	95	274
3000		1850	103	264
4000		1950	112	257
1300		1200	61	180
1700	3164 – 8r (i =2,92)	1200	61	180

Layout of the bottom hole assembly (BHA)

a) The layout of the BHA includes: a bit, a super-drill centralizer, a calibrator, an electric drill with an insert, a centralizer, a device for controlling the trajectory of wells, a telemetry system of the STE, a device for monitoring the insulation of the electric drill system-a current supply of the UKI type (UKIO), weighted drill collar (DC), drill pipes, a check valve, a leading pipe, pantographs, swivel. In all elements of the layout from the electric drill to the current collector, cable sections of the current supply of the electric drill are mounted. Wells with a depth of 1,700 m in the eastern part of the area and 4,100 in the western part are drilled both vertically and obliquely [18].

b) the role of centralizers when drilling with electric drills with a diameter of 215 mm, 240 mm and 290 mm is performed by 3 blades welded to the body of the electric drill. The blade has a length of 300 m and a width of 60 mm. The first three blades are welded to the body of the electric drill in its lower part (on the spindle), and the second - in the upper part at a distance of 10 m from the first "centralizer". The third centralizer is installed at a distance of 10-12 m from the device for monitoring the insulation;

c) the diameters of the blade centralizers are designed to be 3-5 m smaller than the diameter of the bit used for drilling and are equal to 485, 390, 292 mm for bits with a diameter of 490; 393.7; 295.3 mm, respectively;

d) for electric drills with diameters of 164, 190 mm (185 mm) (when drilling with bits with diameters of 190.5 and 215.9 mm), the centralizers are not welded. When drilling wells with these electric drills 1, the centralizer (calibrator) is installed on the shaft of the electric drill under the gearbox insert at a distance of 1.5-2.0 m from the bit. A smaller distance is accepted for the electric drill E-164, a larger one - for the electric drill E190-8r.

e) the following BHA are recommended [19, 20]:

- a bit Ø 190.5 mm + an electric drill Ø 164 mm with a centralizer on a spindle Ø 189 mm + a centralizer Ø 189 mm + a device for monitoring the insulation + a DC Ø 146 mm - 10-12 mm + a centralizer Ø 189 mm + a DC Ø 146 mm (by calculation) + drill pipes Ø 127 mm.

- a bit Ø 215.9 mm + an electric drill a bit Ø 190 mm (185 mm) with a centralizer a bit Ø 214.3 mm on a spindle at a distance of 1.5-2.0 m from the bit + a centralizer a bit Ø 214.3 + a device for monitoring the insulation + DC Ø 146 mm - 10-12 m + a centralizer Ø 214.3 mm + DC Ø 146 mm (by calculation) + drill pipes Ø 127 mm.

f) when drilling wells with electric drills, drill pipes inside the ends steel drill pipes with a diameter

of 114, 127, 140 mm with cable sections of the type: KST-1; KST-1-T; KST-11 are used.

g) as a weighted bottom, a DC with a diameter of 146-254 mm of design length with cable sections KST P or KST – 1 is provided [21, 22].

h) in order to control the insulation resistance of the "Electric Drill-current supply" system, an insulation monitoring device of the UKI type (UKIO) must be included in the drill string layout.

f) the set of curvature and stabilization of the angle of the directional section of the borehole is carried out using the telemetry systems STE-164 and STE-215:

- when drilling a section of a set of curvature, a BHA is used - a bit + an electric drill with mechanism of curvature (MC) + STE + DC Ø 146 (178 mm) - by calculation and drill pipes [23, 24];

-if an additional set of zenith angle is required, the centralizer is installed above the chisel, and when the zenith angle is reduced, the centralizers are installed above the electric drill;

i) the recommended parameters of the hole profile of directional wells on the Goturdepe area are given in Table 2.

Table 2. Recommended parameters of the borehole profile of directional wells on the Goturdepe area

Parameters of the borehole profile	The western section of the square	The eastern section of the square
The length of the vertical section, m	900	1000
Curvature set interval, m	900 – 975	1000 – 1070
Zenith angle of curvature, deg	26	11
Radius of curvature in the interval of zenith angle set, m	380 – 400	380 – 400
Horizontal deviation of the borehole	400	335

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Issue Article

Annaguly Rejepovich Deryaev
Scientific Research Institute of Natural Gas of the State Concern „Turkmengas”
Doctor of Technical Sciences, Principal researcher,
Corresponding Member of International Academy of Theoretical and Applied Sciences,
Ashgabat, Turkmenistan
annagulyderyayew@gmail.com

THE EFFECTIVENESS OF THE USE OF ELECTRIC DRILLING AND THE CHARACTERISTICS OF THEIR EQUIPMENT COMPONENTS

Abstract: *The article considers the analysis of the selection and recommendations, as well as instructions on the effectiveness of the use of the method of electric drilling and their components during the construction of wells in the Western part of the oil and gas fields of Turkmenistan to accelerate the commercial rate of penetration and reduce the time for mechanical drilling. To analyze the determination of the effectiveness of the use of electric drilling and the selection of their component equipment, materials from previously drilled wells were used and the possibility of drilling wells with electric drilling based on information received from the bottom of the well in real time was considered.*

This paper provides a detailed analysis of the efficiency of drilling by electric drilling of deep directional oil and gas wells and monitoring their trajectory in real time, and also provides recommendations and operating instructions for various types of electric drills, as well as their accessories.

This work can be used to perform the assigned tasks when drilling oil and gas wells and for accelerated field development.

Key words: *power, amperage, gear insertion, inclinometry, efficiency, curvature mechanism, bit, penetration, current supply, welding, transformer, voltage.*

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Introduction

The efficiency of the hole drilling technology with the use of electric drills and mass-produced technical means is determined by:

Using gearboxes-inserts with different gear ratios, which allow drilling at optimal conditions using bits with a sealed oil-filled support, which leads to a significant increase in penetration per bit.

Using a telemetry system, which reduces the time spent on orienting the tool and increases the accuracy of the well drilling.

The use of a telemetry system allows you not to limit the amount of axial load on the bit, which contributes to an increase in penetration on the flight when working with curvature mechanisms.

At the same time, the time spent on inclinometric work is also reduced. [1, 2]

The ability to control using the energy parameters of the electric drill (power, current) for the operation of the bits, which contributes to the fullest use of their resource.

The moment characteristic of electric drills with gearboxes-inserts, which allows using the values of specific axial loads exceeding the strength limit by drilling rocks.

Using washing liquids with various additives that increase the efficiency of the drilling process [3, 4].

Low pressure drop on the engine, which allows you to realize a large hydraulic power in the hydraulic nozzles.

The possibility of using elements of the bottom of the drill string of various types, which helps to increase the durability of the bit, eliminates the need to expand and study the bottom-hole zone and improves the quality of the wellbore [5, 6].

Electric drill equipment

When drilling with the use of electric drills, standard drilling rigs (without automatic descent ascent) are additionally equipped with a complex of submersible and ground equipment made in the form of separate prefixes to the main equipment used in turbine and rotary drilling.

The ground equipment includes special power transformers for drilling with the use of TMTE 630/6 electric drills, stations and control panels for electric drills (UZEB-80 complex device), a current collector, as well as devices for caring for the electric drill and current supply.

Along with electric drills, gearboxes-inserts to the electric drill, prefixes for core sampling, check valves, insulation monitoring devices, mechanisms for stabilizing the direction of the hole, pipe logging probes and telemetry systems belong to the service complex. The use of telemetry systems makes it possible to conduct the process of drilling wells on the basis of continuous downhole information received in real time [7, 8].

The electric drill is powered by a special current supply mounted inside the drill pipes. Electricity is transmitted through the two wires-a pipe system.

For the installation of the current supply, measuring drill pipes equipped with locks are used.

Operating mode of electric drills

The correct choice of the operating mode of the electric drill has a significant impact on its service life and the efficiency of the bit. The operating mode of electric drills is selected based on the conditions for ensuring rational operation of the bits, while also taking into account the operating conditions of electric drills, which, if possible, should not differ significantly from the nominal parameters of the electric motor [9, 10].

Operating instructions

1.When setting up overload protection and charging the electric drill, the current setpoint should be calculated for a long-term permissible current value of 140A.

2.When setting up short-circuit protection, the calculation of the current rate should be carried out according to the values of the starting currents given in Table 1 by taking into account the depth of the face and the gear ratio.

3.The installation of the required voltage value on the TMTB-630 drilling transformer should be carried out taking into account the depth of the face and the gear ratio of the gearbox.

4.The correctness of the value of the set voltage should be monitored by the value of the idling current of the electric drill motor in the downhole zone. If the no-load current is underestimated in comparison with the above, the voltage on the drilling transformer should be increased, if it is increased, the voltage on the drilling transformer should be reduced [11, 12].

Technical data of the equipment used in drilling wells using electric drills

The electric drill is a submersible downhole unit designed to rotate the bit when drilling wells. It consists of an asynchronous three-phase oil-filled motor with a short-circuited rotor and an oil-filled spindle. Between the motor and the spindle, in case of technological necessity, insertion reducers IR (single or double), curvature mechanisms MC or SE stabilizers are installed to maintain a given direction of the wellbore trajectory.

The connection of the electric motor and the spindle and the mechanisms mounted between them (IR, MC, SE) is carried out by means of body threads, and their shafts by means of a toothed coupling and a hinged sleeve with rubber rings. The shaft of the electric drill is full, through the hole of which a washing agent is supplied to clean the well bottom.

In the upper part of the electric drill there is a translator with a neck for grabbing an elevator, ending with a lock nipple for connection to drill pipes. In the nipple of the translator there is a contact rod of the cable entry.

The cavity of the electric motor is filled with transformer oil (TKP) or aviation oil of the MS-20 brand (MK-22) with electrical strength (50 Hz purity and 20 C temperature (not lower): kW. The pressure in the cavity of the electric motor must exceed the external pressure by a value of 0.294- 0.049 MPa (3.0-0.5 kgf / cm^2).

The electric drill spindle is used to transfer the axial load created by part of the weight of the drill string through the body of the electric drill to the bit, bypassing the rotor of the electric motor, as well as to transfer torque from the electric motor to the bit [13, 14]. The spindle cavity is filled with MS-20 (MK-22) aviation oil. The pressure in the spindle cavity must exceed the external pressure by a value of 0.294-0.049 MPA (3.0-0.5 kgf/cm^3).

The oil pressure in the cavity of the electric drill must be monitored using a pressure gauge and by the amount of compression of the compensator spring.

The body of the electric drill must be grounded by connecting to a circuit whose grounding should not exceed 0.66 ohms.

Electric drill current supply

The current supply is used to transmit electricity and electric drill using a string of drill pipes.

The current supply consists of separate cable sections mounted in drill pipes used as an electrical wire for the "two wires - pipe" power supply system.

The current supply is designed to transmit electricity at a frequency of 50 Hz with a voltage of up to 3000V, a current of 165 A with a short-term increase (within 3 seconds) to 400A.

Cable sections can be operated at hydraulic pressure up to 115 MPa (1150 kGf/cm^2) and ambient temperature up to 100 C.

The cable section KST1 consists of a segment of a two-core hose cable of type 4 KTSHE 2x50 or two segments of a single-core circular cable of type KTSHE 1x50, a two-pin rod, a two-pin coupling to the ends with a support for fastening in a drill lock [15, 16].

Decoding of the designation: C-cable, S-section, T-current supply, 1-modification number.

KST1 cable sections are used in a set with drill pipes (B127) and H140.

Drill pipes with planted inner ends B127x10 are made of the same length 12000 + 50 mm.

Drill pipes H 140x10 are made of two lengths: 11950 + 50 mm and 12050 + 50 mm.

On the pipes with a length of 12050, one identification belt is applied with red paint, on the pipes with a length of 11950 mm - two belts.

Drill locks of type ZE1-155 are used for pipes B127 and D167, 129, and locks of type ZE1-185 are used for pipes H140.

A power transformer for an electric drill.

The three-winding power transformer TMTB-630/6 with a capacity of 630 kW, 155 A, 600/1100 - 2300/525 V serves to power the electric drill and the winch motor.

The middle winding (MW) has 25 steps of 50 V to regulate the voltage during drilling.

Voltage regulation of the power supply windings of the electric cord (CH) in the range from 1100 to 2300 V is carried out in 25 steps of 50 V at each stage.

If it is necessary to expand the limits of voltage regulation, counter or consonant activation of the MW and low winding (LW) is possible. In this case:

- with a consonant switch-on, 910 V is added to the voltage of the MW winding:

- with a counter switch - 910 V is deducted . The presence of an additional 115 and 230 V winding at the "B" phase in the case of phase misalignment makes it possible to compensate for voltage asymmetry in the "current supply-electric drill" system [17, 18].

Complete UZEB-80 U2 Device (UZEE-65MU2)

The complete UZEB80 U2 device is designed to control and protect all types of electric drills used in drilling oil and gas wells.

According to its technical level, the complete device UZEB-80U2 has operational advantages compared to the complete device UZEB-65 G1U2.

Elements of increased reliability have been introduced into the UZEB-80. Instead of relay contactor elements, the protection system is made on integrated circuits of increased reliability. The use of a block design of the control and protection device reduces downtime on drilling rigs during installation, commissioning and repair, does not require special commissioning equipment and qualified adjusters.

Reducer-insert (RI)

Reducer inserts are designed to reduce the rotation speed of the rock-crushing tool and increase the torque of the electric drill. They are installed between the motor and the spindle of the electric drill. Technical data and characteristics of planetary oil-filled gear inserts are given in Table 2.

The electric drill can use two sequentially connected gearboxes with different gear ratios, which provides a wide range of fixed bit rotation speeds.

The efficiency of planetary gearboxes is 0.90-0.94.

To limit the maximum torque of the electric drill when using gearboxes, the rated voltage of the electric motor must be lowered.

Mechanisms of curvature (MC)

The curvature mechanisms are designed to force the curvature of the wellbore trajectory, cutting new holes and combating the curvature of the well. They are made in diameters corresponding to a number of electric drills in 1; 1.5; and 2-degree versions and are installed between the motor and the spindle of the electric drill, when using gearboxes-inserts - between the gear spindle.

Electric drill current collector (TE)

The current collector is designed to transfer electricity from a stationary system - a current supply cable to a rotating system -a current supply in drill pipes, as well as the transition from a three-phase system to a “the two wires-a pipe” system by grounding the lower contact ring. Connection of the current collector to the supply line is carried out by a three-core cable of the KTHSE 3 x 50. The current collector is mounted directly under the swivel. Its body is protected from turning by two special tubes attached to the swivel and pantograph housings. In order to avoid chafing of the insulation hose shell, the cable is attached at the two extreme points so that it does not touch the mortar hose [19, 20].

Core sampling device

Core sampling during electric drilling is carried out using a special device SK-164/80. This device is a modified design of the core collector SK-164/80 ED in relation to the electric drill (the connecting adapters have been changed and the valve has been installed). The core collector is manufactured in a single-section design.

By screwing an additional section of the housing and the core intake pipe, it can be assembled in a 2-3 section design. Depending on the design, it has a core intake pipe length of 8200, 16400 and 24600 mm, respectively.

Devices and devices for the care of electric drill and current supply

A complex of special devices and devices is used for the maintenance and maintenance of electric drills and current lines, including:

-a device for measuring and pumping oil into the engine, spindle and gearbox-an electric drill insert. It is a tee, one process of which is screwed into the valve of the motor or spindle by means of an M10xl thread, and a pressure gauge for measuring oil pressure and a hose from a hand pump are connected to two others;

-tanks with a manual pump and electric heating for pumping transformer oil into the electric drill engine and oil MS-20 into the spindle and gearbox insert;

-a device for heating and filtering castor oil, which is powered through a separation transformer at a voltage of 220 V;

-ring brushes and brush brushes for cleaning and lubrication of contact (rods and couplings) connections of the current supply;

-pressure gauges for measuring the insulation resistances of the current supply.

Setbacks, racks for laying drill pipes

Drill pipes are installed on the setback with locking couplings down. The design of the setback provides for the possibility of installing HI40 drill pipes with locking couplings having an outer diameter of 185 mm. To install drill pipes B127 with locks with a diameter of 155 mm, special guide strips must be mounted on the base of the candlestick. The device of the setback should provide the possibility of flushing the contact muff sections in the drill pipes with special devices [21, 22].

Racks for laying drill pipes should have horizontal sections along the length of the pipe And be located so as to make it convenient to replace damaged cable sections in drill pipes, for which it is necessary to provide an approach to the pipes from both ends. Pipes on the walkway are laid with a lock nipple to the drilling rig.

Check valve ball type (CHVB)

The ball check valve is installed in a string of drill pipes with a current supply and is designed to prevent the reverse movement of the flushing fluid during the build-up, descent and lifting operations and blowout.

When using gearboxes-inserts, restrictions are introduced related to their strength, which is carried out by reducing the value of the supply voltage.

The choice of the voltage value at the terminals of the secondary winding of the TMTB-630/6 transformer for powering the electric drills used depending on the drilling depth is made in accordance with which the values of the idle current of the electric drill corresponding to these voltages and the of the magnitude of the no-load current of the electric drill [23, 24].

According to the correspondence of the actual values of the no-load current indicated in Tables 1 and 2, the correctness of the voltage selection is judged.

Selection of the drilling transformer voltage during operation of the electric drill E 240-12 V 5 (140 kW,1450 V,135 A,450 rpm, efficiency = 65, 57., Co =0.63)

Table 1. Selection of the power current, idling during operation of electric drills

Drilling depth, m	Without reducer		
	Electric drill data		
	Transformer voltage, V	Inrush current , A	Idle current, A
0	1550	315	113
1000	1700	315	125
3000	1800	280	130
4000	1800	252	125
5000	2000	257	148

Table 2. Selection of the power current, voltage idling during operation of electric drills

Drilling depth, m	Without reducer			Gear ratio		
	Electric drill data			I=1,75		
	Voltage V	Inrush current, A	Idle current, A	Voltage V	Inrush current, A	Idle current, A
0	1350	310	95	1300	309	95
1000	1550	314	137	1350	287	105
2000	1550	286	135	1500	290	115

3000	1550	256	133	1550	297	126
4000	1700	254	138	1700	254	138
5000	1880	249	147	1800	249	147

Continuation of table 2.

Drilling depth, m	Gear ratio					
	I=3			I=10		
	Voltage V	Inrush current, A	Idle current, A	Voltage V	Inrush current, A	Idle current, A
0	990	240,9	89	600	139,7	34
1000	1090	240,3	98	650	134,5	39
2000	1200	234,6	107	700	129,5	43
3000	1300	226,4	119	750	126,4	45
4000	1400	221,3	128	800	121,6	49
5000	1500	216,2	139	850	118,5	57

The choice of the drilling transformer voltage during operation of the electric drill E190-8MB5 with gearboxes having different gear ratios is shown in Table 2.

The choice of the transformer voltage of the drilling transformer during operation of the electric drill E190-8M2-B5 (106 kW 1140 V, 121A, 660 rpm, efficiency-69.5 Cos = 0.64) without a reducer and with reduceres having different gear ratios is shown in Table 3.

Table 3. Selection of the transformer of electric drills

Drilling depth, m	Without reducer and with reduceres with gear ratio I=2, I=3			With reducer I=10 Electric drill data		
	Electric drill data			I=1,75		
	Voltage V	Inrush current, A	Idle current, A	Voltage V	Inrush current, A	Idle current, A
0	1250	374	102	1100	310	80
1000	1350	348	115	1100	304	75
2000	1450	344	118	1200	292	79
3000	1550	338	121	1350	290	97
4000	1650	332	124	1500	287	115
5000	1750	317	150	1600	277	125
6000	1850	305	165	1700	267	133

The choice of the drilling transformer voltage during operation of the electric drill E164-8MV5 (71 kW 1000 V, 73A without gearboxes and with gearboxes having different gear ratios and overall, installation dimensions and weight of electric drills is shown in Tables 4 and 5.

Table 4. Selection of the drilling transformer voltage when operating an electric drill without reducer and with reduceres having different gear ratios and overall dimensions

Drilling depth, m	Gear ratio					
	I=3			I=10		
	Voltage V	Inrush current, A	Idle current, A	Voltage V	Inrush current, A	Idle current, A
0	300	60	640	174	21,2	
1000	1100	263	58	740	170	25,3
2000	1100	227	55	840	167	29,1
3000	1200	217	62,1	940	161	32,5

4000	1300	212	69,7	990	151	36,4
5000	1400	202	78,2	1040	143	42,0
6000	1500	198	89,5	1150	141	49,2

Table 5. Selection of the drilling transformer voltage when operating an electric drill without reducer and with reduceres having different gear ratios and overall dimensions

Name of the parameter	The norm for an electric drill type			
	E164-8-V5	E190-8-V5	E240-8M-V 5	Э290-12АМ-В5
Diameter of the electric cord, mm	164	190	240	290
Length of the electric drill, mm	11700	12900	13600	12600
Thread A on the upper adapter	З-133	З-147	З-171	З-189
Thread B on the adapter for the chisel	З-117	З-117	З-152	З-177
Weight of the electric drill, kg, 5%	1500	2200	3600	4500

Characteristics of the TM-630/6 transformer, technical data of planetary reducer–inserts, types of single and double curvature mechanisms are shown in Tables 6, 7.

The standard sizes of the bending mechanisms used and their technical characteristics are given in the tables 8, 9.

Table 6. Characteristics of the TM-630/6 transformer

Name of parameters	**Norms**
Rated power, kVA	630
Rated voltage of the high voltage winding, V	6000
Rated voltage, V	1100-2300
Rated voltage of the low voltage winding, V	525
Diagram in the winding connection group	/ /-0-11
The rated current of the high voltage winding, A	60,7
The rated current of the medium voltage winding, A	155
The rated current of the low voltage winding, A	630
The voltage regulation limits of the medium voltage windings and the number of steps	50 to 25 steps
Additional windings for balancing electric drill currents	115 and 230V
Overall dimensions in mm, (height, length, width)	2735x2635x12
Transformer weight, kg	5500

Table 7. Technical data of planetary (RI) reducer –inserts

Type of reducer	Gear ratio	Output shaft rotation frequency		Nominal moment	Maximum kN (ts)
		0,017s-1	rpm		
RI 164 – 3MV5	3	3,74	220	-	-
RI 164 - 10 MV 5	10	1,19	70	4000 (400)	250 (25)
RI 185 – 2 MV 5	2	6,12	360	3600 (360)	250 (25)
RI 185 – 3 MV 5	3	4,08	240	5400 (540)	300 (30)
RI 185 – 10V5	10	1,19	70	5400 (540)	300 (30)
RI 190 – 10V5	10	1,27	75	4500 (450)	300 (30)
RI 125 – 3 MV 5	3	3,74	220	7500 (750)	350 (35)
RI 240 – 2 MV 5	2	5,85	345	5900 (590)	350 (35)

RI 240 – 3 MV 5	3	4,25	250	8850 (885)	400 (40)
RI 290 – 2V5	2	3,825	225	1000 (100)	400 (40)
RI 290 – 3 MV 5	3	2,55	150	1157 (116)	400 (40)

Table 8. Single curvature mechanisms

Designation	Angle of curvature, degrees
MI 164 – 185	1
MI 164 – 1, 5V5	1,5
MI 185 – 1 V 5	1
MI 185 – 1, 5 V 5	1,5
MI 215 – 1 V 5	1
MI 215 -1,5 V 5	1,5
MI 215 – 2 V 5	2
MI 240 – 1 V 5	1
MI 240 – 1,5 V 5	1,5
MI 240 – 2 V 5	2

Table 9. Double curvature mechanisms

Designation	Angle of curvature, degrees
MI 164 – 1 – 1V5	1
MI 164 – 1 - 1, 55V5	1,5
MI 164 – 1 - 2V5	2
MI 185 – 1 - 1V5	1
MI 185 – 1 – 1,5V5	1,5
MI 185 -1 - 2V5	2
MI 215 – 1 - 1V5	1
MI 215 – 1 – 1,5V5	1,5
MI 215 – 1 - 2V5	2
MI 240 – 1 - 1V5	1
MI 240 – 1 -1,5V5	1,5
MI 240 – 1 – 2V5	2

To work with a two-wire current supply without an upper grounding adapter, a current collector TE-2MV5 is used. The third phase is grounded directly in the current collector.

A current collector of the TE-ZMV5 type is used to work with a two-wire current line with an upper grounding adapter, see Table 10

Decoding: T-current collector; E - electric drill; 2 or 3-number of cable entry contacts; M-modification; B-climatic version; 5 - placement category.

The connection of the drill pipe column to the phase must be carried out in the pantograph by attaching its ring marked "B" to the shaft of the pantograph with two copper conductors with a cross section of 35 mm^2 each.

Table 10. Parameters of the current collector TE-2V5

Name of parameters	Norms
Voltage between the rings, V	2500
Current. A	200
The current is maximum, short-term, And	600
The maximum pressure of the washing liquid, kgf / cm^2	350
Shaft rotation speed (maximum), rpm	200

The weight of the tool held by the pantograph, t	300
Resource before write-off, h	1000
Time to failure, h	200
Weight, kg	450

Device for monitoring the isolation and position of the DMIO type diverter.

The DMIO is designed to monitor the insulation resistance of the current supply and the winding of the electric drill when it is powered according to the " two wires-a pipe " scheme, as well as to measure the angle of the deflector position and the zenith angle of the well during drilling.

The structure of the DMIO includes a deep device and a ground device. A device without a unit is used only for insulation control.

DMIO are used with diameters of 127, 164 and 215 mm. Moreover, DMIO 164mm can be used to work with an electric drill with a diameter of 185 (190 mm), and DMIO 215 mm for working with an electric drill 240 mm. The parameters of the DMIO 164 mm and 215 mm are shown in Table 11.

Table 11. DMIO parameters are 164 mm and 215 mm

Name of parameters	Norms
Operating current at a temperature of not more than 90 C, A.	from 50 to 200
The circulating fluids	from 0 to 360 from 0 to 120
DMIO 164 UZ DMIO 215 UZ	
Measurement limits:	
- angle of installation of the deflector, degree	
- zenith angle, degree	

The electrical circuit for switching on the telemetry system is given for the communication channel is the current supply of the electric drill.

With the help of telesystems, zenith angles up to 55 degrees, the azimuth of the system and the angle of installation of the deflector in the range from 0 to 360 degrees are measured. The relative infallibility of the measurement is no more than 2.5 degrees.

Telesystems are available in diameters of 164, 185 and 215mm, their data are given in Tables 12, 13.

The technical characteristics of the check ball valves are given in table 14.

Table 12. Technical data of STE with a diameter of 164, 185 and 215 mm

Type	Thread	D, mm	Z, mm	L, mm	Weight, kN
STE -164	3-133	164	10020	9520	900
STE -185	3-147	185	10545	10045	800
STE -215	3-171	215	9942	9512	1300

Table №13. Technical data of the STE with a diameter of 164, 185 (190) and 215 mm

Name of parameters	Norms
Measurement limits: - zenith angle of the well, degree from 0 to 55 (from 0-110) from - azimuth (magnetic) boreholes, degree 0 to 360 from 0 to 360 - angle of installation of the deflector, degree Measurement error: - zenith angle of the well, no more - azimuth (magnetic) of the well, no more Angle of installation of the diverter, no more	 from 0 to 55 (from 0-110) from 0 to 360 from 0 to 360 2,5 2,5 2,5 2,5 – 2,5

Table 14. Technical data of CHVB

Name of parameters	Norms	
	CHVB 114-B5	**CHVB 140-B5**
Outer diameter of the body	155	185
Valve ,mm	2020	2020
Length, mm	25	40
Maximum axial load, ts	150	150
Maximum pressure drop, kgf/cm^2	5	5
Maximum closing pressure, kgf/cm^2	180+20	221+20

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Issue Article

O'ktam Bazarbayevich Palvanov
International Islamic Academy of Uzbekistan
Ph.D. Lecturer,
davr0101@mail.ru

FAMILY STABILITY IN ISLAM

Abstract: *Common sense recognizes that the family is the basis of all societies. The development and progress of every society depends on its foundation - the family. For this reason, special attention is paid to family issues in Islam. In Islam, marriage is a life-long contract between a man and a woman, based on certain norms and conditions, to build a family and leave offspring. After all, the strength and stability of the family depend on the compatibility of the husband and wife. Therefore, in Shari'a, a man and a woman are ordered to study each other's genealogy, profession, and similar aspects before starting a family. Also, certain responsibilities are assigned to the married couple and it is impossible not to fulfill them.*

Key words: *rukn, shart, sunnat, mustahab, kufu', monastic and solitude life, family, Qur'an, hadith.*

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Introduction

A healthy mind can understand that the foundation of every society is the family. Accordingly, the well-being of the family is also of great importance in the development of society. Special attention is paid to this topic in Islam. In Islam, marriage is a life-long contract between a man and a woman, based on certain norms and conditions, to build a family and leave offspring, in the name of Allah, the Sunnah of Muhammad (PBUH), and the testimony of a large number of Muslim people. Therefore, certain responsibilities are assigned to the husband and wife, and it is impossible to avoid them.

According to the Sharia, illegal cohabitation without marriage is adultery, which is one of the major sins warned about the severity of punishment in the Qur'an and hadiths on the one hand, and on the other hand, a child born out of wedlock is labeled as "bastard" for life. Both social and humanities and natural sciences indicate that the historical epistemology of the family goes back to the time of the emergence of mankind and that the family is formed between a man and a woman. After all, this is also mentioned in the sources of Islam. In particular, it is blessed in the Holy Qur'an as follows:

وَاللَّهُ جَعَلَ لَكُمْ مِنْ أَنْفُسِكُمْ أَزْوَاجًا وَجَعَلَ لَكُمْ مِنْ أَزْوَاجِكُمْ بَنِينَ وَحَفَدَةً وَرَزَقَكُمْ مِنَ الطَّيِّبَاتِ أَفَبِالْبَاطِلِ يُؤْمِنُونَ وَبِنِعْمَةِ اللَّهِ هُمْ يَكْفُرُونَ.

God has given you mates from among yourselves; and has produced for you, from your mates, children, and grandchildren *[1:274].*

Islam has turned mankind away from a monastic and solitude life. Accordingly, it is a sin to go alone without starting a family. In a hadith narrated from Abū Ayyūb al-Anṣārī, it is blessed as follows:

أَبِي أَيُّوبَ قَالَ: قَالَ رَسُولُ اللَّهِ صلى الله عليه وسلم: أَرْبَعٌ مِنْ سُنَنِ المُرْسَلِينَ: الحَيَاءُ، وَالتَّعَطُّرُ، وَالسِّوَاكُ، وَالنِّكَاحُ.

The Messenger of Allah said: "Four are from the Sunan of the Messengers: modesty, using Atar, the Siwak, and marriage". [3:291]

Therefore, all the prophets were ordered to convey to people the need to build a family. Also, this situation is emphasized in the hadith narrated by Tawus ibn Kaysan (r.h.):

رسول الله صلى الله عليه وسلم أنه قال: لا رهبانية في الإسلام.

Rasulullah (PBUH) said: "There is no monastic life in Islam".

All people in the world, especially every girl or every woman, have the right to be happy, and this is fulfilled by starting a family. Therefore, they can search for their happiness, choose and search for a more suitable spouse, and lifelong companion. In this good faith, they have the right to know and inquire about someone's character, ancestry, etc. The mutual worthiness of the husband and wife is also important

for the stability of the family. In particular, in the hadith narrated from Aisha (r.a.), these two aspects are emphasized:

عَنْ عَائِشَةَ قَالَتْ قَالَ رَسُولُ اللَّهِ صلى الله عليه وسلم: تَخَيَّرُوا لِنُطَفِكُمْ وَانْكِحُوا الأَكْفَاءَ وَأَنْكِحُوا إِلَيْهِمْ.

Messenger of Allah said: "Choose (women) for your offspring, and marry compatible women and marry (your daughters) to worthy (men)". [4:296-297]

Love and kindness are considered among the highest human emotions. In a family, there is love and affection between husband and wife. In addition, in Islam, it is emphasized that the husband should be kind to his wife. After all, these two situations are important factors in ensuring family strength. It is blessed in the Qur'an as follows:

وَمِنْ آيَاتِهِ أَنْ خَلَقَ لَكُمْ مِنْ أَنْفُسِكُمْ أَزْوَاجًا لِتَسْكُنُوا إِلَيْهَا وَجَعَلَ بَيْنَكُمْ مَوَدَّةً وَرَحْمَةً إِنَّ فِي ذَلِكَ لَآيَاتٍ لِقَوْمٍ يَتَفَكَّرُونَ.

And of His signs is that He created for you mates from among yourselves, so that you may find tranquility in them, and He planted love and compassion between you. In this are signs for people who reflect *(Surah al-Rum, 21 ayah).*

Also, in a hadith narrated from Abdullah bin Abbas (r.a.), it is stated as follows:

عَنِ ابْنِ عَبَّاسٍ قَالَ قَالَ رَسُولُ اللَّهِ صلى الله عليه وسلم: لَمْ نَرَ لِلْمُتَحَابَّيْنِ مِثْلَ النِّكَاحِ.

The Messenger of Allah said: "We have not seen anything better than marriage for two people (man and woman) who love each other!".

Reference : Sunan Ibn Majah 1847

In-book reference : Book 9, Hadith 3

English translation : Vol. 3, Book 9, Hadith 1847

All matters related to family relations are defined separately in the Shari'ah. After all, they have a direct impact on ensuring the well-being of the family. That is why these aspects have been paid attention to in Islam. Neglecting those obligations, avoiding their fulfillment, and leaving the family to fend for themselves are actions contrary to the Shari'ah. This means sin. For example, in the hadith narrated by Aisha (r.a.), these situations are also emphasized:

عَنْ عُرْوَةَ قال: دخَلَتِ امرأةُ عُثمانَ بنِ مَظْعُونٍ واسمُها خَوْلةُ بنتُ حكيمٍ علي عائشةَ وهي بَذَّةُ الهيئةِ فسألَتْها عائشةُ: ما شأنُكِ؟ فقالت: زَوْجي يقومُ اللَّيلَ ويصومُ النَّهارَ فدخَل النَّبيُّ ﷺ فذكَرَتْ عائشةُ ذلكَ له فلقي النَّبيُّ ﷺ عُثمانَ بنَ مَظعونٍ فقال: يا عُثمانُ إنَّ الرَّهبانيَّةَ لَمْ تُكتَبْ علينا أما لكَ فيَّ أسوةٌ حَسَنةٌ ! فواللهِ إنِّي لَأخشاكم للهِ وأحفَظُكم لِحدودِه.

The wife of Othman bin Mazun, whose name is Khawla bint Hakim, entered upon Aisha. She was beautiful, so Aisha asked her: What is the matter with you? She said: My husband prays at night and fasts during the day. So, the Prophet (PBUH), entered and Aisha mentioned that to him. Then the Prophet (PBUH) met Othman bin Mazun and said: O Othman, monasticism was not prescribed for us. So, don't I have a nice example for you!? By Allah, I fear Allah more than you, and I am more obedient to Allah's orders than you. [2:70-71]

A husband's helping his wife with daily household chores is one of the praiseworthy deeds in Islam. After all, this also serves the well-being of the family. This situation has also come as an example in the lifestyles of the Prophet (PBUH). Ordinary people cannot claim to be superior to Him in every aspect.

In a hadith narrated by al-Aswad ibn Yazid (r.a.), one of the tabiin scholars, the family lifestyle of the Prophet (PBUH) is described as follows:

الأسود قَالَ: سَأَلْتُ عَائِشَةَ رضي الله عنها مَا كَانَ النَّبِيُّ صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ يَصْنَعُ فِي بَيْتِهِ؟ قَالَتْ: كَانَ يَكُونُ فِي مِهْنَةِ أَهْلِهِ فَإِذَا حَضَرَتِ الصَّلاَةُ خَرَجَ إِلَى الصَّلاَةِ.

Al-Aswad said, "I asked 'A'isha, may Allah be pleased with her, "What did the Prophet, may Allah bless him and grant him peace, do when he was with his family?" She replied, "He would do chores for his family, and when it was time for the prayer, he would go out".

Therefore, husband and wife are equally responsible for the family's stability and prosperity. Fulfilling the responsibilities and duties of both parties with a single unbiased good intention can become a meritorious act at the level of prayer. On the contrary, evading and avoiding them is a sin on the one hand, and causes misunderstanding on the other.

Marriage conditions. In Islam, the norms related to family relations have been set separately. Some of them are immutable basic principles, while others have improved under the influence of certain historical processes. The opinions and arguments of the scholars of Ahl as-sunna wa-l-jama'a on the topic serve to solve the problems related to the field on a scientific basis even today. In particular, in the early period of Islam, the marriage contract was concluded orally witnessed by at least two Muslim men, and announced. Later, scholars, taking into account the requirements of the time and the situation, have additionally applied the formalization of marriage in written form to this regulation. It was compiled in two copies; one copy was kept in the qazikalon and the other in the couple. Already, marriage in Islam is a solemn contract, and Sharia has defined the rules and procedures that guarantee its stability. A marriage must strictly comply with the specified requirements for it to be recognized as valid. Otherwise, it will not be recognized as a marriage. The consequences cause serious problems. Circumstances related to the direct marriage contract are reflected in the principles of Sharia, such as rukn, shart, sunnat, and mustahab. Based on the summation of the opinions of the scholars of Ahl as-Sunna wal-l-Jamaa regarding marriage, there are three pillars of marriage:

First. A man and a woman should be free from obstacles to marriage. Different circumstances prevent a man and a woman from starting a family together. One of them is the fact that they are close relatives, that is, mahram, strictly prohibits marriage.

Secondly, it is natural that their serious illnesses also prevent them from building a family. Also, the lack of kufu (for example, in terms of lineage, profession, and socio-economic), that is, equality between them, can be an obstacle to marriage.

Second. A man should verbally express his consent to start a family in a clear sentence. The bride should hear this speech of the bridegroom. This confession is called "Ijab" (Ijab, past tense) in Sharia, and without it, even if the marriage is concluded, it will be invalid.

Third. It is a woman's acceptance of an offer to start a family with a clear sentence. The bridegroom should hear this speech of the bride. It is called "qabul" (acceptance, past tense) in Shariah, and without it, even if a marriage is concluded, it will be invalid.

So, these three pillars form the basis of marriage. In them, the parties - a man and a woman - must verbally express their voluntary consent to start a family. Marriage cannot be concluded if none of them is found.

The second category related to marriage is called "shart" (condition). It is also divided into two categories such as conditions of marriage and conditions in marriage. The terms of marriage refer to the procedure established by the Sharia, and it cannot be lost in any case during the process. The conditions in marriage refer to the demands made by both the husband and the wife or by one of them. They may or may not make demands, which means that this is a voluntary mutual agreement. Although it is a voluntary act, it must be followed after it has been agreed upon. It is blessed in the Qur'an as follows:

يَا أَيُّهَا الَّذِينَ آمَنُوا أَوْفُوا بِالْعُقُودِ

O you who believe! fulfill the obligations! *[1:106]*

There are four conditions of marriage. Without any of them, the marriage is not valid.

First. Appointment of bride and groom. That is, the two parties know each other. In Sharia, those who want to marry are allowed to look at each other.

عن المغيرة بن شعبة، قال: أتيتُ النبي صلى الله عليه وسلم فذكرت له امرأةً أخطِبُها، فقال: اذهب فانظر إليها، فإنه أجدرُ أن يُؤدمَ بينكما.

The Messenger of Allah said: "Go and look at her! Because seeing is a more worthy thing for the love between you to last longer". [3 : 295]

Second. The consent of the groom and the bride to start a family with each other. Both parties must voluntarily agree to the marriage. There should be no pressure or intimidation on them.

Third. A close relative of the bride must participate in the marriage process. A woman cannot start a family away from close relatives like her parents and siblings. According to most scholars of Ahl as-Sunna wa-l-Jamaa, the consent of a woman's close relative is considered important for the marriage to be valid.

The fourth. Witness to the marriage contract. According to Sharia, the minimum number of witnesses for a marriage must be two free reliable Muslim men or one free reliable Muslim man and two free reliable Muslim women. Also, the bridegroom and the bride should gather together with the witnesses, and the witnesses should personally hear the acceptance of the bridegroom and the bridegroom. indeed, one of the purposes of introducing witnesses is to publicize the marriage. In particular, this situation is emphasized in the hadith narrated from Aisha (r.a.):

عَنْ عَائِشَةَ قَالَتْ رَضِيَ اللَّهُ عَنْهَا أَنَّ رَسُولُ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ قال: أَعْلِنُوا هَذَا النِّكَاحَ وَاجْعَلُوهُ فِي الْمَسَاجِدِ وَاضْرِبُوا عَلَيْهِ بِالدُّفُوفِ.

The Messenger of Allah said: "Make this marriage publicly known, solemnize it in the mosques, and play tambourines in honor of it". [3:296]

The reason for performing the marriage in the mosque is that it should be performed in front of the public, not in the presence of a couple of relatives and friends. It is also to attract the attention of many people and inform them.

Dowry is one of the important parts of the marriage contract. After all, the bridegroom must pay it to the bride before or after the marriage.

CONCLUSION

In conclusion, it should be noted that in Islam, special attention is paid to building a family and ensuring its strength. After all, the family is the main foundation of society. For this reason, genealogy is one of the issues that special attention is focused on. Because, on the one hand, this is one of the main goals of building a family, and on the other hand, it is one of the main factors in its stability. Therefore, the parties to get married should first inquire about each other's family circumstances and ancestors before getting married. The right choice will serve the birth of a mentally healthy and physically strong generation.

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Issue Article

Viktor Eduardovich Marchyukov
Institute of Service Sector and Entrepreneurship (branch) DSTU
bachelor

Eduarda Romanovna Lependina
Institute of Service Sector and Entrepreneurship (branch) DSTU
bachelor

Artur Aleksandrovich Blagorodov
Institute of Service Sector and Entrepreneurship (branch) DSTU
master's degree

Vladimir Timofeevich Prokhorov
Institute of Service Sector and Entrepreneurship (branch) DSTU
Doctor of Technical Sciences, Professor
Shakhty, Russia

Galina Yurievna Volkova
LLC TsPOSN «Ortomoda»
Doctor of Economics, Professor
Moscow, Russia

FEATURES OF THE DEVELOPMENT OF CLOSED ADMINISTRATIVE-TERRITORIAL FORMATIONS (CATE) AND SUPPORT SETTLEMENTS (SNP) IN THE ARCTIC ZONE UNTIL 2035

Abstract: *The article analyzes a closed administrative-territorial entity (CATE) - this is an administrative-territorial entity created in order to ensure the safe functioning of organizations located on its territory that carry out the development, production, storage and disposal of weapons of mass destruction, processing of radioactive and other highly dangerous man-made substances the nature of materials, military and other facilities for which, in order to ensure the defense of the country and the security of the state, a special regime for the safe operation and protection of state secrets is established, including special living conditions for citizens and support settlements (SCP), on the basis of which the accelerated development of infrastructure is carried out. The entire territory of a closed administrative-territorial entity is the territory of a municipal entity with the status of an urban district, ensuring the implementation of guarantees in the field of education, the availability of medical care, cultural services and the implementation of other needs of the population of the territory of one or more municipal entities. The categories of support settlements follow from the definition of SNP and are divided into three main tasks solved during the activities of enterprises and organizations located in them, namely:*

ensuring the security of national informationresources of the Russian Federation from external threats, protection of the sovereignty of the Russian Federation, its independence and state integrity;

ensuring the protection of national interests from internal threats, ensuring the implementation of constitutional rights and freedoms of citizens, civil societyra and harmony in the country;

ensuring a decent quality and standard of living, socio-economic development of the country (including the role of bases for the development of geological exploration and mineral resources centers, implementation economic and (or) infrastructure projects in the Arctic).

These groups of tasks allow us to distinguish three fundamentals groups of support settlements (in accordance with the tasks performed by the ONP):

strategic SNP,

ENP for internal security,

SNP ensuring socio-economic timesVitya.

***Key words**: competitiveness, demand, quality, accessibility, innovation, digital technology, economic policy, industrial policy, union of federal, regional and municipal branches of government; profitability, profit, financial stability, stability, purchasing power.*

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Introduction

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As part of the research, we present the speech of the President of the Russian FederationV. Putin, namely: Dear colleagues, good evening!

We have already met some of them on first meeting. As for the second question for which we have gathered. Just now we are with you were at a large enterprise, which was commissioned and dedicated to the development of the Arctic - in the broad sense of the word. Yes, these are specific Arctic projects related to liquefied natural gas, but in general such projects are very important for the development of the Arctic zone as a whole - and for the country's economy, of course, I have already talked about this.

But the Arctic zone is important - and we have talked about this many times in relation to various situations - for the country strategically. There are defense issues, resource base, and so on, I won't list everything.

At the same time, big problems have accumulated here, which, of course, require our special attention. For example, let's say, the deterioration of communal infrastructure and housing stock even in large cities of the Arctic reaches 70 percent, and in small remote villages and so-called ZATOs, closed administrative territories, this problem is even more acute.

I would like to note in this regard that, thanks to certain decisions made earlier, over the past three years, of course, something has been done and progress has been made in resolving a number of issues. For example, apartment buildings are undergoing major renovations, courtyards and other public spaces are being spruced up, and new social facilities are appearing. Unfortunately, due to weather conditions, we did not get to Severomorsk; we wanted to get there by helicopter, but due to the weather it did not work out. But I know that a lyceum with 1,200 seats was built there, and in Zaozersk there is a sports and recreation complex with a swimming pool. In the military town of Sputnik - also here in the Murmansk region - a major renovation of a building with a library and a children's art school was carried out.

Nevertheless, the pace of work in terms of social development is clearly insufficient. It must be larger-scale and, of course, must be systematic. It is clear that the budgetary capabilities of the regions are limited. Moreover, the development tasks of a number of settlements are directly related to issues of national security and are of national importance. Therefore, a great responsibility here lies with the federal center.

Let me remind you that last year, at a meeting dedicated to the Arctic, we decided to develop an action plan for the development of housing, energy and social infrastructure in CATUs and settlements in the Arctic zone where our military units are stationed. However, the problem is still being solved, to put it mildly, slowly. Today, colleagues, I would like to talk to you about this, to talk about the reasons for the delay in deadlines.

I would also like to draw your attention to the fact that the improvement of cities in the harsh conditions of the North is connected with the solution of issues, as I have already said, of a defense nature. Now I will not go into details here, but in these areas we have many interests in the field of defense and security. Therefore, people who live in these conditions must live in human conditions, and special attention must be paid to this.

In this regard, I would like to emphasize once again: these issues are of fundamental importance. I won't go into details now, we just talked with the governor, and at one time we talked with the Minister about this. Let's take this very seriously.

At the end of our meeting, I will say a few words. And now I would like to give the floor to the governor. Please, Andrey Vladimirovich. A. Chibis: Dear Vladimir Vladimirovich! Dear Colleagues!

Firstly, you have already spoken about the military formations that are based in our country. We are proud that the Red Banner Order of Ushakov Northern Fleet is based in the Murmansk region. More than 80 percent of the entire Northern Fleet is located on the territory of our region, not counting other units of the Ministry of Defense of the Russian Federation.

Therefore, from the very beginning of my work as governor of the Murmansk region, attention to the settlements where military personnel and members of their families live has become the most important priority for the work of our entire team.

We have 27 settlements, including five ZATOs with military deployments, in which about 150 thousand people live with their families. And soon the number of residents of these cities and towns will increase significantly: these are sailors, submariners, marines, motorized riflemen, tank crews, pilots and many others. All of them fulfill their military duty with valor, defending their homeland, including as part of a special military operation.

Over the past four years, we have concentrated financial opportunities, resources - everything that is possible: both national projects and individual decisions of the Government on the renovation of CATUs in accordance with your instructions, Vladimir Vladimirovich, as well as the resources of the regional plan "Live in the North!" just for the development of these settlements. And taking into account the expenses of 2023, they invested almost 14 billion rubles, to be precise - 13.9 billion rubles, a third of which came from the federal budget.

Thanks to this, the first school in Severomorsk in 30 years was built, you just mentioned it in your opening speech, six kindergartens, eight outpatient clinics and first aid stations, 529 apartments, 199 houses and courtyards adjacent to more than 400 apartment buildings were renovated. Ten sports facilities and six cultural facilities were built and reconstructed, 26 public spaces were landscaped, more than 30 modern children's play and sports complexes were installed, and 105 kilometers of roads were repaired. And we renovated a school in Zaozersk, and we will complete three schools as part of a major overhaul this year. 25 empty capital construction projects have been demolished, which, of course, let's just say, simply disfigure these cities and towns. It is clear why they were formed, including taking into account the change in the number of troops at one time, when it was reduced.

I would especially like to express my gratitude for the support to Yuri Petrovich Trutnev and the Minister for the Development of the Far East and the Arctic Alexey Olegovich Chekunkov, thanks to whom we received additional funds as part of a single Arctic subsidy and began the construction of important facilities for military families - this is a school in Pechenga, a new building schools (the school, by the way, was awarded the title of Hero of the Russian Federation to Mikhail Popov, a participant in a special military operation; he is alive, continues to carry out tasks within the framework of the North Military District), a swimming pool in Severomorsk, a House of Culture in Alakurtti, and we are also installing 20 more sports and games in military garrisons complexes as part of the additional funding we received. This is what we all managed to do together in these territories, concentrating all possible resources, including with the support of the federal budget and, of course, thanks to your instructions in this regard. There is this movement. People really saw the changes, felt these changes, because since the 90s, frankly speaking, not much attention has been paid to these cities and towns.

But, taking into account, on the one hand, and this must be honestly admitted, the still deplorable state of a huge number of residential buildings in these settlements, social facilities, the critical deterioration of engineering infrastructure in a number of settlements, and on the other hand, the upcoming significant increase in the number of military personnel by our territory, a systemic decision is required on the comprehensive development of housing and infrastructure for our military and their families. In order to provide for new military personnel and their families, it is necessary to build 134 apartment buildings and 37 social and communal infrastructure facilities. These figures have been previously verified with our military colleagues. For these purposes, according to preliminary calculations, about 135 billion rubles are required. Of course, it is extremely necessary to create comfortable living conditions for those families and those military personnel who are already serving here in the North. For the most part, these are units of the Northern Fleet. After all, Vladimir Vladimirovich, these are young, active, usually large families, we just discussed this, who live in difficult climatic conditions, this is also evident from today's weather. Of course, the worst thing is the meager, undeveloped infrastructure of the garrisons. To do this, it is necessary to build 106 residential buildings to resettle people from the existing housing stock. These are the houses in which people live, which, according to experts, are either useless or incorrectly repaired; people simply need to be moved from there. Renovate 362 residential buildings that can still serve and operate, build and repair 302 social and engineering infrastructure facilities. The preliminary requirement for these purposes is 148.6 billion rubles. That's a lot of money. If we take the amount of the total costs that I just talked about - both for those who must come to serve us and for those who are already serving - for the proper conditions, for those who ensure global security through nuclear deterrence, security of the Arctic and the Northern Sea Route, 283.5 billion rubles are needed. But we are, of course, talking about a minimum ten-year period. And if we take the annual volume of investments that are required in order to organize this work, depending on the period of the plan that must be approved in accordance with your instructions, it is about 20–28 billion rubles per year. But once again I really want to draw attention to the quality of people's lives, which requires radical change. This task of developing such settlements is

clearly stated in Arctic development strategies, which, Vladimir Vladimirovich, you approved in 2020.

I propose, taking into account the above, which we also discussed with you while we were traveling, to provide for an integrated approach to the resettlement of military personnel with their families. This should be a conditional master plan, when settlement provides for the formation of the entire social infrastructure: schools, kindergartens, access to medicine. That is, in new locations it is necessary to concentrate all the important needs of people, additionally stimulating the development of small and medium-sized businesses there. And special attention must be paid to creating places for military wives.

In Soviet times, and what we see now in the territory, especially in the Pechenga district, which borders Norway, is a series of locations with several houses, which, of course, do not have the necessary infrastructure. When we talk about an integrated approach, we need to design, in fact, new settlements in order to concentrate both military personnel and members of their families there, and create all the necessary conditions for their quality living. We discussed this in advance; it is technologically correct, of course, and, most importantly, it can be done. Dear Vladimir Vladimirovich, I ask for your instructions to approve the appropriate set of measures, taking into account the information provided. I say again, of course, this is a matter of very serious reconciliation, including the amount of funding, but we are talking about a ten-year period. It's really possible to do this in ten years, but I also outlined the amount of funds needed annually. Another issue that requires your support is the topic of the development of strategically important Arctic support settlements - cities, for example, Murmansk, around which very powerful and important projects are now being developed for the Arctic, for the country. Of course, this requires attracting and retaining specialists with the appropriate competence in order to implement these projects, which means that investments in urban infrastructure and in the development of the urban environment must be concentrated and require an appropriate volume.

There is very effective experience in the cities of the Far East, when, through the creation of a master plan and a set of measures based on it, appropriate measures are launched to change the urban environment. I have already reported to you that we are, of course, trying to put the city of Murmansk in order, we are achieving certain things: landscaping and repairs, but concentrating resources for strategically important cities, of course, requires a more serious level of support. I would ask for your instructions to launch such work in the Arctic support cities. We discussed this issue at a meeting of the State Council working group on the development of the Arctic, all colleagues (regions, representatives of the federal Government, and the Minister of the Far East and the Arctic) appreciated and supported this approach. And if you have your support, we are ready to very quickly begin work on identifying such cities together with the Ministry of the Far East and the Arctic and submit it for consideration to the Government. Well, at the end of my speech, I would like to ask for your support for the city of Severomorsk - this is the capital of the Northern Fleet, for the reconstruction of three iconic social facilities of our capital of the Northern Fleet, which, unfortunately, today are, to put it mildly, in a deplorable state. These are the Central Regional Hospital, the large CSKA stadium and the House of Officers of the Northern Fleet. According to preliminary estimates, this requires about 5,100 million rubles. I ask you, dear Vladimir Vladimirovich, for instructions on our support, on the allocation of federal funds to solve, among other things, the specific problems of these three facilities in the city of Severomorsk. This is the capital of the Northern Fleet and, of course, deserves such increased attention. In conclusion, I would like to thank our colleagues and colleagues from the Ministry of Transport, the Ministry of Health, the Ministry of Construction and the Ministry of Education, who really help us - and have helped and continue to help us - including concentrating resources on the ZATO and ONP, where our military personnel live. It is thanks to such joint work, including with the Ministry of Defense, that we have been able to move forward in four years. But I have already described the problems. The report is finished. Thank you for your attention. Vladimir Putin: Thank you.

Please, Chekunkov Alexey Olegovich.

A. Chekunkov: Dear Vladimir Vladimirovich! Dear Colleagues!

Three years ago, strategic documents were adopted: Presidential Decrees on the Fundamentals of State Policy in the Arctic and the Development Strategy of the Arctic Zone of the Russian Federation until 2035. These documents, including provide for the comprehensive development of settlements in which military units are stationed - the approach that Andrei Vladimirovich Chibis spoke about.

In order to ensure an improvement in the quality of life of people in the North, the task is to increase the income of the Arctic regions and develop the economy at an accelerated pace. The Government of the Russian Federation applied mechanisms created in the Far East. The entire territory of the Arctic zone is recognized as a free economic zone. New investment projects receive government support measures. As a result, the dynamics of creating new enterprises turned out to be even higher than in the Far East. The implementation of 715 new investment projects with a total volume of 1.6 trillion rubles has begun. In fact, 356 billion have already been invested, 12 thousand new jobs have been created. New enterprises create

additional budget revenues, which, in turn, make it possible to develop the social sphere. In the long term, significant socio-economic effects will come from the implementation of the Northern Sea Route development plan. State support for investment projects is provided in such a way as to maximize the benefit for the Arctic regions, including closed administrative territories and the ONP. For example, for the Murmansk region a separate decision was made on the NOVATEK project. Today, Vladimir Vladimirovich, you launched a unique plant where not only the plant construction project itself, but also contractors received the status of resident of the priority development territory. We have verified this approach with the Accounts Chamber and the Federal Treasury. As a result, these construction companies were registered in the region, and the regional budget received an additional two years of more than 4 billion rubles in income, which, among other things, made it possible to take the first steps in the program for the renovation of ZATOs and ONP. Also, on your instructions, the state program for the socio-economic development of the Arctic provides funds for the development of social infrastructure. In the current Budget Law, this is an average of 2 billion rubles per year. These funds provide the Arctic regions with additional resources to solve priority problems, but do not provide a comprehensive solution to all the tasks you have set. Dear Vladimir Vladimirovich!

Today, a new economy is being created in the Arctic, and Russia's security framework in the North is being strengthened. The success of solving these problems depends on where and how people live. The Russian Arctic is five million square kilometers, almost 20 thousand kilometers of maritime border. Along its entire length there are strategically important objects, as you said, Vladimir Vladimirovich, of both a defense and economic nature. Almost 2.5 million people live in 250 settlements above the Arctic Circle. It is advisable to identify support cities and towns (ZATA and ONP) that provide key tasks in the field of security and in the field of economy. The focused development of such support cities will create the basis for retaining people and attracting new in-demand specialists to the Arctic. An example of such focused development is the development plan for the city of Norilsk until 2035, adopted on your instructions. The plan, totaling 120 billion rubles, involves financing - 24 billion from the federal budget, 15 from the regional and 81 from extra-budgetary sources. Thus, the plan binds the city and its key enterprise to a long-term development program.

The Ministry for the Development of the Far East and Arctic is ready, together with the Arctic regions, to prepare comprehensive plans for the development of support cities, as well as Arctic agglomerations, where several settlements use common infrastructure.

As part of the implementation of your instructions for the preparation of master plans for Far Eastern cities, we, together with Yuri Petrovich Trutnev and Maxim Stanislavovich Oreshkin, worked not only with urbanists and architects, but analyzed the structure of the economy and employment, where people work in these cities, built the trajectory of the city's development from the current state to the target, planned.

We are ready to apply the same approach in the Arctic within the framework of ZATA and UNP.

Dear Vladimir Vladimirovich!

The main development support mechanisms used in the Arctic were first tested in the Far East. And one of the most popular among people and useful for the economy was your solution on the Far Eastern mortgage; 74 thousand families have already taken advantage of it. It gave impetus to the construction industry; in 3.5 years, the volume of completed housing in the Far Eastern Federal District doubled, to 4.5 million square meters. The increase in housing supply made it possible to contain prices; the increase in the cost of a square meter in the Far East during this period was one and a half times lower than the national average. On each and every trip to the Arctic regions, people asked us about the possibility of extending Far Eastern mortgages to the Arctic. We worked with Anton Germanovich Siluanov on possible solutions and found mechanisms that would attract new developers to the Arctic without increasing the price per square meter. This is a condition under which a preferential mortgage at two percent is provided only for new housing in the primary market and at the price of the Ministry of Construction.

Dear Vladimir Vladimirovich, we ask you to support the expansion of the Far Eastern Mortgage program to the Arctic, taking into account this condition. Thank you for your constant attention to the development of the Arctic.

Vladimir Putin: Thank you, Alexey Olegovich.

Let's summarize some results.

The first thing I would like to draw your attention to is. It is necessary to complete the coordination of an action plan for the development of the housing, energy, and social infrastructure of these ZATOs and ONP, as well as the populated areas of the Arctic zone as a whole - this is broader, including where our military formations are stationed. I will add that funding for the activities of this plan must come from different sources, and this must be agreed upon. And, as I already said, all this must be done before September 1. Let me remind you that this is the modernization of primary health care, renovation of schools, updating of the housing and communal services system, housing construction, landscaping, and so on.

Second. The plan should be formed on the basis of the master plans discussed here, if possible for each of these settlements or, as the Minister proposed, for

several united in agglomerations for the purpose of effective development of the territories, I agree. Another point that we didn't talk about now, but we talked about with the governor while we were moving here: we need to think in advance about the employment of members of military families. There are different opportunities here, there is nothing new or complicated here, you just need to think about it in advance, including ensuring the availability of programs for retraining or mastering new specialties for those people who want to do this. The fourth is about the so-called support settlements of the Arctic zone. I agree with you, support these proposals and ask the Government, together with the regions, to determine a list of such settlements. It is clear that population size alone is not the main thing in this case. We must keep in mind that even small settlements, small villages can be of strategic importance for the country, and we need to think about this.

For supporting Arctic settlements, it is also necessary to prepare master development plans for the period until 2035, similar to those that have already been developed for Far Eastern cities. I ask you not to delay this work, so that by October 1, 2024, on the basis of ready-made documents, we can approve comprehensive plans for the long-term development of Arctic cities also until 2035 and with clear sources of financing. At the same time, it is important to begin the practical implementation of measures in 2025, no later. Further. The minister also spoke today about the "Arctic mortgage". I think that such a measure can become a serious support for citizens living in the regions of the Arctic zone. We know the results of this preferential mortgage at two percent in the Far East; it really played a role: 73 thousand Russian families improved their living conditions using this mortgage. I agree to distribute it to young families living in the Arctic zone. That is, for them the preferential mortgage rate will also not exceed two percent. I propose to set the validity period of this measure until 2030.

As for the facilities in Severomorsk, we have now agreed on this, a new sports complex will be built by the Ministry of Defense, the stadium will be put in order with the help of the funds that are allocated - (addressing Yu. Trutnev) redistribution, as I understand it, Yuri Petrovich - redistribution certain resources allocated to this zone. The Ministry of Defense has made a decision regarding the Officers' House - it will put it in order. As for the central hospital, the Minister of Health promised that this issue would also be resolved during the finalization of the budget. I assume that all this will be fulfilled. Everything we agreed on today must be formalized in the form of appropriate instructions.

Thank you all very much. I proceed from the fact that everything we agreed on, and especially everything that will be recorded on paper, will certainly be fulfilled. Thank you, all the best.

Main part

The main problem in developing criteria for ZATA and ONP is to assess the role that specific settlements play in ensuring the development of the surrounding territory: according to this definition, ZATA and ONP should play a significant role in ensuring national security (including ensuring socio-economic development) not only not so much on its own territory, but around it.

The most difficult problem here seems to be assessing the role of settlements in the development of the surrounding territory (for most settlements an individual assessment of transport accessibility is required, taking into account seasonality, passability of winter roads, etc.). Therefore, the analysis is based on general patterns identified on the basis of a study of the role of certain industries of specialization of Arctic settlements in the economy of the Russian Arctic. In general, the algorithm for determining the criteria for support settlements was based on the first stage - the selection of basic activities - such types and/or areas of activity that in populated areas of the Russian Arctic, as a rule, have a significant impact on the development of the surrounding territory. Further, at the second stage, criteria for assessing the level of development of basic industries and/or the degree of their influence on the development of the surrounding territory were selected. The following main groups of basic industries of potential support settlements of the Russian Arctic were selected, influencing the development of the territory outside the settlement of their location, namely:

ensuring Russia's external security;

ensuring internal security of Russia;

security socio-economic development and a decent standard and quality of life, including the followingcurrent subgroups:

manufacturing industry (subject to the significant role of the relevant enterprise in the industry and/or specialization in the production of uniqueproducts);

activities on transport and logistics support for the development of the Russian Arctic, including the development of mineral resource centers;

social and cultural support activitiespopulation of the Russian Arctic;

activities on innovation, informationstaffing and staffingeconomic development of the Russian Arctic (including geological exploration and geodetic work, meteorological services, R&D in the development of specialized goods, technologies and services for use in the Russian Arctic, higher education, and other research activities);

activities for administrative, organizational and service support of the mining industry (including administrative divisions of resource mining companies, drilling operations, maintenance and repair of wells, and other services in the field

ofrecovery of oil and gas, repair of mining equipment, etc.).

Initial indicator baseand methods of analysis. The range of indicators used can be divided into several thematic categories based on the nature of data sources and information storage formats, namely:

Basic indicators:

(1) status of ZATO and ONP;

(2) position in an officially established gamelow zone;

(3) administrative status.

Indicators in the field of internal security:

(4) presence of MFC;

(5) availability of emergency response points (relatedto fire rescue units, sea rescue coordination centers, sea rescue sub-centers);

(6) presence of Ministry of Internal Affairs points.

Indicators characterizing the role of settlements as supply bases:

(7) availability of food supplies;

(8) category of fuel and lubricants warehouses.

Indicators of development of the mining industry.

The indicators of this group were calculated using geographic information systems or packages for working with tabular data - based on primary indicators for licensed areas (Rosgeolfond), received upon a special request. The analysis of the level of development of the mining industry was carried out on two logical grounds: geographical and corporate.

On the first basisa 150-kilometer zone around each settlement was analyzed. Using spatial connection tools in a given buffer zone, the following were calculated:

volumes of gas, oil, gold-platinum productionraw ores, diamonds, other solid minerals according to the last available year (hereinafter referred to as TPI);

average values of the base production increasechi for the specified categories of minerals over the past 5 years;

values of the estimated supply of reserves of the specified categories of minerals while maintaining the current level of production (ratio of volumereserves in categories A + B + C1 to production volume).

The unit of analysis was the licensed areas (source: Rosgeolfond), to which thereceivedupon request, quantitative data on deposits of hydrocarbon raw materials and solid minerals. The analysis took into account all areas within the 150 km zone, including those that are not entirely contained within this buffer zone. Thus, the analysis of the development of the mining industry was carried out with a reserve.

On the second - corporate - basis, data on the extraction of raw materials and the provision of raw materials were also summarized, but they were grouped by the city closest to the license area and by the corporate decision-making center. This method is more accurate in terms of determining the connection between a populated area (as a decision-making center) and the prospects of individual fields. However, it is not possible to unambiguously compare each licensed area with a specific decision-making center (most often, either due to the complex system of subordination and co-ownership of enterprises, or due to the difficulty of systematizing and verifying the accuracy of data for small companies). Therefore, the corporate method of linking the parameters of licensed areas was carried out only for the largest decision-making centers: the settlements in which the headquarters or regional representative offices of the largest subsoil users of the Arctic zone were located were considered. A total of 21 oil and gas companies and 20 companies specialized in the extraction of solid minerals were selected. Thus, for each settlement the following were calculated:

volumes of gas, oil, gold productionnew ores, diamonds, other solid minerals in deposits owned by companies with a head office or regional office in a given locality;

values of estimated reserve availabilitythemselves indicatedcategories of minerals while maintaining the current level of production at the sites of companies with a head office or regional office in a given locality.

Due to lack of data, calculation of the average valuebasis increase on a corporate basis is impossible.

Indicators of development of the education and medical spheres. This block includes the following indicators, namely:

the presence of state and non-state institutions of higher education (including branches);

the presence of scientific departments (including scientific institutions in the direct department of the federalexecutive authorities, availabilityscientific organizations established by government bodies of a constituent entity of the Russian Federation; scientific laboratories, testing grounds, hospitals of state scientific institutions, as well as their branches with a small number of employees (except for stations within the structure of Roshydromet); presence of a directorate of a state reserve or national park.

Data is based on materials provided upon special request by the Ministry of Scienceand higher education of the Russian Federation, and were supplemented by analyzing the official websites of all federal ministries and their subordinate organizations, official websites of regional branches of the Russian Academy of Sciences. A big problem is the collection of data on relatively small Arctic divisions of scientific institutions (branches, laboratories). The work uses a list collected from the official websites of institutions of the Academy of Sciences, as well as higher educational institutions. However, it may be incomplete, therefore it is used as a basis for forming criteria for determining SNP and ZATO on the declarative principle;

Availability general education And secondary specialized educational institutions;

availability of hospitals, clinics, dispensaries and maternity hospitals at the regional/district and inter-district levels;

the presence of other medical institutions of the Russian Ministry of Health system (hospitals, clinics, dispensaries)pansers of a level below the inter-district level, outpatient clinics, paramedic and obstetric centers and ambulance stations);

the presence of medical institutions of any category and form of ownership in populated areas of the roadless zone (subject to the implementation of measuresaccording to recommendations).

The data sources were materials, semiavailable on request. To link organizations to a specific locality according to indicators 36–37, address data was used, the analysis was carried out using the functionality of table editors. The abundance of errors when recording addresses led to individual anomalies in the indicators, which were corrected manually. For indicators 38–40, the OKTMO code was used.

Indicators characterizing the role of a settlement in the settlement system. To characterize a settlement as a central place, indicators specially developed for the purposes of the project were used, based on the construction of so-called Voronoi polygons, which assume that each polygon (partition cell) forms a set of points located closer to one of the elements of the input point data set than to to anyone else. The division of the territory into Voronoi polygons can be interpreted as a division into optimal accessibility zones in off-road conditions, characteristic of a significant part of the Arctic zone. The calculation of Voronoi polygons was carried out twice: the first time for settlements performing certain functions in the field of internal security (the status of an administrative center, the presence of a Ministry of Emergency Situations or MFC), the second time for settlements that have government organizations carrying out medical activities. Based on the results of each simulation, the following indicators were calculated, namely:

population in the Voronoi test site, formed bathroom in this locality;

the ratio of the population in the Voronoi polygon to the own population of the desired locality. When calculating the population, all settlements in the Arctic zone were taken into account (and not just those with a population exceeding 500 people). The existing limitation is that the Voronoi polygons were calculated only within the Russian Arctic - thus, the indicators for settlements located near the border of the Russian Arctic are likely to be underestimated.

Indicators characterizing the transport and logistics situation, namely:

list of airports - selected valid existing airfields of the Russian Arctic;

passenger turnover (thousand people per year) and cargo turnover (tons per year) of airports - averages were calculatedindicators for 2018–2022;

list of fuel and lubricants warehouses - divided into 4 categoriesmountains by capacity (over 100 thousand m3, 20–100 thousand m3, 10–20 thousand m3, 2–10 thousand m3);

list of wholesale food depots and warehouses;

list of seaports indicating the capacity of cargo terminals (thousand tons per year),

list of river ports.

Additional indicators. Additionally, to assess the degree of narrow economic specialization (essentially mono-profile) of large urban districts, the Herfindahl-Hirschman index for employment structure was calculated. Data source: municipal statistics from Rosstat. In addition, the state register of cultural heritage sites was additionally analyzed to assess the prospects for tourism. For each settlement, the number of cultural heritage sites (regardless of status) and the number of cultural heritage sites at the federal level were calculated. The method used is similar to the calculation of indicators.

Selection of criteria for identifying ZATOs and ONPs, their categories and subcategories. Due to the complexity of the classification object, the selection of criteria was carried out using a mixed method. On the one hand, the criteria used were the presence of enterprises and organizations of a certain profile in populated areas (for activities with a wide area of influence on the development of the surrounding territory). On the other hand, for industries where the scale of influence on the surrounding area depends on the characteristics of specific enterprises, qualitative and quantitative characteristics of the relevant enterprises and/or aggregate industry economic indicators for the selected locality were used.

However, during the analysis, cases were identified when a settlement actually has a significant impactinfluence on ensuring national security and socio-economic development of the surrounding territory, however, this function cannot be determined on the basis of available national databases (for example, the presence of unique enterprises, organizations providing socially significant services for indigenous peoples, etc.). Therefore, in the end, two ways are proposed to determine the list of SNPs and ZATOs:

universal, based on existing federal databases;

applicant, based on an application from the local administration and/or other interested parties.

In the latter case, the status of the ONP and ZATO is determined on the basis of an application from the administration of the locality, which includes evidence of compliance of the given locality with the criteria provided for the application method of forming the definition of ONP and ZATO.

In addition, a previous study showed the feasibility of differentiating the criteriafor

masteredand off-road under zones of the Russian Federation. The roadless zone of the Russian Arctic includes settlements that are completely devoid of land transport links - the category of settlements. Thus, the following categories and subcategories (in some cases also types) of support settlements in the Arctic zone of the Russian Federation are proposed.

ONP providing externalsecurity of Russia. The following potential criteria were considered: the presence of a settlement with the status of a ZATO and/or the fact that the settlement was included in the border zone of the Russian Federation, the location of units of the Russian Ministry of Defense in the settlement, etc. Due to the lack of open data, ONP in the field of ensuring external security were selected as a criterion criteria for having ZATO status and belonging to the border zone of the Russian Federation; It is also possible to include other settlements in the Russian Arctic into the ONP category in agreement with the relevant departments.

Criteria determining the category of the ENP for ensuring external security, the subcategory “ZATO”, namely:

whether the locality has the status of a closed city;

subcategory “ONP border zones”:

the fact of the location of this settlement within the border zone of the Russian Federation;

special subcategory of ONP external security Russia (application criterion):

on the recommendation of relevant departments (Russian Ministry of Defense, Russian FSB).

Differentiation of criteria for mastered and unmastered no control is carried out under the Russian Arctic zones.

The subcategory “ZATO”, due to the lack of data on many types of objects and/or the objects themselves (for example, MFC) and taking into account the specifics of the mode of functioning of the administrative-territorial entity, is allocated to a separate subcategory, for which the criteria for determining membership in other categories of public organizations are not applied. This is the only subcategory of the ONP, the settlements of which cannot simultaneously belong to other categories and subcategories of the ONP - ensuring the internal security of Russia. The following are considered as potential criteria: placement in a populated area of state and municipal authorities exercising state and municipal administration; bodies and organizations providing public services, as well as divisions of the Ministry of Internal Affairs of Russia and the Ministry of Emergency Situations of Russia. The population size in the potential zone of influence was also considered as an indirect criterion, which was assessed using the method of the so-called Voronoi polygons. The condition of receiving some government services outside of the place of registration allows us to consider the MFC point as an instrument of influence on the development of the surrounding area, namely in the area of ensuring the availability of government services. Units of the Russian Ministry of Emergency Situations stationed in populated areas, as far as can be judged from the official websites of the relevant units, as a rule, carry out prompt response to emergency situations not only on the territory of the populated area, but also beyond its borders. For example, the Federal State Budgetary Institution “6th Detachment of the Federal Fire Service of the State Fire Service for the Yamalo-Nenets Autonomous Okrug (negotiable)” with its location in the city of Gubkinsky promptly responds to fires and carries out rescue operations, participates in the prevention and elimination of emergencies situations and their consequences at the facilities of the Gubkinsky gas field of Purgaz CJSC and the Komsomolsk gas field of Gazprom Dobycha Noyabrsk LLC, as well as the elimination of road accidents within the boundaries of the units’ departure. It is not possible to collect open data regarding the response zones of units of the Ministry of Internal Affairs of Russia; therefore, the location of units of the Ministry of Internal Affairs of Russia is inappropriate to use as a criterion for identifying closed administrative and administrative units.

Population within one or another accessibility zone from a potential strong point is an ideal indicator. As noted above, due to existing limitations - primarily in the field of assessing transport accessibility in off-road areas, which requires the accumulation of information on local helicopter flights, winter roads, etc. - it was calculated estimated (Voronoi polygons). However, according to the data obtained, the potential zones of influence of many administrative centers include points that are practically not connected with them in transport terms. On the one hand, this reflects the objective situation of the low level of transport accessibility in many areas of the Arctic. On the other hand, the data obtained were still considered inappropriate for use as criteria. In the future, for most categories of SNP, data on the accessibility of the nearest larger settlement by land transport, taking into account winter roads, can be used. Ideally, the basis for assessing the population size in the transport accessibility zone could be based on data from responses to a specially introduced Rosstat population census question (for example: settlements where people traveled during the past year), similar to how in many Western European countries The census includes a question not only about place of residence, but also place of work (settlement).

Geographical analysis of selected features shows that the presence of the status of an administrative center of a subject of the Russian Federation clearly coincides with the presence in the territory of the locality of the MFC and units of the Ministry of Emergency Situations of Russia (those related to fire and rescue units were considered). In addition, both

types of these organizations are represented in the following cities and towns: Apatity, Vorkuta, Gubkinsky, Dudinka, Iskateley, Kirovsk, Kostomuksha, Labytnangi, Monchegorsk, Muravlenko, Nadym, Novy Urengoy, Norilsk, Noyabrsk, Severodvinsk, Segezha, Tarko-Sale, Tura and Chersky.

In a number of settlements with a hundredtus of the center of a municipal district or urban district, represented either by a unit of the Ministry of Emergency Situations of Russia, or by the MFC: Aksarka, Batagay, Belaya Gora, Bilibino, Vidyaevo, Deputatsky, Zhigansk, Zaozersk, Inta, Kalevala, Kandalaksha, Kem, Kola, Krasnoselkup, Leshukonskoye, Loukhi, Mezen, Muzhi, Nikel, Olenegorsk, Olenek, Onega, Polyarnye Zori, Saskylakh, Severomorsk, Srednekolymsk, Tazovsky, Tiksi, Turukhansk, Usinsk, Ust-Tsilma, Khonuu, Chokurdakh and Yar-Sale. Some regional centers and/or urban districts do not have either an MFC or units of the Ministry of Emergency Situations of Russia: Lavrentiya, Pevek, Provideniya, Egvekinot, Belushya Guba, Gadzhievo, Lovozero, Ostrovnoy. On the contrary, there is a division of the Russian Ministry of Emergency Situations or MFC in several villages that do not have the status of regional centers: Igarka, Pangody, Bor, Karaul, Novodvinsk, Ugolnye Kopi, Khatanga, Amderma, Valdai, Verkhneimbatsk, Vorgashor, Vorogovo, Gaz-Sale, Dikson, Zotino, Nadvoitsy, Nosok, Polyarny, Purpe, Revda (Murmansk region), Severny, Snezhnogorsk, Urengoy, Khanymei and Kharp.

In addition, there are seas in Murmansk and DiksonRussian rescue coordination centers, and in Tiksi and Pevek there are sea rescue centers. As a result, the following characteristics were selected that determine belonging to the category of ONP and ZATO in the field of ensuring internal security by category, the criteria for identifying the category of ONP and ZATO ensuring internal security, ONP of the first order, namely:

the presence of the status of an administrative center of a subject of the Russian Federation, the presence of the status of a city district or the administrative center of a municipal district in combination with the presence of a multifunctional center for the provision of public services and a unit of the Ministry of Emergency Situations (fire and rescue units, marine rescue coordination centers or marine rescue sub-centers);

criteria for identifying the category of ONP and ZATO ensuring internal security, ONP of the second order, namely:

the presence of the status of an urban district or the administrative center of a municipal district and/or the presence of an organization of one of the following types: a multifunctional center for the provision of public services, a unit of the Ministry of Emergency Situations (fire and rescue units, marine rescue coordination centers or marine rescue sub-centers).

Differentiation of criteria for mastered and unmastered no control is carried out under the Russian Arctic zones. It is potentially advisable to develop a criterion based on assessing the population size in the zone of best transport accessibility of the ONP - this is especially important, but, unfortunately, most difficult in the roadless zone of the Russian Arctic.

ENP in the field of socio-economic development. The criteria for identifying ONP and ZATO of this category are determined by separate subgroups of types of basic industries (activities); Accordingly, subcategories of ONP and ZATO are identified in the category of ONP and ZATO in the field of socio-economic development. ONP and ZATO with unique and dominant production facilities in the manufacturing industry.

Based on the fact that unique manufacturing enterprises operate in the settlements of the Russian Arctic, as well as enterprises that provide a significant contribution to the production of products in their industry, a special subcategory is distinguished - ONP and ZATO with unique and dominant industries. Unique production means the production of products that are not produced anywhere else in Russia, and transferring the production of this type of product to other populated areas is impossible or economically infeasible. As a rule, the location of such manufacturing enterprises within the Russian Arctic is due to the presence of immovable “specific assets” (a unique deposit, as well as previously created production infrastructure and workforce), the transfer of which to another location is either impossible or extremely ineffective. The dominant production can be recognized as an enterprise located in a populated area of the Russian Arctic, providing at least 1/3 of the products of the corresponding industry, and similarly: transferring the production of this type of product to other populated areas is impossible or economically infeasible.

Examples of unique and/or dominant manufacturing industries, namely:

enterprisesMMC "Norilsk Nickel" in Norilsk: production of nickel concentrate, determined by reference to the mining site;

MMC Norilsk Nickel enterprise in MonchaGorsk: the world's largest and the only production of electrolytic nickel in Russia, tied to the existing complex of infrastructure and workforce;

Zvezdochka and Sevmash enterprises in SeveroDvinsk, tied to the specifics of the White Sea, favorable for the activities being carried out;

Large-tonnage construction center under constructionnal seastructures in Murmansk (Belokamenka), tied to the infrastructure of the city of Murmansk and the characteristics of the Kola Bay water area.

The criterion for identifying a subcategory of SNP with unique and dominant industries (application criteriary) the presence of enterprises that satisfy one of the following conditions, namely:

1) ensuring the production of at least 1/3 of the industry's products in the Russian Federation;

2) the impossibility/economic inexpediency of moving the enterprise outside the Russian Arctic (based on the declarative principle);

3) differentiation of criteria for developed and roadless subzones of the Russian Arctic is not carried out.

Transport and logistics ONP and ZATO. The functions of supporting transport and logistics settlements in the Russian Arctic can be performed by transport hubs that provide communication with the main settlement zone, occupy a central place in regional and intermunicipal transportation, are in a transit position on the main supply routes, serve large remote resource extraction sites or play the role of large warehouse and logistics bases. Their spatial distribution is uneven: the specificity of the roadless zone lies in the functioning of local transport systems, isolated from each other, respectively, each of them has its own strongholds. To identify transport and logistics ONPs and ZATOs, a number of qualitative and quantitative criteria were used, reflecting different aspects of the functioning of transport, namely:

Availability of direct passenger flights to Moscowwu - allows you to identify key points,which provide communication with the main settlement zone;

the presence of an airport with a passenger turnover of over 50 thousand people per year - the largest passenger air hubs;

the presence of an airport with a cargo turnover of over 500 tons per year - the largest cargo air hubs;

presence of a freight railway terminal -railway junction stations;

presence of a seaport - cargo hubs, supportsupply points;

the presence of a seaport with a cargo terminal capacity of more than 5 million tons - the largest cargo hubs and supply bases;

presence of a river port - internal supply basesnia;

presence of a fuel and lubricants warehouse (category I and II - with a capacity of over 20 thousand m3) - the main warehouse and logistics centers.

Settlements and rotation camps that meet at least one of the criteria were included in the final list of transport and logistics ONP, with one exception: it did not include settlements in the road zone, in which only the criterion of having a category I or II fuel and lubricants warehouse was met (this is Monchegorsk , Kirovsk, Pangody, Pravokhettinsky). For transport schemes of the developed part of the Russian Arctic, the factor of locating warehouse centers is much less significant than for transport schemes of the roadless zone, which often have no alternative.

Based If settlements meet the above criteria, a summary matrix was compiled and the sum of points was calculated (1 criterion - 1 point). Settlements with a score of 2 and above were classified as multifunctional, the rest - as monofunctional (with the exception of settlements with 2 points according to the sum of criteria 5 and 6 - monofunctional ports of the Northern Sea Route of the first order). Rotational camps were classified as a separate type due to their high specificity: their supply schemes are weakly dependent on public transport infrastructure, their functional role is radically different, they are focused on servicing a specific field, and not the surrounding area. In addition, in some cases, important transport facilities or large fuel and lubricant warehouses are located in settlements with a population of less than 500 people - such settlements are also proposed to be included in the number of support ones, despite the fact that in all other cases only settlements of larger numbers are taken into account.

ONP and ZATO for socio-cultural provision of the populationAZRF. A key factor in performing the functions of an ED in this area is the availability of medical institutions, so the main feature of an ED will obviously be the presence of a medical institution with a license to provide medical services. When selecting the criteria for identifying EDs and ZATOs in the field of sociocultural support, an assessment was made of the zones of influence of potential ZATOs and EDs in which medical institutions are located, using Voronoi testing grounds, however, as in the case of administrative centers, the picture did not adequately reflect the real situation. Unfortunately, the situation in reality is close in its inefficiency to the calculated one: interviews with specialists showed that often the nearest medical institution is not authorized to provide the required volume of medical care, which sometimes creates a threat to the life and health of patients. Therefore, in the future, it is advisable to conduct a detailed study of the transport accessibility of Arctic settlements, especially significant for roadless areas. Based on the results obtained, a selection will be made of objects as reference settlements, which are the points of best transport accessibility for the maximum number of residents and workers in the "zone of influence" (the latter case is a special problem, since it requires taking into account not only permanent residents, but also shift workers, accounting which have not yet been systematized).

As a result, it was proposed to distinguish EDs and ZATOs according to the existing classification of the level of service: state regional/district and interdistrict medical institutions, as well as maternity hospitals of any category - category I; city and district hospitals, clinics and dispensaries - category II.

However, in off-road conditions, proximity to the point of medical care is of critical importance, therefore, a differentiated approach to the selection of criteria for identifying emergency departments depending on the transportsituations. For settlements located inroadless subzone of the Russian Arctic, it is proposed to identify an additional type of emergency medical service for socio-cultural support of the third order according to the criterion of the presence of any state (medical and midwifery stations, outpatient clinics) and non-state medical organizations (including medical organizations in the department of mining companies). However, the allocation of this subcategory of emergency departments is advisable subject to the subsequent implementation of measures to create the possibility of providing emergency medical care in these medical organizations. In addition, it is recommended to include all settlements in which state first-aid posts and outpatient clinics are located as a type of emergency social and cultural support, regardless of the transport situation.

Besidesmedical institutions, the grounds for identifying support settlements included objects of cultural and natural heritage of federal significance, as well as, based on the application criterion, settlements with institutions that contribute to the preservation and development of the culture of the indigenous and/or old-timers, as well as institutions providing services to the population of the surrounding territory in an amount of at least 25% of the volume of services provided to the population at the location of such institutions.

Criteria for identifying ONP and ZATO in the sociocultural categoryprovision. Subcategory of ED and ZATO - medical care centers, namely:

type of emergency department - medical care center Irow:

the presence of public medical institutions at the regional/district or inter-district level or the presence of a maternity hospital at any level;

type of SNP - centerprovision of medical care of the second order:

the presence of public medical institutions: hospitals, clinics or dispensaries at the district or city level.

In some cases, hospitals and other medical institutionsat the national level are located in settlements with a population of less than 500 people - such settlements are also proposed to be included in the number of support ones, despite the fact that in all other cases only settlements with a larger population are taken into account:

type of emergency department - medical care centerIII order, at least one of the following conditions must be met:

availability of public medical institutions: paramedic and midwife station, outpatient clinic;

the presence of a medical institution of any category and form of ownership in populated areas of the roadless zone (subject to the implementation of measures in accordance with the recommendations).

View of the SNP with natural and cultural heritage sitesdiya (for developed and roadless subzones of the Russian Arctic):

the presence of natural and cultural heritage sites of federal significance.

Type of ONP and ZATO for cultural development (declarative):

the presence of cultural institutions aimed at preserving and developing the culture of indigenous minorities and/or the old-timer population;

the presence of cultural institutions that provide services to the population living outside the locality (including tourists), in an amount of at least 25% of the volume of services provided to the population living in the locality.

ONP and ZATO in the field of innovation and information supportsocio-economic development of the Russian Arctic. In this category, the key feature chosen is an indicator often used in studies of the region's innovative potential—the presence of a university; in Russian conditions, these are institutions of higher education, as well as organizations included in the system of the Russian Academy of Sciences. Thus, as a criterion for ONP and ZATO in the field of innovation and information support for the socio-economic development of the Russian Arctic of the first order, the criterion of the presence of a state higher educational institution and/or state scientific institutions directly subordinate to federal executive authorities was chosen (in the latter case we are talking about such important institutions as the federal state budgetary educational institution of higher education, located under the Ministry of Health of the Russian Federation, the Northern State Medical University in Arkhangelsk - an ancient forge of medical personnel for the Far North, as well as two branches of the departmental scientific institute - the federal state budgetary scientific institutions "All-Russian Research Institute of Fisheries and Oceanography" in Murmansk and Arkhangelsk (Federal Agency for Fisheries).

Taking into account the specifics of the Arctic, it is of great importanceThere are also a number of scientific institutions, often of a small scale: scientific testing grounds and laboratories (for example, the Igara geocryological laboratory of the P. I. Melnikov Institute of Permafrost Sciences of the Siberian Branch of the Russian Academy of Sciences, the Integrated Geophysical Station of the Yu. G. Shafer Institute of Cosmophysical Research and Aeronomy Siberian Branch of the Russian Academy of Sciences in the village of Zhigansk of the Republic of Sakha (Yakutia), North-Eastern Scientific Experimental Station in the village of Chersky of the Pacific Institute of Geography of the Far Eastern Branch of the Russian Academy of Sciences and many others). Unfortunately, it was not possible to compile a

guaranteed complete list of such scientific institutions even with the help of a request to the Ministry of Science and Higher Education of the Russian Federation. Therefore, it was decided to introduce a declarative criterion for determining SNP in the field of innovation and information support for the socio-economic development of the Russian Arctic of the second order - based on the list of secondary scientific and educational institutions of the Russian Arctic as a preliminary list. In addition to scientific stations and testing grounds, it includes the following types of scientific and educational institutions: branches of state educational institutions of higher education; non-state educational institutions of higher education (headquarters or branches); government institutions implementing secondary specialized education programs; scientific organizations established by state authorities of the subject (as an example, the state government institution of the Yamalo-Nenets Autonomous Okrug “Scientific Center for Arctic Research”); educational organizations in the field of additional professional education, established by federal executive authorities (the federal state autonomous institution of additional professional education “Arkhangelsk Aviation Training Center” of the Federal Air Transport Agency is extremely important for staffing the Russian Arctic - it trains helicopter pilots); scientific laboratories, testing grounds, hospitals with a permanent staff of scientists in the department of state scientific institutions (except for stations within the structure of Roshydromet); branches of a state scientific institution with a small number of employees (a striking example is the Research Institute of Agriculture and Ecology of the Arctic - a branch of the Federal State Budgetary Institution "Krasnoyarsk Scientific Center of the Siberian Branch of the Russian Academy of Sciences"); Directorate of state reserves or national parks. However, many departmental, private, and regional enterprises and organizations operating in the field of R&D remain outside these criteria. To take them into account, it is also proposed to use application criteria. In total, the following system of criteria is proposed.

Subcategory of ONP and ZATO in the field of innovation and information support for socio-economic developmentAZRF:

type ONP and ZATO - centers of innovation and informationfirst order security:

the presence of a state higher educational institution and/or state scientific institutions directly subordinate to federal executive bodiesauthorities;

type of ONP and ZATO - centers of innovation and information support of the second order (application criterion):

the presence of one of the following types of scientific and educational institutions: a branch of a state educational institution of higher education; non-state educational institution of higher education (head office or branch); a state institution implementing secondary specialized education programs; a scientific organization established by government bodies of a constituent entity of the Russian Federation; educational organization in the field of additional professional education, established by the federal executive body; scientific laboratory, test site, hospital with a permanent staff of scientists in the department of state scientific institutions (except for stations within the structure of Roshydromet); a branch of a state scientific institution with a small number of employees; directorate of a state reserve or national park;

type of ONP and ZATO - specialized R&D centers (application criterion):

the presence of enterprises and organizations of private, regional and municipal ownership,carrying out activities in the field of scientific research and development (or their separate divisions, OKVED code 72) provided that they meet the criteria for the intensity of activity in the field of R&D;

type of ONP and ZATO—exploration support centers (declarative):

the presence of enterprises in the field of geological exploration (OKVED code 71.12.3 Geological exploration, geophysical and geochemical work in the field of subsoil study and reproduction of the mineral resource base), provided with the necessary minimum infrastructure: a fleet of all-terrain vehicles, staff, a core storage facility and/or a stone storage facility of a certain area;

type of ONP and ZATO—centers for providing specializedinformation (application):

presence of enterprises operating in the field of geodesia and cartography, hydrography,ecology and environmental management, geophysical and heliophysical work, architecture;

viewONP and ZATO—centers for the implementation of experimental technologies (application):

Availabilityenergy generation sources with a capacity of more than 100 kW using alternative fuels;

the presence of laboratories and testing grounds specializing in the testing of innovative equipment and/or technology.

ONP and ZATO administrative organizational and service support for the mining industry

To systematize indicators, all types of activities in mining industry were mergedinto the following groups, namely:

gas production;

oil production;

mining of gold-platinum ores;

diamond mining;

extraction of other solid minerals.

For each group, production indicators and reserve availability were analyzed (the ratio giveninformation about reserves and production

levels), production dynamics over five years in two different ways, namely:

for licensed areas that fully or partially fall within a zone with a radius of 150 km from each populated area;

for licensed areas associated with the head and/or regional office of the company that owns the license for the extraction of minerals in the corresponding licensed areas.

Both methods have their own characteristics and limitations for use. Linking data to the area around a settlement may in some cases (especially for small settlements) give a false connection between the settlement and the mining industry (for example, no further than 150 km from the village of Nelmin Nos in the Nenets Autonomous Okrug, hydrocarbon production is carried out, but the village is not is the production or personnel base for their extraction). Linking data on production and reserves to the location of the head or regional office of the company - the owner of production licenses in the relevant areas potentially more adequately reflects the economic base of settlements (locations of company offices), but due to the specifics of registration of licensed areas, data on them in some cases do not reflect connections with the local production base: the license area relates only to the company's head office in Moscow. In most cases, however, linking reserves and production indicators to specific localities where the company's offices are located is considered adequate, which makes it possible to estimate, as a first approximation, the potential for natural resource production in those license areas for the development of which a specific city—the location of the company's office—is the management authority base. Similar assessments were carried out for 20 leading companies in mining in each of the identified categories. The offices of these companies are shown on the "Decision Making Centers" map (in two general categories: in the oil and gas complex and in the mining industry, including gold mining).

A populated area, however, can be the base for the development of a deposit, even if there are no company offices there (for example, Pevek for the Kinross Gold company, which mines gold at the Kupol deposit). Often, service departments and other contractors are present in such cities and towns, and workers are located (including for permanent residence, etc.). For a preliminary assessment of the range of such settlements - potential candidates for the status of support settlements - supply bases for the mining industry, the first criterion was used, based not on the organizational, but on the spatial proximity of the settlement and mining sites, namely data on a set of sites within a radius of 150 km from the populated area. To level out errors and exclude settlements that are not involved in the production of raw materials, it is necessary to use a declarative criterion.

Subcategory of ONP and ZATO administrative and organizationaltechnical and service support for the mining industrysti:

type of ONP - mining industry support centers1st order laxity:

the presence of the head office of a company that is one of the largest 20 producers of the Russian Arctic in the corresponding group of mining industries (or the head office of its separate division or subsidiary) subject to the condition of estimated reserve availability in the licensed areas of the distributed subsoil fund, licenses for the use of which belong to this company, for a period of at least 20 years.

Despite the development of universal criteriaallocation of ONP and ZATO - centers for supplying the extractive industry of category I, the company can submit an application to revise the list of ONP of this subcategory based on a package of licenses for the extraction of mineral resources and reports on current production (application criterion);

type of ONP - mining industry support centers 2nd order laxity (declarative criterion):

- a joint application of local government bodies in whose department the given settlement is located, and a company (group of companies) extracting minerals in licensed areas of the distributed subsoil fund within 150 km from the given settlement (based on information about the package of licenses for the extraction of minerals minerals and reports on the current production of a company or group of companies mining mineral resources in licensed areas within 150 km from a given locality) (application criterion), and data on service enterprises technologically related to ensuring the extraction of mineral resources. The application must contain evidence of simultaneous compliance in a given locality with the following conditions, namely:

1) the estimated provision of mineral reserves in a separate group of mining industries in licensed areas of the distributed subsoil fund located within 150 km from a given locality exceeds a period of 20 years;

2) average base increase for the 5 previous years beforethe yield of mineral resources of the same group of industries in licensed areas within 150 km from a populated area exceeds 0.1;

3) location in a given locality of service enterprises and organizations technologically related to ensuring the extraction of mineral resources.

Despite the declarative principle of determining this type of SNP and ZATO, a preliminary list of SNP and ZATO is presented, determined on the basis of the following criterion: the estimated supply of mineral reserves in a separate group of mining industries in the licensed areas of the distributed subsoil fund, located within 150 km from a given populated area point, exceeds the period of 20 years; the average base increase over the previous 5 years of mineral production of the same group of industries in licensed areas within 150 km from a populated area exceeds

0.1. If in the settlements of this preliminary list there are service enterprises technologically related to the extraction of mineral resources, such settlements can apply for inclusion in this type of ONP and ZATO - centers for supporting the mining industry of the second order;

type of ONP - promising centers for supplying the mining industry (preliminary list forclarifications based on applications):

a populated area that is the closest to a licensed area of a distributed subsoil fund (a group of adjacent license areas), but no further than 200 km from it, where it is planned to put into operation new deposits of solid minerals or hydrocarbons with a production potential for a period of at least 20 years and a potential average the annual production volume over the next 20 years is at least 1% of the annual production volume of the corresponding type of minerals in the Russian Arctic (according to a joint application of the company - the license holder and municipal authorities).

Proposals for the list of support settlements of the Russian Arctic based on the selected criteria.

Based on the identified criteria, 3 main categories of SNP were identified, and the third category - SNP for ensuring socio-economic development - is divided into five subcategories, distinguished according to universal and/or declarative criteria. In some subcategories, individual types of SNPs are additionally identified. A complete list of proposed support settlements by category, subcategory and type (for some subcategories) is presented in the Federal Law of the Russian Federation; In addition, a cartographic display of the proposed SNP system is presented for individual categories and subcategories in the Federal Law of the Russian Federation. The functions performed by ONP and ZATO in ensuring national security and socio-economic development of the Arctic with the chosen approach are presented in the Federal Law of the Russian Federation.

Proposed method for isolating SNPs and pre-sex CATOsmakes it possible to include the same populationa particular point into different categories and subcategories of support settlements - for example, if it has both strategic, transport and logistics significance, and is also important as a point of information support for socio-economic development. The greater the number of subcategories of the UNP a specific locality is included in, the higher its cumulative impact on ensuring national security and socio-economic development of the Russian Arctic. A system of points was developed showing the degree of cumulative impact of the SNP on ensuring national security and socio-economic development of the Russian Arctic, based on the number of cases of inclusion of a given SNP in different subcategories of SNP, identified according to universal criteria (inclusion in subcategories of SNP of the first order - 2 points, inclusion in subcategories of II order SNP - 1 point). At the same time, it is possible to include settlements in additional types of SNP, allocated according to the application criteria, which will lead to an increase in the sum of points of the cumulative impact of SNP on ensuring national security and socio-economic development of the Russian Arctic.

However, the analysis carried out allows us to establishto develop the primary hierarchy of the ONP and ZATO according to the degree of diversity of impact on ensuring national security and socio-economic development of the Russian Arctic (without taking into account the stronghold settlements allocated on the basis of the application principle). In total, the list of settlements included in this hierarchy included 180 settlements of the Russian Arctic (in two cases - in the subcategories of the SNP of innovation and information support for the development of the Russian Arctic of the second order and the SNP - centers for supporting the extractive industry of the second order - during the formation of this hierarchy of the SNP and ZATO preliminary lists of support settlements, compiled according to a narrowed set of criteria, are taken into account; in the final version, it is planned to form a list of SNPs of these types according to the declarative principle).

In the proposed system of criteria, the reference populationThe main points of the Russian Arctic are divided according to the number of directions and the strength of influence on ensuring national security and socio-economic development of the Russian Arctic into the following four groups:

1. Key support settlements with maximum impact on ensuring national security and socio-economic development of the Russian Arctic: Anadyr,Apatity, Arkhangelsk, Dudinka, Kirovsk, Murmansk, Nadym, Naryan-Mar, Novy Urengoy, Norilsk, Noyabrsk, Salekhard.

Key settlements with a medium level of impact on security national securityand socio-economic development of the Russian Arctic: Batagai, Vorkuta, Gubkinsky, Iskateley, Kandalaksha, Kola, Kostomuksha, Krasnoselkup, Labytnangi, Monchegorsk, Onega, Pevek, Polyarny, Provideniya, Severodvinsk, Segezha, Tazovsky, Tarko-Sale, Tiksi, Tura, Turukhansk, Coal Mines, Usinsk, Khatanga, Chersky.

Key settlements with limited impact on ensuring national security and socio-economic development of the Russian Arctic: Amderma, Belaya Gora, White Sea, Belomorsk, Bilibino, Vidyaevo, Gadzhievo, Dikson, Zhigansk, Zaozersk, Zyryanka, Igarka, Inta, Kamenka, Karaul, Kem, Kovdor, Lovozero, Mezen, Muravlenko, Cape Kamenny, Nadvoitsy, Nikel, Novodvinsk, Nosok, Olenegorsk, Ostrovnoy, Polyarnye Zori, Severomorsk, Snezhnogorsk of the Murmansk Region, Snezhnogorsk of the Krasnoyarsk Territory, Solovetsky, Srednekolymsk, Umba,

Urengoy, Ust-Tsilma, Chokurdakh, Egvekinot, Yar-Sale.

Key settlements of local importance (in bold highlighted populated points with a population of less than 500 people or rotational camps with infrastructure that isThis is the basis for classification as a SNP): Beringovsky, Aksarka, Antipayuta, Antsiferovsky Bor, Anyuysk, Barentsburg, Batagai-Alyta, Belushya Guba, Bovanenkovo, Bolshoye Anisimovo, Bor, Borovoy, Vaegi, Valdai, Varandey, Velikovisochnoye, Verkhneimbatsk, Verkhnyaya Inta, Verkhoyansk, Volochanka, Vorgashor, Vorogovo, Gaz-Sale, Gyda, Dalnie Zelentsy, Deputatsky, Dolgoshchelye, Zapolyarny, Zelenoborsky, Zotino, Indiga, Kalevala, Kanchalan, Karatayka, Karpogory, Koashva, Kolymskoye, Krasnoye, Kutopyugan, Lavrentiya, Leshukonskoye, Longyugan, Loukhi, Lugovoi, Maloshuika, Markovo, Meinypilgyno, Muzhi, Nakhodka, Nelmin Nos, Nenoksa, Nes, Neshkan, Nivsky, Nizhneyansk, Nizhnyaya Pesha, Novorybnaya, Novy Port, Nyda, Oksino, Olenek, Olenya Guba, Oma, Pangody, Pinega, Pravokhettinsky, Primorsky, Priozerny, Purovsk, Purpe, Revda (Murmansk region), Ryrkaipiy, Rytkuchi, Sabetta, Samburg, Saskylakh, Safonovo, Svetlogorsk, Severny, Severomorsk-3, Seyakha, Surinda, Syndassko , Telviska, Tolka, Tukhard, Uemsky, Ust-Belaya, Ust-Kara, Ust-Kuiga, Uelen, Khalyasavey, Khanymey, Kharampur, Kharp, Khatyrka, Kheta, Khonuu, Khorei-Ver, Chupa, Yagelny, Yamburg.

It is also expected that additionala comprehensive list of support settlements on a declarative basis in those subcategories where this is provided.

An approximate package of measures to support support settlements by selected categoriesand subcategories.

Measures of state support for supportingIt is advisable to divide the settlements of the Russian Arctic into two packages: a general (single) package of support measures and packages of support measures for individual categories (subcategories, types) of support settlements of the Russian Arctic. The latter, in turn, are divided into packages of regular measures focused on state support for categories, subcategories and types of support settlements in the Russian Arctic, identified according to universal criteria, and specialized, focused on subcategories and types of support settlements in the Russian Arctic, allocated according to the declarative principle. The first, general package of support measures is aimed at preserving the ONP and ZATO as the most important populated centers in the Arctic. The need to implement this package of measures is determined by the negative impact of the characteristics of the Arctic on socio-economic development as a whole: specific natural conditions require additional costs for heating and lighting, as well as for organizing seasonal storage of fuel, food and other goods in case of limited delivery times; a sparse network of settlements and low population density prevent economies of scale in the production of goods and services (practically depriving Arctic settlements of competitive advantages over more southern settlements in most areas of economic activity); the poor development of transport infrastructure requires additional transportation costs. Since the preservation and development of support settlements in the Arctic is critical for the socio-economic development of the Arctic as a whole (including for ensuring safe navigation along the Northern Sea Route and the Arctic transit transport corridor, as well as for the development of mineral resource centers), the preservation of fully functioning support settlements in the Arctic requires state support. The overall package of measures includes measures to improve the comfort of the urban environment and eliminate the consequences of population decline in recent decades (measures for controlled compression of actively used urban space, demolition of empty buildings, etc.), as well as to ensure socio-economic development with qualified personnel.

In the latter case, it is advisable to implement a program/subprogram for providing personnel to the enterpriseties and organizations of support settlements on terms of co-financing with municipal and regional authorities, as well as on PPP terms (depending on the form of ownership of enterprises and organizations - potential recipients of new personnel) or with full federal funding (federal enterprises and organizations - Federal State Unitary Enterprise, etc.). Taking into account the peculiarities of attracting personnel identified during the anthropological study, such a program should include, for example: facilitating internships for university students located outside the territory of the Russian Arctic - at enterprises of the Russian Arctic; in the absence of places in state preschool educational institutions - compensation for the costs of care and supervision services for preschool children, etc. Work with experts showed that in order to attract personnel to the educational institutions of the Russian Arctic, it is advisable to use a new mechanism for the Russian Federation, namely the creation of institutions for attracting remigrants (persons who have both experience living in the Arctic and experience working/studying outside it) - by analogy with Chinese practice, as well as the practice of some private companies.

The second group of measures is represented by specialized packages of measures differentiated by individual categories and subcategories (in some cases, by individual types) of support settlements and closed administrative territorial entities of the Russian Arctic.

Conclusion

The conducted research convincingly showsthat the patterns of urban development, as well as their functions, are unique in the Arctic, mainly due to poor connectivity between populated areas due to harsh climatic conditions.

Arctic cities and settlements demonstrate a number of paradoxes or special cases of the development of urban interactions that must be taken into account when forming a specialized system of supporting settlements in the Arctic.

1. In the Arctic, a special type of network interactions between cities and settlements is being formed ("extended network region"), in the absence of high transport connectivity, it is held together according to a problem principle: cities interact within this system in order to solve common, region-specific problems.

Analysis of the functions of Arctic cities allowed you reveal There are not many activities based on intra-Arctic networking. This is the training of specialized personnel (pilots, doctors, etc.) with specific competencies; this is ensuring security, where the network principle is most clearly manifested (in the entire Russian Arctic, for example, there are only two marine rescue and coordination centers of the Russian Ministry of Emergency Situations - in Murmansk and the village of Dikson). Within the network region, the "division of labor" (mutual complementarity) between Murmansk and Arkhangelsk is clearly visible. This is a phenomenon that can be confusing when the stereotypical approach about the "correct" model of the region's structure as a centralized one is extended to the Arctic, however, in the practice of urban development, such complementarity of the functions of urban centers (provided they closely interact with each other - commodity, information) is quite a normal phenomenon, Moreover, historically, such forms of urban systems are associated precisely with the most dynamically developing areas with high innovative potential. What is noteworthy is the "under construction" of this network in the eastern part of the Russian Arctic, and here it is logical to complete the construction of our own subcenters of the general Arctic urban network. Norilsk has the greatest potential to become the third key center of the Arctic network region, and ideally it could be an urban agglomeration of key population centers in the north of the Krasnoyarsk Territory, each of which would also perform its own function in it. This:

Dixon (main specialization in the field of securityresearch on the safety of navigation on the Northern Sea Route, a historically powerful meteorological research center, as well as an obvious center of concentration of cultural heritage, including the as yet undocumented);

Dudinka (port and sociocultural functions);

Turukhansk (nave activity support centersminingindustry and sociocultural center);

Igarka (logistics and sociocultural center, location of a unique permafrost museum and potentially an agricultural production centerfor the population of the agglomeration).

Norilsk in this system can play the role of a hub educational, medical, scientific and cultural center, a logistics platform based on airportsthat and the existing food base, as well as a management and organizational center.

Of course, a condition for the successful development of the Taimyr region agglomeration as the main core of development of the eastern Arctic of Russia is to ensure internal connectivity between all these centers: only under this condition, the interaction of enterprises of the listed settlements could give a synergistic effect for the development of both the north of the Krasnoyarsk Territory and the eastern Arctic as a whole. It is obvious that the specialization of this "third capital" of the Russian Arctic should be most effectively associated with solving problems that are most specific to the eastern part of the Arctic. These are problems of permafrost and climate change, pioneering geological development of the territory, but first of all, ensuring safe navigation and forecasting ice conditions (which was historically provided from Dikson, where the headquarters of the NSR maritime operations was located). Problems with the delivery of goods in difficult ice conditions, which appeared on the NSR in the fall of 2021 (they were called the "Pevek crisis" in the press), make us think about creating an integrated system for ensuring navigation along the NSR. Taking into account the existing division of the Northern Sea Route into the western and eastern parts, it would be advisable to locate such a center in Taimyr.

2. Instead of the classical hierarchical regional system of cities, specific roles are being formed settlements in the settlement network, namely:

base cities, being intermediaries between large cities of the main settlement zone, providing the Arctic with a whole range of services, which in urban studies are usually characterized as "large urban" (research and development, personnel training, etc.),

island cities that provide the population and economic agents in hard-to-reach areas with the necessary set of vital and socially significant services (medical care, government services, communications, etc.). Although many activities are not competitive from a cost perspective, they have a competitive advantage based on uniqueness. As a rule, it is these cities that are the main bases for providing urban services to mineral resource centers.

3. In the Russian Arctic there are many so-called supplier cities with a narrowed range of types of economic activity (cities near fields that do not have the status of district or regional centers, inter-district social facilities, educational and scientific institutions,

etc.). Many of them, however, formally (and often informally) perform the functions of providing social services for residents of the surrounding territory (residents of smaller settlements, including representatives of indigenous peoples, rotation workers who use such cities for recreation, families of military personnel stationed in military camps outside outside cities, etc.). To increase the viability of such cities, it is advisable to take measures to expand them into multifunctional support centers, especially if they have a convenient transport location in relation to areas with a relatively dense rural population and active activity of resource extraction companies. An example of such a settlement is Vorkuta: with a reduction in coal mining, the functions of socio-cultural, transport and logistics and information and innovation support for the development of the surrounding territory should come to the fore, and Vorkuta already performs these functions in relation not only to the adjacent regions of the Komi Republic, but and in relation to the eastern, most inaccessible part of the Nenets Autonomous Okrug, as well as to some areas of the Yamalo-Nenets Autonomous Okrug.

An assessment of the potential for mining within a 150 km radius of all Arctic regions carried out during the researchical populatedpoints, as well as in licensed areas, the licenses for which belong to large companies stationed in Arctic settlements, makes it possible to determine the priority of measures to "complete" the functions of support settlements in cities and towns with raw material specialization. This measure is also important from the point of view of relieving social tension.

The research carried out represents a possible range of applied measures implementation which appropriate in support settlements of different categories and undercategories(according to the proposed list). All measures are aimed at strengthening the functions of support settlements and closed administrative territorial entities already represented in Arctic cities and towns of the corresponding category (the majority of these), or in rare cases at completing the functions of closed administrative and administrative units in highly specialized settlements that have the potential to develop as supporting In addition, it is advisable to develop a system of economic, informational and sociocultural interaction between support and other settlements of the Arctic for the sake of effectively ensuring national security in the Arctic zone of the Russian Federation.

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Issue Article

Shushanik Armenovna Magtesyan
Institute of Service Sector and Entrepreneurship (branch) DSTU
bachelor

Karina Sergeevna Kopaeva
Institute of Service Sector and Entrepreneurship (branch) DSTU
bachelor

Artur Aleksandrovich Blagorodov
Institute of Service Sector and Entrepreneurship (branch) DSTU
master's degree

Vladimir Timofeevich Prokhorov
Institute of Service Sector and Entrepreneurship (branch) DSTU
Doctor of Technical Sciences, Professor
Shakhty, Russia

Galina Yurievna Volkova
LLC TsPOSN «Ortomoda»
Doctor of Economics, Professor
Moscow, Russia

THE RELATIONSHIP AND DISTINCTIVE FEATURES OF ZATOS AND ONPS IN THE ARCTIC ZONE

Abstract: *The article reflects the result of a detailed analysis of all Arctic settlements in Russia with a population of more than 500 people. taking into account not only standard statistical parameters, but also specially collected data on the location of medical and educational organizations, logistics infrastructure (including the largest civilian warehouses of fuels and lubricants), proximity to licensed areas for mining, etc. The research work carried out is the basis for identifying closed administrative territorial formations (CATOs) and support settlements (SUP) of the Russian Arctic. The detail of the analysis allows us to form a flexible system of criteria for support settlements in the field of external and internal security, as centers of socio-cultural support for the population of the Arctic, centers of service and administrative support for the implementation of resource projects, innovative, information and personnel support for the development of the Arctic, as well as placement points unique enterprises and organizations.A closed administrative-territorial entity (CATE) is an administrative-territorial entity created in order to ensure the safe functioning of organizations located on its territory that carry out the development, production, storage and disposal of weapons of mass destruction, processing of radioactive and other highly dangerous man-made materials, military and other facilities for which, in order to ensure the defense of the country and the security of the state, a special regime for the safe operation and protection of state secrets is established, including special living conditions for citizens. The entire territory of a closed administrative-territorial entity is the territory of a municipal entity with the status of an urban district, and a supporting settlement is a settlement located outside the boundaries of urban agglomerations, on the basis of which the accelerated development of infrastructure is carried out, ensuring the implementation of guarantees in the field of education, the availability of medical care, services in the sphere of culture and the implementation of other needs of the population of the territory of one or more municipalities.*

***Key words**: competitiveness, demand, quality, accessibility, innovation, digital technology, economic policy, industrial policy, union of federal, regional and municipal branches of government; profitability, profit, financial stability, stability, purchasing power.*

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Introduction

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A striking example is the weak interaction between the Norilsk industrial region and Igarka. Historically, Igarka was one of the bases for the development of Taimyr (in particular, in the field of providing air communications, vocational education for the peoples of the Far North, and wooden housing construction). However, at present, the development of these cities occurs almost completely in isolation (with the exception of ensuring the operation of power lines, and also, from 2021, providing Internet communications). In many areas, Igarka is artificially "tied" to Krasnoyarsk, and in some cases (providing medical care to women in labor) transportation by plane to Krasnoyarsk 1300 km looks simply blatantly illogical (it is about 200 km to Norilsk, and the capacity to receive Igarka patients is in Norilsk is). At the same time, at the everyday level, connections between Igarka and Norilsk are maintained: privately, residents of Igarka go (in the summer, during the navigation period) to Norilsk for medical care (bypassing existing schemes for the provision of medical services), to sell wild plants, etc.; In Norilsk (Kayerkan), a kind of "diaspora" of former Igarans lives, ensuring the stability of ties (the opportunity to spend the night, etc.).

Establishing connections between Norilsk and Igarka could in the future be mutually beneficial in the following areas (the choice of areas is preliminary, detailed assessments are needed), namely:

production of natural milk for the Norilsk dairy plant on the basis of the Igarsky state farm (currently in a state of crisis, although milk production is still maintained);

restoration of vegetable production in Igarka and supplies to the markets of Norilsk and Dudinka (advantage over imported ones - in freshness, with a loss in price);

provision by medical institutionsNorilsk complex medical services for residents of Igarka instead of Krasnoyarsk (the advantage for Igarka is the reduction of time for transporting patients, the advantage for Norilsk is the expansion of funding by attracting additional patients).

The problem is the lack of transport connections: attempts in the last decade to launch flights to Igarka failed for economic reasons. It seems that flights by themselves cannot in a short time initiate a sufficient number of interactions that would bring flights to the payback mode. It is almost obvious that such flights should receive additional financial support at least for the first time - just as start-up entrepreneurs receive support (in other words, a kind of "transport incubator" should be launched: the long existence of the flight will allow the establishment of business relationships, which, in turn, queue will provide demand for maintaining the route). In addition, it is advisable to combine the launch of a flight with organizational changes, and, in particular, with changes in the medical care system.

Today the Russian urban Arcticthus presents an extremely contrasting picture. On the one hand, there are dozens of cases of depopulation of villages and urban areas - it is not surprising that the subject of research for many Russian scientists is increasingly the problems of "compression", the general inefficiency of Arctic cities, and in the applied sphere one hears the head-on question of whether cities are needed at all in the Arctic. But there is another Arctic - the Arctic of rapidly growing cities, mainly in oil and gas producing regions, and they are characterized by the exact opposite set of problems: the high cost of housing, which creates significant problems in attracting scarce specialists, overloaded social infrastructure - against the backdrop of investments in improvement that are exceptional for Russia. The quality of the urban environment of small "oil and gas" cities would be the envy of residents of many even regional centers in central Russia. However, a retrospective analysis clearly shows that the prosperity of modern oil and gas cities may turn out to be temporary - akin to the prosperity that Igarka, Dikson, Vorkuta and other cities of the Far North experienced in the past. It is obvious that the most prosperous cities of the Russian Arctic are in the boom stage of the frontier cycle (the boom & bust cycle), which has been well studied using foreign materials. A scenario for a successful exit from the resource cycle was proposed by Alaskan economist Lee Huskey - according to his "Jack London hypothesis". Its essence is that a young city during a period of frontier boom can accumulate a critical volume and diversity of economy, which will allow, as the main resource is depleted, to continue the life of the city at the next, post-raw materials stage. That is, the city, according to Husky, must move from the frontier

development scenario to the “normal” one. However, the question of the very possibility of a “normal” scenario for city development in the Arctic is open - here it is necessary to answer the question: which of the niches possible for cities in the urban network are, in principle, open in the Arctic.

The spectrum of roles of Arctic cities in the settlement system: an audittheoretical schemes

Let us consider the theoretical possibilities for Arctic cities to play different roles in the Russell system.nia. There are obviously no major hub cities (alpha cities) in the Arctic: all existing cities are smaller. For the growth of Arctic cities to the level of global ones, what is lacking, first of all, is a sufficient volume of regional markets as supporting structures of the innovative economy: in fact, the entire population of the global Arctic (just over 5 million people) is two to three times less than the population of a “normal” global city - and it is size, as already mentioned, that provides the economic opportunity for diversity necessary for innovative development (the connection between size and diversity is deeply developed in the works of M. Fujita). The second factor is, of course, the poor transport connectivity of the Arctic as a whole. True, Anchorage in Alaska is one of the world's largest air cargo ports (cargo traffic between East Asia, Canada and the USA passes through it), but this is clearly not enough to form a global city in the full sense of the term. Regional capitals—second-order hub cities—are already possible in the Arctic. However, there are some peculiarities here too. In the Russian Arctic, Arkhangelsk, which historically has been the focus of development of a vast territory of the Russian North, most closely meets the criteria for a hub city. The region has a pronounced cultural specificity, completely focused on the regional center, which, in turn, has a strong (for a Russian regional center) system of “knowledge” infrastructure - universities, scientific institutions. The current level of income in this case is not indicative: we are talking about the structure of the regional economy, and here Arkhangelsk is an unconditional, classic regional hub city. The situation in the Murmansk region is somewhat more complicated: the economy of Murmansk has historically been focused on servicing activities related to the sea (navy and merchant fleet, fishing, etc.), while the economy of the Murmansk region is largely associated with mining; It is no coincidence that a kind of competition has developed within the region between scientific institutes in Murmansk and Apatity. However, Murmansk is a nodal center not only and not so much of its own region, but of the Russian Arctic basin as a whole, and here the problem of conceptual understanding of the Arctic as a network region arises. Historically, the Arctic (especially Western European) has similarities with other network regions such as the Hanseatic League and the Mediterranean, and in this regard, the metaphor “Arctic Mediterranean” proposed by A. N. Pilyasov is completely justified. But it is worth paying attention to the fact that network regions, which are a network of interconnected equal nodes (connected “everyone with everyone”), are based on the extraordinary permeability of space. Several centuries ago, when the northern land was an almost insurmountable barrier, navigation (combined with movement along rivers and portages) actually connected the vast Arctic territories of Western Eurasia, and also allowed penetration to Mangazeya and further to Taimyr. Cultural contacts along the sea were so close that they led to a strong interweaving of the cultures of the Norwegians and the Pomors, as a result of which even the hybrid pidgin language “Russenorsk” arose. Yes, compared to the impenetrable spaces of the taiga, the Arctic was extra permeable, and one could quite justifiably talk about the existence of a network region.

Modern science of regional development workThis is true, in fact, with multidimensional space: if the range of a physical distance prevents the development of close connections between, say, a pair of cities, then there may be factors that, on the contrary, contribute to the development of such connections, that is, they seem to compensate for the range of physical distances. To designate such factors that “correct” physical space, the term “proximity” is used; distinguish social, organizational, institutional types of proximity, ensuring close interactions over long distances, thanks, respectively, to social connections, belonging to the same corporate structure, common norms and rules, as well as common areas of activity (cognitive proximity, implying common problems and methods for solving them).

The specificity of the modern Arctic is that its development requires solving a number of very specific problems. This is ensuring health and working ability in extreme conditions, improvement and functioning of the urban economy of polar cities, construction in areas where permafrost occurs, etc. Common to the Russian Arctic is the problem of ensuring navigation along the Northern Sea Route. Paradoxically, it is the commonality of problems - despite poor transport accessibility - that unites Arctic settlements into a single network, and it is no coincidence that this commonality is institutionalized through a number of official organizations: the Arctic Council and the Northern Forum, the UArctic network university, the association of mayors of winter cities, regional structures like the Barents Council region, etc. - perhaps there is hardly another region of the world where such close attention is paid to strengthening intermunicipal and international relations. From a theoretical point of view, this is natural. Due to poor transport connectivity and harsh conditions in the Arctic (with rare exceptions), there is no possibility of building normal regions - however, a “stretched” network region is being built, in which

the interaction of remote cities is enhanced due to cognitive and gradually organizational proximity. This proximity is based on a commonality of problems: the modern Arctic network region is being formed around the arrangement of life in conditions of Arctic specifics. This is precisely the niche of competitiveness of Arctic cities: for them, among the few areas of activity, competitiveness in the field of uniqueness, the ability to satisfy the narrow, but very specific needs of Arctic consumers in their own and other Arctic cities turns out to be open. It is the ability to satisfy the specific needs of local consumers (thanks to local knowledge) that is one of the foundations of competitiveness and, in general, the viability of Arctic and northern cities. One of the striking examples is the preservation of the machine-building plant in Magadan in the conditions of the collapse of many domestic mechanical engineering enterprises: its products (washing devices) are focused on the characteristics of the gold sands of specific Kolyma deposits.

The existence (albeit in a weakly expressed form) of an Arctic network "extended" region (due to cognitive, "problematic" proximity) has a direct consequence for solving the problem of support settlements in the Arctic zone of the Russian Federation. It means that the development of the Arctic as a whole is influenced by those settlements that are involved in the network exchange of innovative, information products, as well as other products aimed at meeting the specific demand of Arctic consumers. What is important here is the focus on specificity, and not on production volumes, since competition is built precisely on the advantage of uniqueness (and even monopoly). At the same time, the very principle of functioning of a network region means that the role of a city or town in the economy of such a region is not directly related to size: a small settlement can be quite viable in such a system if it is a monopoly, a unique producer of uncontested products.

The size of this niche should not be overestimated, however, in conditions of a very narrowed range of species, it is more economicalical activities, which in principle can be effective in the Arctic conditions, this area should be given the closest attention.

Note: different systems of urban interrelations can overlap and mutually penetrate each other, just as global cities are simultaneously included in global and their own regional networks.ty (New York is a business center both on a global scale and in the northeastern macro-region of the United States) - and the Arctic "extended" region forms connections that are additional to the classic regional ones, at least in relation to the Murmansk and Arkhangelsk regions.

Further analysis shows another system of interconnections between settlements emerging in the Arctic, and again atypical. We are talking about interaction in the North-South system. This topic is one of the most developed in domestic science and practice in connection with the study of areas of new development. In the applied sphere, at the end of the Soviet period, an idea was formed of a hierarchy of so-called development bases from rear (outside the Far North) to outpost ones. It is to the system of hierarchy of development bases that a number of later proposals for identifying the supporting cities of the Arctic and the Far North go back. It is interesting that even then development bases were understood paradoxically in a post-industrial context - as "spatio-temporal concentration of development services"; this definition was given in the late 1970s by A. A. Sysoev, a representative of the Kosmachev school of research into pioneer development of the territory.

In terms of different types of systems of inter-city economic interactions defined above, the system of development bases can be interpreted as another "extended" region, but this time not a network, but a hub: as a rule, Arctic cities are "tied" to a certain rear base (as this called in Soviet times). The existence of such "extended" regions is clearly manifested in the field of migration. Here, there are migration flows of extraordinary strength, inexplicable from the point of view of ordinary migration factors, between the northern regions of the country and some southern ones: between the Murmansk, Arkhangelsk regions and St. Petersburg, between the Komi Republic and the Kirov region, between the Yamal-Nenets Autonomous Okrug and the south of the Tyumen region, the Kurgan region and some others. Powerful migration (as well as economic) ties over such large distances would not be possible if it were not for additional fuel and additional factors of proximity. Initially, these connections were formed largely in the conditions of the frontier, that is, super-profits due to the rapid commissioning of large volumes of natural resources and the concomitant development of the Northern Sea Route. Like the "archipelago" of cities of the nuclear project, a system of long-distance connections between the North and the South, between rear and outpost bases, was formed in the space of the country, and the functioning of connections over long distances could not be carried out without additional replenishment of resources due to frontier conditions for resource development or additional funding for the development of the North due to the strategic aspects of this process. Research shows that in modern conditions (after a significant weakening during the economic crisis of the 1990s), such long-distance connections continue to be maintained through already established networks of fraternities, and often organizational structures (branches in the North of southern universities, real estate agencies, etc.) etc. simplify contacts between North and South).

What do such connections provide for the development of Arctic cities? Dov and what do the

Arctic cities themselves provide to these connections? In essence, Arctic cities make up for the lack of large cities in the Arctic itself through long-distance connections with "rear bases". From the rear bases they receive the very driving forces of innovative development that large cities provide to their regions: these are the products of research centers for the development of new technologies and new equipment, this is personnel training, this is, finally, access to the sphere of culture and art, which is inaccessible in small towns (theaters, advanced galleries, etc.).

Arctic university cities reliablyare the forges of personnel for the Arctic zone of the Russian Federation. In particular, more than 90% (of the total number of employed) graduates of the Murmansk Arctic State University, the Murmansk branch of the Russian Academy of Economy and State University, the Northern (Arctic) Federal University in Arkhangelsk and its branch in Severodvinsk, the Institute of Management in Arkhangelsk, and the Noyabrsk Institute of Oil find work in the Arctic and gas; 100% of graduates of the Apatity branch of the Murmansk State Technical University are employed. Mostly, employment takes place in the region of study, although some universities train several dozen people not only for their own, but also for other regions of the Arctic: Murmansk State Technical University - with a degree in navigation (mainly for the Arkhangelsk region), Northern (Arctic) Federal university - for the Komi Republic, Murmansk region, Nenets Autonomous Okrug, etc. In general, Arctic universities are at least two thousand graduates employed in the Arctic zone of the Russian Federation annually.

For comparison: all Tyumen universities give for Arktiki - mainly Yamalo-Nenets Autonomous Okrug - approximately 800 people, which is less than what the Northern (Arctic) Federal University trains alone.

In turn, Arctic settlementsstep by consumersgoods and services of their hub cities (from food to high-tech services).

It is this type of connection (nodal city - regional periphery) that allows us to say that between SeIt is the regions that are formed by faith and the South. However, these regions are special because they are literally stretched over distances for which, under normal conditions, intra-regional connections are usually no longer effective. In addition, Arctic cities have a special function: they not only serve as consumers of goods and services from their "rear bases," but also act as conductors of their influence further into areas of new resource development (which in modern conditions is increasingly carried out on a rotational basis). Arctic cities here are distribution centers for the supply of food and household goods, equipment and fuel, and gathering points for rotational crews. Here, "intermediate" points in the higher education system are often created - branches whose students complete their studies at base universities to the south. Intermediate links in the chains of providing fundamental services are also formed here (for example, fundamental geological research is concentrated in scientific organizations in the main settlement zone, while expedition bases, granaries, etc. are concentrated in the Arctic). The role of distribution centers (outpost bases) distinguishes Arctic cities from "ordinary" peripheral hub cities of lower orders. The latter are more characterized by production functions, as well as the provision of goods and services to the immediate periphery (which, in turn, forms a sales market for them). In Arctic cities, due to specific conditions, there are almost no production functions (with rare exceptions), so the importance of transport, logistics, distribution functions increases radically - this is the first thing. Northern cities almost do not receive flows of daily (pendulum) migration from the immediate periphery, as is typical for ordinary cities, but they themselves often turn out to be a hotbed of rotational migration to neighboring (or remote) mining areas, in other words, peculiar "agglomerations inside out" - and this is their second difference. Third, the level of connectivity of such cities with their regional center is still very weak. Figuratively speaking, instead of a regular minibus or train, you have to travel to a hub city by plane with a corresponding increase in travel costs, which forces you to transfer to northern cities some of the functions that would normally be available in a regional center (for example, in northern base cities it is usually presents a wider range of household services than in cities of the same size in the main settlement zone).

In some cases, northern base cities can be considered not only as intermediate points betweenbetween the rear base and resource development areas, but also as "island cities" - a completely special type of city, apparently represented only in sparsely populated areas of the world and partly described in the concept of remoteness, which is gaining popularity abroad. Located in remote, transport-isolated areas, they are no longer so much conductors of city services as their sole suppliers for a territory with a radius of thousands or more kilometers. In other words, where, under favorable conditions, a full-fledged region could have developed, in fact there is one city, which is practically an unalternative center for the provision of many types of services, and it is this unalternativeness that serves as the basis for its viability in Arctic conditions.

It is obvious that maintaining the internal diversity of economic activities in suchinsulator cities require extraordinary costs (among domestic scientists, the Soviet economist Yu. V. Yaremenko paid attention to this aspect), therefore, as a rule, they are formed in frontier regions (that is, areas of excess income), which is fraught with weakening of functions in conditions of depletion of the corresponding deposits. And if, for example, Norilsk

is capable of providing a fairly wide range of services (from scientific research to providing access to modern leisure infrastructure such as specialized cafes, a water park, sports facilities, etc.), then remote island villages, as a rule, provide only vital a set of services: emergency medical care, secondary (sometimes specialized secondary) education, simple banking services, government services, internal security, road and energy services, communications, bread baking. As in the case of the existence of a networked Arctic region, the development of such settlements would be economically ineffective if not for the factor of their uniqueness in the conditions of sparsely populated areas, where, despite their small population, there is nevertheless a demand for these services from indigenous people.

Such “cities of captivity” are often carried out in Arktickfunctions that in the main settlement zone would be performed by much larger settlements. Thus, a city of 30 thousand in the so-called Moscow region could be simply a residential area, almost devoid of services (the shortage of which would be compensated for by other accessible settlements), but in the Arctic it is absolutely no alternative center in terms of providing, for example, medical care ; Likewise, a city of 100,000 people in the Arctic, in captivity, performs almost metropolitan functions.

Таблица 3. Трансформация функций арктических городов и направления выявления их влияния на экономику Арктики как потенциальных опорных населенных пунктов

Универсальные типы городов	Функции	Система информационных и экономических взаимодействий, в рамках которых реализуются городские функции	Типы городов в условиях Арктики	Функции	Системы взаимодействий	Возможные критерии
1	2	3	4	5	6	7
Глобальные города	Генерация инноваций (и соответствующей институциональной системы) как основы мирового технологического развития	Макрорегионы и сеть глобальных городов	–	–	–	–
Города – партнеры сетевых регионов	Генерация инноваций (и соответствующей институциональной системы) как основы мирового технологического развития	Сетевые регионы (как исключение – растянутые сетевые регионы)	Города – партнеры Арктического сетевого региона	Генерация инноваций (и соответствующей институциональной системы) как основы мирового технологического развития	Арктический сетевой регион	Уровень взаимодействия с другими городами Арктики (в том числе уровень транспортной доступности); уровень развития специфических арктических компетенций

Picture 1.

The phenomenon of island cities forces us to reconsidersighton cities in Arctic mining regions. Cities that, by all indications, should have become “supplier cities” are expanding their functions to the role of island cities - that is, they are becoming uncontested points of medical care, the formation of cultural life, uncontested transfer hubs and trade and distribution bases. This trend paradoxically increases (albeit not much) the viability of particularly remote Arctic cities and towns: being not only strictly production centers (as, however, even decision makers in these cities themselves often think), but also uncontested centers for the provision of services for the surrounding area, they gain the competitive advantage of uniqueness. It can be assumed that this somewhat increases their economic viability in the conditions of colossal Arctic increases in prices associated with impassability, extreme climatic conditions, seasonality of many types of activities, etc. Thus, even a cursory theoretical analysis of the settlement network in the Arctic allows us to identify the main 50 functions of Arctic settlements, determined by their role in the settlement network in specific Arctic conditions (Table 1), and accordingly outline directions along which it would be possible to assess the degree of influence of a settlement on the economic development of the Arctic as a potential supporting settlement of the Russian Arctic. The

following sections will evaluate the validity of this hypothesis regarding the functions of Arctic human settlements.

Main part

Determination of support settlements of the formbased onprovisions of the National Security Strategy of Russia and on the basis of paragraph 43 of the unified action plan for the implementation of the Fundamentals of State Policy of the Russian Federation in the Arctic for the period until 2035 and the Strategy for the Development of the Arctic Zone of the Russian Federation and Ensuring National Security for the Period until 2035 (approved by order of the Government of the Russian Federation dated April 15, 2021 No. 996-r) "Development of a list and mechanisms of state support for the development of settlements in which bodies and organizations performing functions in the field of ensuring national security and (or) functions as a base for the development of geological exploration and mineral resource centers are located , implementation of economic and (or) infrastructure projects in the Arctic."

The definition of national security given in the National Security Strategy of the Russian Federation allows us to specify the expression "bodies and organizations performing functions in the field of ensuring national security are located" as bodies and organizations operating in three main areas of ensuring national security, namely:

*ensuring the security of national information resources of the Russian Federation from external threats, protecting the sovereignty of the Russian Federation, its independence and state integrity (hereinafter referred to as strategic functions);

*ensuring the security of national information protection from internal threats, ensuring the implementation of constitutional rights and freedoms of citizens, civil peace and harmony in the country (hereinafter referred to as functions in the field of ensuring internal security);

*ensuring a decent quality and standard of living, socio-economic development of the country (hereinafter referred to as the functions of ensuring socio-economic development), including the functions of a base for the development of geological exploration and mineral resource centers, the implementation of economic and (or) infrastructure projects. The proposed interpretation of national security means, in particular, that the functions of a base for the development of geological exploration and mineral resource centers, the implementation of economic and (or) infrastructure projects in the Arctic are an integral (and in the Arctic conditions - fundamental) part of the functions of ensuring socio-economic development.

Development criteria and a list of support settlements was carried out taking into account the specifics of the territorial organization of the economy and society in the Arctic, due to the impact of which its general spatial patterns of socio-economic development are violated. The key methodological principle has become a functional one: it is proposed to identify supporting settlements based on the nature of the activities of the enterprises and organizations located in them, taking into account their potential impact on the socio-economic development of the surrounding territory. At the same time, the methodology for determining the list of support settlements in the Russian Arctic is based on the following features of the territorial organization of the economy and society identified earlier, namely:

*first feature- this is the specificity of the local territorial division of labor in areas of new development - the formation of a two-part local economic system, consisting of a settlement (development base) and distributed (usually over a vast area) activities for the primary extraction of natural resources. Although the bulk of industrial products are produced outside the populated area (and often with the involvement of labor employed on a rotational basis), the populated area is an integral part of this system, providing transport, logistics and service services, and, to a large extent, the reproduction of personnel, provision of medical care, etc. However, activities in the field of information and innovative support for mining operations are of particular importance. Services of this kind, provided by enterprises and organizations of the locality (geological work, oil services, etc.), are a key factor in extending the operability of the entire system over time, since they ensure the renewal of resource reserves "in breadth" (new fields) or "in depth" (ensuring the development of hard-to-recover reserves);

*the second feature is the specific role of the settlements of the North in the interregional division of labor in the "North is the main settlement zone" system. Here, populated areas serve as the main "conductor" of development - logistics centers on a trans-regional scale, as well as a base for adapting equipment and technologies developed in key economic centers of the country and the world for the specific conditions of the North and the Arctic;

*the third feature is the network organization of the settlement and economic system, characteristic of the Arctic as a special (network) region. In fact, the system of settlement and economy in the Arctic is a network of relatively weakly connected local centers, while in the main settlement zone of Russia monocentric regions with clearly dominant centers predominate, with which, in turn, all settlements in the region are connected by year-round transport routes (a similar structure - and then adjusted for worse transport connectivity - in the Arctic is represented only in the Murmansk and Arkhangelsk regions; the

Arctic regions of the Republic of Karelia are part of such a system with a center in Petrozavodsk).

The network organization of settlement and economy is characterized by specialization of individual nodes of the system with the exchange of goods and services not according to the "regional center - serviced periphery" scheme, but according to a more complex scheme. In particular, in the Russian Arctic, a kind of "division of labor" often develops between administrative centers, transport hubs and main bases serving mineral extraction areas: Yamalo-Nenets Autonomous Okrug, Chukotka Autonomous Okrug, the Arctic part of the Krasnoyarsk Territory and the Republic of Sakha (Yakutia)); in some cases, scientific and innovation centers (Apatity) are also isolated.

This circumstance makes it impossible to identify a small number of multifunctional support settlements: the network system of organizing settlement and economy in the Arctic must be compared with a system of sufficiently numerous support settlements of different functional specializations (Figure 1).

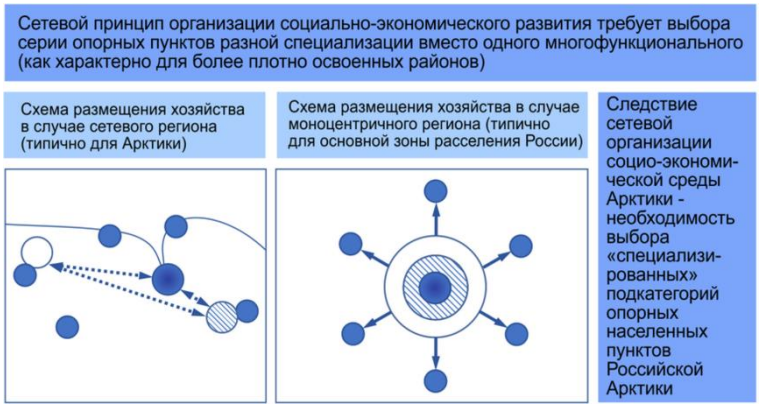

Figure 1. The need to identify specialized intersecting categories of SNP as a consequence of territoriality real organization of the Arctic zone of the Russian Federation

One of Features of the network organization of economy and settlement is a sharp imbalance in the territorial structure of the transport and logistics infrastructure and settlement system. A comparison of these two parameters quite clearly makes it possible to identify settlements that perform the functions of transport and logistics bases for mineral resource centers and other mineral development areas outside settlements.

Spatial "mismatch" of settlement centers (including specific infrastructure for serving the population, in particular food supplies) and centers of transport and logistics services for mining areas brighter Allit manifests itself in the territoryChukotka and Nenets Autonomous Okrug with adjacent areas.

A comparison shows that the bulk of Chukotka's settlement centers are located in the east of the region and in the Chaun-Bilibinsky district, while economic activity is concentrated mainly in the western part of Chukotka, and the supply (judging by the location of fuel and lubricants bases) comes from the west, from the territory of the Republic of Sakha (Yakutia). At the same time, sometimes centers that are extremely small in terms of population play an important role in the transport and logistics support of mining areas; cities located to the south of the territory of the district serve as transport and logistics centers for supplying the Nenets Autonomous Okrug, such as Vorkuta, connected by winter roads to the eastern regions of the Nenets Autonomous Okrug, and Usinsk (central regions of the Nenets Autonomous Okrug). This example shows well, firstly, the interregional significance of many stronghold settlements in the Arctic, even if they are small in population (Usinsk); secondly, according to the above maps, it is obvious that settlements can play the role of a transport and logistics base, which are not stereotypically associated with the logistics functions of servicing remote territories, but only with mining in the immediate vicinity - while Vorkuta turns out to be not only a coal mining center, but also transport "gateway" to the east of the Nenets Autonomous Okrug.

There is a paradox: on the one hand, as already indicatedAlthough higher than the main settlement zone, in the Arctic the functions of administrative management of the region and provision of the extractive industry are often separated in space. On the other hand, on the contrary, cities that are usually considered purely as highly specialized industrial centers (Vorkuta, Novy Urengoy, Noyabrsk, Norilsk, etc.) are in fact also important centers in which enterprises and organizations are concentrated that provide services to the population and economic entities in the surrounding area.

At the same time, the area of provision of such services sometimes extends beyond even the territory of the region in whichlocatedcity: thus, Novy Urengoy serves as a food base for Igarka, Vorkuta for the

eastern regions of the Nenets Autonomous Okrug and even partly the Yamalo-Nenets Autonomous Okrug. It was Vorkuta (which is traditionally associated only with the coal mining industry) that was the base for the construction of the Bovanenkovo - Ukhta gas pipeline (the completion of construction significantly aggravated the economic situation in the city).

Thus, the role of single-industry mining cities in providing logistics services to other areas is usually underestimated. That is why, when developing a methodology for determining reference populationspoints of emphasison their role in the socio-economic development of the surrounding territory, and not only (and not so much) on the activities of the city-forming enterprise.

Let us draw attention to the territorial problem of determining the supporting settlements of the Arctic zone of the Russian Federation: often the functions of the basis for the socio-economic development of the territories of the Russian Arctic are performed by settlements that are not formally included in the boundaries of the Arctic zone of the Russian Federation.

A striking example is Magadan and the Magadan region, which are not formally part of the Russian Arctic, but due to established economic and organizational ties, continue to serve as a base for the development of the Chukotka Autonomous Okrug.

Thus, the Magadan region is now the largest supplier of qualified personnel to Chukotka, as evidenced by the migration index and the absolute number of graduates of Magadan universities employed in Chukotka in recent years (according to the Russian Ministry of Education and Science). The absolute number of such migrants is small - a little more than 30 people per year, but one must understand that this is almost the only flow of qualified personnel to Chukotka: practically no people from other regions of the Russian Federation find employment in the Chukotka Autonomous Okrug. Even from the Khabarovsk and Primorsky territories, the number of university graduates who came to Chukotka is 3–4 times less than from the Magadan region (only 5–10 people). This, by the way, casts doubt on the prospects for organizing a separate Arctic university in Chukotka.

Currently, a branch of the Magadan North-Eastern Integrated Research Institute (SVKNII) is successfully operating in Chukotka. Traditionally, the vast majority of scientific research in various fields (geology and geophysics, ethnology, economics, history, medicine, etc.) on the territory of the Chukotka Autonomous Okrug is carried out by Magadan specialists.

In Magadan, over many decades, a material and information base has also been accumulated for the scientific study of the economic potential of Chukotka (the most significant are geological archives and materials - the most important information base for further research into the resource potential of the Far Eastern Arctic).

The most pressing issue, however, is regarding the completion of the Ust-Srednekanskaya hydroelectric power station, the full capacity of which is designed to provide electricity for the development of the Baimskaya ore zone in the Chukotka Autonomous Okrug. Connecting consumers of the Baimsk ore zone should reduce the tariff for electricity supplied to consumers in the Magadan region, and thereby contribute to the development of the economy and improve the living standards of residents of the region. However, it is currently planned to supply the Baimsk ore zone with electricity through new generation facilities in the north of Chukotka (the construction of the floating nuclear power plant alone is estimated at 190.23 billion rubles), new power lines, shore preparation and other work are also required.

Meanwhile, the supply of the Baimsky mining and processing plant based on the implementation of the socio-economic development of all levels of the Ma energy bridge included in the strategic planning documentsGadan - Chukotka" would, according to existing estimates, be significantly cheaper than the new project. In the future, the construction of a power line at the Baimsky GOK would be the beginning of work to eliminate the isolation of the Chukotka energy system from the Central Energy System of Russia and, in addition, could solve the issues of replacing the retired capacities of the Bilibino NPP and creating an energy reserve. However, the currently implemented supply scheme for the Baimsky GOK essentially ignores the existing development base in the Magadan region and follows the path of forming a new, from scratch power supply scheme from the Northern Sea Route. In addition to direct costs, this undermines the economic sustainability of the “sub-Arctic” Magadan region: the feasibility of such a project from the point of view of the Russian economy as a whole can be questioned.

Since the historical regions of the Far North were formed based on economic bases in the so-called Near North (today, for the most part, these regions are not part of the Russian Arctic), a similar situation can be repeated many times along the southern border of the Russian Arctic.

In this studythis problem was left without consideration, however, in the future it is advisable to identify the entire range of economic and socio-cultural functions of the Russian Arctic in order to identify the range of settlements that actually influence the development of the Arctic.

The analysis convincingly shows that ensuring economic activity in the adjacentterritories (with a radius of up to several hundred kilometers) is one of the most important functions of Arctic settlements within the framework of ensuring national security in the Arctic as a whole.

Supporting functions in the development of the economy of the Arctic zone of the Russian Federation are performed by the following groups of industries concentrated in the Arcticlocal settlements, namely:

*industries aimed at the emergence of newtechnologies,types of activities and/or for the development of new areas of the Russian Arctic - this group of industries can be conditionally called Arctic innovative or Arctic propulsive - this is geological exploration, other specialized scientific research, primarily focused on adapting production processes to the conditions of the Arctic and/or individual territories, fields and so on.;

*industries that provide technical and technological support to already established complexes of extractive industries outside cities (including the production of the main products of mineral resource centers): these are oil services and other services for the extractive industry; production of goods and services to support the work of resource extraction companies outside the urban area: transport support, logistics, banking support, etc.; production and repair of equipment and components; often food supply, etc.;

*managerial and organizational activities to ensure resource extraction activities. The effectiveness of management decisions decreases with increasing distance between the place of decision-making and the place of its application (the so-called institutional distance, the detrimental role of which in the development of the North and the Arctic is shown in the works of Alaskan scientists), therefore it is necessary to locate management structures in cities - development bases (compared to their placement in the main settlement zone of Russia).

Similar security functions are performed byArctic settlements in the social-cultural spheretour services for the entire population of the Russian Arctic (including indigenous minorities, workers hired on a rotational basis, as well as military personnel in the event of their quartering near populated areas). In particular, the role of Arctic settlements is especially great in ensuring the conservation and reproduction of the population in sparsely populated areas of new development and also, obviously, in the sphere of ensuring external and internal security.

It is advisable to base the definition of support settlements in the Russian Arctic on an assessment of the support functions of settlements (Arctic propulsion, service, management, as well as support in the sociocultural sphere, in ensuring internal and external security). In other words, the greater the influence a settlement has on the development of the surrounding territory, the more it can be considered a supporting one.

At the same time, the second specific feature of the role of Arctic settlements in ensuring national security and socio-economic development must be taken into account. In the Arctic, even small settlements can play the role of an organizing center, a development base for the surrounding territory (including mineral resource centers, as well as for areas inhabited by indigenous peoples) on the same scale as larger settlements outside the Arctic usually perform. Therefore, when assessing the degree of influence of Arctic settlements on the development of the surrounding territory, one cannot rely on the size of their population (although many methods for assessing the influence of settlements on the surrounding space are based specifically on population size - these are methods for assessing the potential field, various interpretations of Christaller's concept of "central places" and etc.).

Taking into account these limitations, the fact of the presence of enterprises and organizations of basic types of activity in the settlement (according to the definition adopted above - affecting the development and security not only in the territory of the settlement, but also beyond its borders) can be used as the main methodological method for selecting reference settlements). When developing criteria for support settlements, the following can be clarified: the area of influence of the basic industries of support settlements, the scale of production of goods and services in these industries and other quantitative parameters.

Finally, one more caveat needs to be made. There are a few manufacturing enterprises in the Arctic, which, however, are leading in their industry, significantly influencing the development of the industry and the country's economy as a whole. These are, in particular, the enterprises of the MMC "Norilsk Nickel" - the world's largest nickel refining production in Monchegorsk, as well as the production of nickel matte and semi-finished precious metals - in Norilsk, these are the defense enterprises "Sevmash" and "Zvezdochka" in Severodvinsk, the construction Center for the construction of large-capacity marine structures in Murmansk (Belokamenka) and some others. These enterprises do not fit into the concept of a base, but the cities where they are based, of course, should be classified as the core settlements of the Russian Arctic due to the uniqueness of the enterprises located in them and their role in the economy of the country as a whole. The above provisions lead to the following definition of support settlements.

The core settlement of the Arctic zone of the Russian Federation is defined as a settlement located within the Russian Arctic and in which enterprises and organizations, playing significant role in providing in the locality and the surrounding area one or more of the following areas, namely:

*protection of the national interests of the Russian Federation from external threats, protection of the sovereignty of Russiaskaya Federation, its independence and state centerflatness;

*protection of national interests from internal threats, ensuring the implementation of constitutional

rights and freedoms of citizens, civil peace and harmony in the country;

*decent quality and standard of living, socio-economic development of the country (including serving as bases for the development of geological exploration and mineral resource centers, implementation of economic and (or) ininfrastructure projects in the Arctic).

According to this definition, a specific locality in the Russian Arctic can perform functions within the framework of either one, two or three tasks to ensure national security - depending on the type of relevant enterprises and organizations located in it. So, for example, Severomorsk (a closed administrative-territorial entity) performs functions both in the sphere of ensuring the protection of Russia's national interests from external threats (which is due to the status of a ZATO), and in the sphere of ensuring the quality and standard of living (industrial enterprises - for example, a bakery; and also the social sphere, etc.) and internal security (for example, the activities of departments of the Ministry of Internal Affairs).

To formulate proposals regarding the inclusion of Arctic settlements in the list of support centers, 256 settlements were analyzed Russian Arctic - all settlements with a population of at least 500 people (at the beginning of 2021), for which a total of 57 indicators have been collected (in addition to statistical ones, including indicators of the development of the mining industry within a radius of 150 km from the settlement, characteristics of the transport situation, location government, medical organizations, fuel and lubricants warehouses and food depots, etc.). Additionally, in connection with the analysis of transport development, permanent settlements with a smaller population (22 in number) were considered, in which large fuel and lubricants warehouses and/or large transport enterprises are located, as well as a number of rotational camps with large cargo or passenger turnover of airports.

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Issue Article

Marina Igorevna Salfetnikova
Institute of Service Sector and Entrepreneurship (branch) DSTU
bachelor

Saveliy Ruslanovich Bilich
Institute of Service Sector and Entrepreneurship (branch) DSTU
bachelor

Artur Aleksandrovich Blagorodov
Institute of Service Sector and Entrepreneurship (branch) DSTU
master's degree

Vladimir Timofeevich Prokhorov
Institute of Service Sector and Entrepreneurship (branch) DSTU
Doctor of Technical Sciences, Professor
Shakhty, Russia

Galina Yurievna Volkova
LLC TsPOSN «Ortomoda»
Doctor of Economics, Professor
Moscow, Russia

EDUCATION IS THE BASIC BASIS FOR THE SOCIAL AND ECONOMIC DEVELOPMENT OF THE REGIONS OF THE ARCTIC ZONE WITHIN THE FRAMEWORK OF THE ONP AND ZATO

Abstract: *In the article, the authors analyze why in closed administrative and administrative units of the Arctic zone of the Russian Federation there is an acute problem of a shortage of qualified personnel in the economy, which the regional system of vocational education is designed to level out. The main subject to whom its functioning is directed are school graduates. In this regard, the problem of compliance with the capabilities of the vocational education system to accept and train, at the expense of budget funds, graduates of CATU and ONP schools in the regions of the Arctic zone is being updated. In the context of a shortage of personnel, a decrease in the number of young people among the population, and migration outflow from the Arctic zone of Russia, the issue of training the necessary personnel is especially relevant. In the study, a large place is occupied by the characteristics of the demographic situation and the position of youth in the labor market of the Arctic regions. The authors analyzed a large volume of statistical indicators, on the basis of which calculations were made that characterize the potential of the vocational education system of the subjects of ZATA and ONP and the regions of the Arctic zone. The study is based on general scientific methods, as well as methods of comparison and mathematical modeling. Thus, the article presents the potential of the vocational education system in ZATOs and ONPs and in individual regions of the Arctic zone of Russia for training personnel through the use of their own "regional capital" - school graduates of the 9th and 11th grades. Currently, unfortunately, without the introduction of new elements of the organization of vocational training, the vocational education system of most Arctic regions cannot provide the entire volume of school graduates with mastering the educational program in their native region.*

Key words: *Arctic zone of Russia; the youth; vocational education system, region; population; humanitarian development; education; personnel training.*

Language: *English*

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Introduction

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Due to the enormous size of the territory of the Russian Federation, uneven settlement and economic development, and large differences in monetary income, not all residents of our country have equal access to quality services in the field of education. This, firstly, violates their rights, and secondly, affects the labor potential of those territories where accessibility to educational services is reduced. A decline in the level of education limits the possibilities for innovative development. And this, in conditions of intense competition in the scientific and technological sphere, can weaken the position of the state on the world stage. The level of education of the adult population and education coverage are indicators adopted by the UN to assess the level of humanitarian development. Earlier studies by the authors prove that our country is largely able to maintain high positions in the ranking of countries in the world in terms of human development due to high indicators in the field of education. A decline in the level of education of the adult population and educational coverage of the population will inevitably entail a fall in Russia's ranking positions. In this regard, comparative regional studies devoted to assessing accessibility and identifying problems in the field of education seem very relevant. In areas with low population density, it is difficult to rationally organize the functioning of social infrastructure. Such territories include all regions of the Arctic Zone of the Russian Federation (AZRF). If in the Russian Federation the average population density is 8.6 people. per 1 sq. km., then in the regions of the Arctic zone this figure ranges from 0.07 people. per sq. km. in the Chukotka Autonomous Okrug and up to 5.2 people. per sq. km. in the Murmansk region. Therefore, it is not surprising that, for example, in the Nenets Autonomous Okrug with a population of 44 thousand people. and a population density of 0.25 people. per sq. km. there are no universities. But this does not mean that Russian citizens living in these territories may be limited in their ability to obtain high-quality higher education.

Based on official statistics, we will try to assess the degree of physical accessibility of education for residents of Russian regions with extreme climatic conditions that are part of the Russian Arctic, including ZATA and ONP.

At the beginning of 2022, the coverage of children with preschool education in all Arctic regions, with the exception of the Krasnoyarsk Territory, was significantly higher than in the country as a whole: from 64% in the Krasnoyarsk Territory to 90% of children of the corresponding age in the Chukotka Autonomous Okrug, with an average level of this indicator in country 66.5%. If in the Russian Federation as a whole, per 1000 children there were 633 places in organizations carrying out educational activities in educational programs of preschool education, childcare and supervision, then in most Arctic regions this figure exceeded 700, and in the Chukotka Autonomous Okrug There were more places in such organizations than there were preschool children. The structure of personnel training in the Arctic regions has its own characteristics, namely: firstly, in the regions of the Russian Arctic, the number of students enrolled in training programs for skilled workers per 10,000 population is significantly higher than the average in the Russian Federation (Table 1).

So, if in the Russian Federation as a whole this figure in the 2020/2021 academic year. year was 38 people, then in most Arctic regions it exceeded 45 people, and in the Arkhangelsk region it reached 69 people. The only exception is the Chukotka Autonomous Okrug. In the Yamalo-Nenets Autonomous Okrug, the indicator under consideration is close to the Russian average. The number of students enrolled in training programs for mid-level specialists per 10,000 population in the regions of the Russian Arctic is approximately the same as in Russia as a whole. In the Yamalo-Nenets and Chukotka Autonomous Okrugs, this indicator is significantly lower than the Russian average; in the Republic of Sakha (Yakutia) it is 1/3 more than in the country as a whole. And in terms of the number of students enrolled in bachelor's, specialist's, and master's programs, the Arctic territories lag far behind other Russian regions. If on average in the country per 10,000 people. population in 2021 accounted for 289 people. students studying in higher education programs, then in the Arctic regions the value closest to the average level was typical for the Krasnoyarsk Territory - 267 people. In the Chukotka Autonomous Okrug, the indicator in question was 8 times less, in the Yamalo-Nenets Autonomous Okrug - 16 times less than the Russian average, and in the Nenets Autonomous Okrug there are no universities at all.

Table 1. The number of students enrolled in training programs for skilled workers, office workers, mid-level specialists, bachelor's, specialist's, and master's programs in the Arctic regions of Russia in the 2021/22 academic year t (per 10,000 population)

Region	*Number of students enrolled in programs*		
	Preparation skilled workers, employees	*preparation mid-level specialists*	*bachelor's degree specialty, master's degree*
RUSSIAN FEDERATION	38	163	289
Northwestern Federal District	38	148	301
Republic of Karelia	45	164	187
Komi Republic	59	186	195
Arhangelsk region	69	161	164
including:			
Nenets Autonomous Okrug	63	184	-
Murmansk region	40	179	117
Ural federal district	39	184	262
Yamalo-Nenets Autonomous Okrug	36	135	18
Siberian Federal District	48	182	287
Krasnoyarsk region	56	182	267
Far Eastern Federal District	46	189	249
The Republic of Sakha (Yakutia)	56	217	248
Chukotka Autonomous Okrug	10	148	35

As for the material accessibility of education for residents of the Arctic Zone of Russia, a comparison of basic income indicators also indicates weaker opportunities for Russians living in extreme climatic conditions and providing a significant portion of federal budget revenues to receive education, since the standard of living in most of these regions is significantly lower than in the country as a whole. Rosstat data show that real cash incomes of the population of most Arctic regions Russiain 2018–2021 noticeably lagged behind the Russian average. In the Republic of Karelia, the Arkhangelsk and Murmansk regions, the Krasnoyarsk Territory, a lower increase in the indicator was recorded during this period, and the Komi Republic, the Nenets Autonomous Okrug and Murmansk region – strong fall in real incomes of the population. And the proportion of the population living below the poverty line in many regions of the Arctic Zone of Russia in 2021 was significantly higher than in the country as a whole (we are talking about the Republic of Karelia, the Komi Republic, the Krasnoyarsk Territory, the Republic of Sakha (Yakutia).

Main part

The education system plays an integral role in the integration of youth as a social group into the system of social reproduction and the transfer of knowledge and experience between generations. The organization and functioning of the regional education system are determined by the state and dynamics of socio-economic processes. On the one hand, the personnel needs of the region's economy, reflected in the education system, influence the main ratios of the number of students receiving vocational education at different levels. On the other hand, youth act as the subject of the educational process, thereby realizing their interests and needs for personal and professional self-realization. In the context of the formation of coherence between the interests of the economy and the education system, it is necessary to pay attention to all stages of an individual's educational trajectory: general education, secondary vocational, higher, postgraduate and additional. At the same time, the issue of ensuring that the regional education system meets the needs of the individual and the economy is important. If the educational needs of individuals may be unstable and be realized through educational migration and adjustments to educational plans, then adjusting the personnel needs of the economy is a complex multidimensional process that affects the interests not only of the region as a whole, but also of its main actors - the business community, especially the leading employers of the region, social sphere, etc.

For the Arctic regions, in the context of the current personnel shortage and the implementation of large-scale investment projects, the study of the potential of the vocational education system for

training personnel is especially relevant. For the dynamically developing Arctic territories, the problem of matching the potential for training professional personnel by the regional education system with the volume of graduates of the general education system is relevant, that is, to what extent the regional education system can provide training for specialists using the existing contingent. When ensuring the training of specialists by the regional education system, it is important to pay attention to the variety of educational programs and their compliance with the needs of the economy for personnel and the demands of applicants, so that potential students remain to study in their native region, and thereby minimize the volume of educational migration to other constituent entities of the Russian Federation. According to a study by the Higher School of Economics, the rate of post-graduate migration in the Murmansk region and the Komi Republic is 27%, in the Republic of Karelia this share reaches 33% (that is, a third of university graduates in the region are employed in other constituent entities of the Russian Federation), in the Republic of Sakha (Yakutia) - 23%, in the Krasnoyarsk Territory - 20% (every fifth graduate), in the Arkhangelsk Region this figure is higher - 38%.

In this regard, the purpose of these studies is to analyze the potential of the vocational education system in ZATOs and ONP regions of the Arctic zone of Russia for personnel training through the use of their own "regional capital" - school graduates of the 9th and 11th grades.

The study of the potential of the regional vocational education system of the Arctic regions was carried out based on the analysis of official statistical indicators and calculations of the authors of the article. The study used classification, comparison and modeling methods. The emphasis is placed on youth as the main social group - the consumer of educational services in the conditions of formation of personnel supply in the economy of the Arctic regions. Young people as a social group are interpreted ambiguously for various reasons. In this study, the authors rely on the concept enshrined in federal legislation, where youth is defined as "a socio-demographic group identified on the basis of age characteristics, social status and characterized by specific interests and values. This group includes persons aged 14 to 30 years, and in some cases, up to 35 years." The main distinctive social quality of youth lies "in its ability to inherit, reproduce on a qualitatively new basis and transmit to the next generations the entire system of social relations." By realizing their aspirations for self-development and self-realization, young people become the main factor in the development of the economy and staffing of the Russian Arctic zone. What is the reason for such a high migration of graduates of universities and secondary specialized institutions in the regions of the Arctic zone? The position of young people in the labor market is characterized by their involvement in labor relations and "the ability to be the subject of significant economic strategies." Modern research shows that work remains the main factor in the personal self-determination of most young people. The formation of a policy for staffing the economy of the Arctic zone of Russia is taking place in the context of a reduction in the number of young people due to a systemic demographic crisis, which is a nationwide problem. Forecast data from Rosstat indicate a reduction from 27% in 2005 to 18% in 2027 in the representation of the age group aged 14–30 years in the total population of the country. Then a slight increase in the number of young people is expected, the share of which in 2035 will be 20.9%, which is 7% lower than the base figure in 2005. The regions of the Arctic zone repeat the Russian trend of a share reduction in the number of youth, while the situation is aggravated by the outflow of young people for reasons of interregional and foreign migration. On average, in the Arctic zone from 2007 to 2022, the number of young people decreased by a third (33.1%), the reduction in Russia as a whole is slightly larger and amounts to 36.9%. A significant decrease in youth in the Arctic regions in 2022 compared to 2007 is observed in the constituent entities of the European part of the Arctic zone, where the largest reduction was recorded in the Komi Republic and the Arkhangelsk region. A smaller reduction in the number of young people (in comparison with the all-Russian and all-Arctic trend) in the period under review was recorded in the regions.

The share of youth in relation to the number of employed population determines the potential staffing opportunities in the region. A consequence of the trend towards a reduction in the number of young people is a change in the structure of the employed population of the Arctic regions in favor of older workers. According to data for 2019, the share of youth in the Arctic regions aged 15–29 years in the structure of the population employed in the economy was 18.4%, which is slightly lower than the total share in the Russian Federation, where this figure is 19.5% (Figure 1). Only in the Republic of Sakha (Yakutia) and the Krasnoyarsk Territory the share of young people among the employed population in 2019 was higher than the Arctic and Russian indicators - 22.9% and 21.4%, respectively, while in 2007 the share of young people in these regions in the general structure of the employed population was even higher and amounted to 23.1% and 26.3%. On average, for individual Arctic regions at the macro-regional level and in Russia, the decrease in the share of youth in 2019 compared to 2007 was 8.5%.

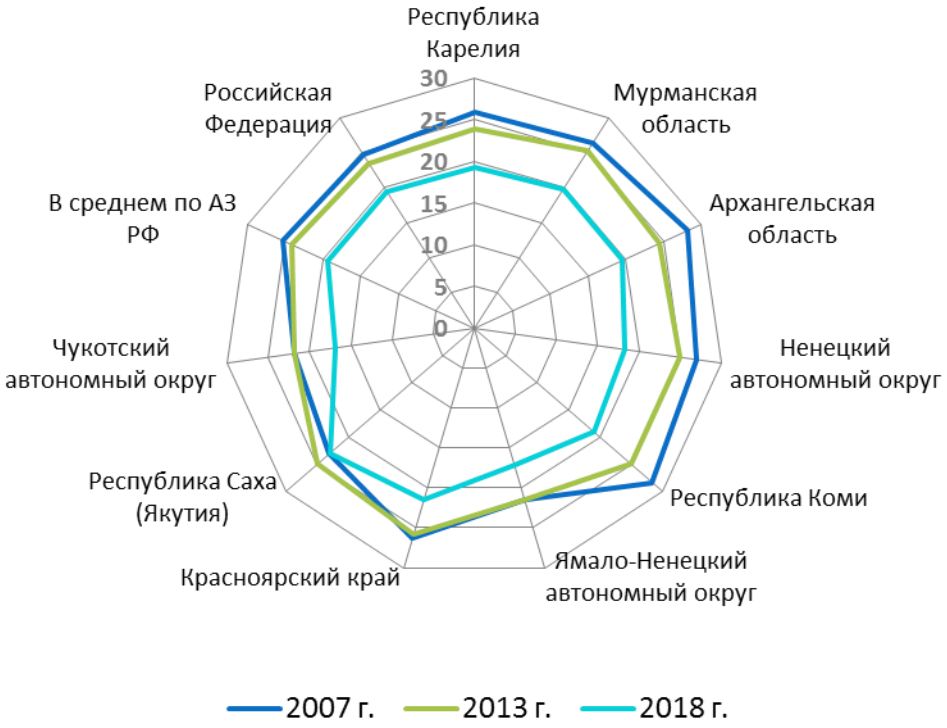

Figure - 1 Share of youth aged 15–29 years in the economically employed population of the regions of the Arctic zone of Russia, % 2013; 2018; 2021

Another important aspect of assessing the situation of youth in the labor market of the Arctic regions is the unemployment rate. This indicator is calculated both according to the methodology of the International Labor Organization and according to the official registration of unemployed citizens in the Employment Services. According to these approaches, the assessment of unemployed youth in the Arctic regions differs.

In accordance with data calculated using the methodology of the International Labor Organization (ILO), in 2019, compared to 2007, all Arctic regions showed a positive trend in reducing the number of unemployed young people. In some regions, the number of unemployed youth decreased by 2 times (Arkhangelsk Region, Krasnoyarsk Territory and the Komi Republic compared to 2007). At the same time, in accordance with the ILO methodology, in the general structure of unemployed citizens, every third unemployed citizen is a young person under the age of 30, and in the Chukotka Autonomous Okrug this share reaches almost half and amounts to 48.6% (Figure 1). It was previously noted that in the Arctic macroregion only every fifth person employed in the economy is a young person aged 15–29 years.

It should be taken into account that, according to the ILO methodology, the unemployed also include young people studying in the vocational education system on a full-time basis, who at the same time "were looking for work and were ready to start it." At the same time, the main social status of this category is studenthood. Thus, ILO unemployment indicators do not fully reflect the real situation in the youth labor market. A more objective picture is reflected in the data of the Employment Services, in which young people are officially registered as unemployed citizens, and accordingly, have the basic social status of the unemployed. For example, in the Arkhangelsk region, among the registered unemployed in 2018, 22.3% were young people aged 16–29 years, which is 10.9 percentage points less than the 2007 figure. A similar situation is developing in other Arctic regions, where the share of young people among the officially registered unemployed is 17.3% in the Krasnoyarsk Territory, 17.5% in the Republic of Karelia, 17.4% in the Arkhangelsk Region, and 17.4% in the Republic of Sakha (Yakutia) – 22.5%. In certain Arctic municipalities of subjects partially included in the Arctic zone, the proportion of young people among officially registered unemployed citizens is generally similar to the regional situation - in the municipalities of the Arkhangelsk region there are 17.2% of unemployed young people (of the total number of officially registered unemployed), in Krasnoyarsk Territory - 24% and in the Republic of Karelia - 14%. The share of unemployed youth in the structure of the employed population of all Arctic regions does not exceed 1%: in the Arkhangelsk region it is 0.6%, in the Krasnoyarsk region - 0.1%, in the Republic of

Karelia and Yakutia - 0.4% each, and in the Chukotka region Autonomous Okrug - 0.9%.

In modern conditions of a rapidly changing world, young professionals can occupy stable positions in the priority sectors of the economy of the Arctic regions due to the relevant knowledge and skills acquired during primary training, which contributes to the increased need among senior workers for advanced training and obtaining additional skills within the framework of the concept of lifelong education. Thus, the position of young people in the labor market in closed administrative and administrative territories of the Arctic regions is characterized by greater representation among the employed population and a smaller share among unemployed citizens. In the context of a personnel shortage in the economy of the Arctic regions, the question of the possibility of training the personnel necessary in the economy and, as a consequence, their demand remains relevant. The main resource for the vocational education system is graduates of the 9th and 11th grades. The professional fulfillment of a future young specialist depends on the availability of educational organizations, the variety of areas of training, and the sufficiency of the number of places to admit future applicants. Thus, an ideal model for the functioning of the education system should take into account both the interests of future students and the personnel needs of the regional economy. The vocational education system of the Arctic zone of Russia is represented by organizations of higher and secondary vocational education, as well as interregional centers for advanced training. However, the network of vocational education organizations in the Arctic zone of Russia is heterogeneous regionally. Most higher education organizations are concentrated in the European part of the Arctic zone. There are federal universities in the Arkhangelsk Region, the Republic of Sakha (Yakutia) and the Krasnoyarsk Territory. However, the territories of these regions partially belong to the Arctic zone, and it is in the "Arctic part" of these regions that the network of professional educational organizations is less widely represented. The exception is the Arkhangelsk region, where the network of vocational education organizations, especially higher education, is concentrated in the capital and large industrial cities included in the Arctic: here in 2019, 78.5% of students received higher education and 62% received secondary vocational education, studying in educational institutions. organizations located in the Arctic zone (Table 2).

Among the regions that are entirely included in the Arctic zone, the most notable is the vocational education system of the Murmansk region, which in 2019 accepted more than 5 thousand students in 165 areas of training (specialties) of bachelor's and specialist degrees. In the Nenets Autonomous Okrug there are no higher education organizations that provide training at the expense of budgetary funds or full-time education, and enrollment in secondary vocational education programs is less than 300 people. In the Yamalo-Nenets and Chukotka Autonomous Okrug, the higher education system provides training in university branches in only one technical specialty.

Table 2. Number and enrollment of educational organizations of higher and secondary vocational education, taking into account branches by regions and territories of the Arctic zone of Russia, 2019

Name of the subject of the Russian Federation AZ		**Characteristics of the vocational education network**			
		VO for the region as a whole	VO for territories included in ZATO and ONP AZ RF	SPO for the region as a whole	SPO for territories included in ZATOs and ONPs in the AZ of the Russian Federation
Regions whose territories are fully included in the AZ of the Russian Federation					
Murmansk region	*#OO*	3		thirty	
	*	1061 people 66 NPCs each		4037 people 99 NPCs each	
Nenets Autonomous Okrug	*#OO*	0		3	
	*	0		292 people 15 NPCs each	
Yamalo-Nenets Autonomous Okrug	*#OO*	3		12	
	*	13 people, 1 NPC each		1905 people 60 NPCs each	
Chukotka Autonomous Okrug	*#OO*	1		4	
	*	15 people 1 NPC each		271 people 11 NPCs each	
Regions whose territories are partially included in the AZ of the Russian Federation					

Arhangelsk region	*#OO*	6	5	50	25
	*	3283 people	2627 people 68 NPCs each	7742	4801 people 126 NPS each
Republic of Karelia	*#OO*	4	0	20	1
	*	2056	0	2444	22 people 8 NPCs each
Komi Republic	*#OO*	6	2	39	6
	*	2199	48 people 4 NPCs each	4837	458 people 30 NPCs each
Krasnoyarsk region	*#OO*	17	1	126	7
	*	11419	188 people 10 each NPC	16552	756 people 40 NPCs each
The Republic of Sakha (Yakutia)	*#OO*	16	0	64	4
	*	4173	0	6747	234 people 12 NPCs each

Legend:

#OO – number of educational organizations of vocational education; * – admission to state educational organizations for full-time study at the expense of the budget, taking into account branches for undergraduate and specialist training programs.

The territories of regions partially included in the Arctic zone are least provided with educational organizations. Thus, in the Krasnoyarsk Territory there are 17 universities and 126 colleges and technical schools, of which in the Arctic there are only 1 university and 7 vocational education organizations, which received 6.2% of the total admission of students for the first year of full-time study at the expense of the budget. In the Republic of Karelia, out of 20 educational institutions of secondary vocational education, only one operates in the Arctic municipality, and in the Republic of Sakha (Yakutia), out of 64, only 4. At the same time, enrollment in these educational organizations of the total enrollment in the region is less than 5%.

Due to the trend of declining youth numbers, the potential student population for higher and secondary education systems is also decreasing. Compared to 2007 indicators, student enrollment in state educational institutions of higher education in the Murmansk region decreased by 3.8 times, in the Komi Republic - by 2.3 times, and in the Arkhangelsk region - by 2.2 times. In the Nenets Autonomous Okrug since 2008, in the Chukotka Autonomous Okrug since 2017, there is no admission of students for the first year of study at state educational organizations.

In the context of a reduction in the number of young people and, as a consequence, the volume of student enrollment in vocational education organizations, the issue of the ability of the education system to provide training for its own school graduates in the region is relevant. The potential of the vocational education system of the Arctic regions was assessed on the basis of statistical data on admission, contingent and graduation of students in general educational organizations of the region (graduation of 9th and 11th grades, contingent of students in 10th grade), admission to educational organizations of higher and secondary vocational education for the first year on a budgetary basis for full-time study.

Thus, the potential of the regional vocational education system (higher and secondary vocational education) is understood as the ratio of graduation from the 9th grade (with the exception of admission to the 10th grade) plus graduation from the 11th grade to admission to full-time educational organizations of higher and secondary education training for budget places.

In general, if we consider the Arctic macro-region, the vocational education system can ensure the admission of potential applicants for mastering educational programs. In individual regions and Arctic territories, the potential of the vocational education system varies significantly. If we consider the Arctic regions as a whole, then the regional education systems of the Krasnoyarsk Territory and the Republic of Sakha (Yakutia) stand out from others, which can provide vocational education not only to their school graduates, but also to graduates from other constituent entities of the Russian Federation (the indicator is 1.28 and 1.17, respectively). Graduates of schools in the Arkhangelsk region, the Republic of Karelia and the Murmansk region can also sufficiently apply for vocational education in their native region (Fig. 5). It is necessary to take into account that the listed subjects of the Russian Federation, with the exception of the Murmansk region, are partially part of the Arctic zone of Russia, therefore it is necessary to consider the potential of the vocational education system also separately for the

Arctic territories. Here, the potential of the vocational education system is sufficient to provide education to school graduates only for the territories of the Arkhangelsk region, for which the indicator is 1.09. This high figure is due to the fact that the Arctic zone of the Arkhangelsk region includes municipalities in which most of the professional educational organizations are concentrated, including the Northern (Arctic) Federal University named after. M. V. Lomonosov.

Applicants (graduates of 9th and 11th grades) from the Arctic territories of the Krasnoyarsk Territory, the Komi Republic, the Republic of Sakha (Yakutia) cannot fully satisfy the need for obtaining vocational education in their home municipality, therefore they are forced to move to another area, most often the capital or get an education in another region. In the Republic of Karelia, school graduates are forced in advance to form an educational migration track, focused either on getting an education in the capital of Karelia or in another subject, since the potential of the vocational education system in the Arctic territories is 0.

In regions that are territorially completely included in the Arctic zone of Russia (Yamalo-Nenets, Nenets and Chukotka Autonomous Okrugs), with the exception of the Murmansk region, the vocational education system can only accept half of the graduates of the 9th and 11th grades; the remaining graduates are forced to build an educational trajectory in other Russian regions.

It should be noted that the presented indicator of the potential of the regional vocational education system represents an ideal type of model, since the condition is assumed that all graduates of the 9th grade, with the exception of those who continued their studies in the 10th grade, entered educational organizations of secondary vocational education, and graduates of the 11th grade entered educational organizations of higher education. In objective reality, the potential of the higher education system in the Arctic regions is even less, since it is necessary to take into account the fact that 11th grade graduates can receive education in secondary vocational education programs. If you pay attention to the statistics, then in the Republic of Sakha (Yakutia) the share of graduates of the 11th grade of the region of the current year of graduation who entered educational organizations of secondary vocational education in the same year is 31.8%. 16.4% of 11th grade graduates entered universities; the remaining graduates (51.8%) did not choose the regional vocational education system. In the Arctic territories of the Republic of Sakha (Yakutia), the share of graduates who entered colleges and technical schools is 3.4%, the remaining 96.6% of 11th grade graduates left the Arctic regions to receive education either in their native region or beyond. Thus, every second 11th grader drops out of the regional vocational education system of the Republic of Sakha (Yakutia). It should be noted that data is presented on the inclusion of 11th grade graduates in the regional vocational education system of the 2019 graduates this year. Among these graduates there may also be a proportion of those who were drafted into the ranks of the Armed Forces of the Russian Federation (at the same time, for young people who successfully passed final exams, a deferment is provided for the current year), or did not continue their studies in the vocational education system this year. As a rule, the total share of such reasons is no more than 10% of the total graduation rate: the all-Russian trend in the distribution of school graduates by educational track.

A similar situation with the Republic of Sakha (Yakutia) has developed in the Republic of Karelia, the Komi Republic and the Krasnoyarsk Territory. In these regions, approximately half of 11th grade students are also not included in the regional vocational education system, with the exception of the Komi Republic, where this share reaches 70.1%. At the same time, almost all 11th grade students in the Arctic territories leave their area to receive vocational education. In the Arkhangelsk region, half of the 11th grade graduates (53.2%) from the Arctic territories enter universities, every third graduate chooses the secondary vocational education system, and every fifth graduate does not enter the vocational education system. The majority of 11th grade graduates leave the Chukotka (88.7%), Yamalo-Nenets (98.2%) and Nenets (84.7%) autonomous okrugs to receive vocational education due to its limited or non-existent nature. As a rule, the preferred regions for training are Moscow and St. Petersburg or neighboring regions. In the Murmansk region, 14.6% of 11th grade graduates entered universities and 5.3% chose colleges and technical schools, the remaining 80% were not included in the regional vocational education system.

Conclusion

Thus, the analysis of the main indicators of educational coverage of residents of the Arctic regions of Russia, based on official statistics, allows us to speak about reduced physical accessibility of higher education for residents of the Arctic regions. The financial accessibility of education is also lower than in the country as a whole, due to the lower living standards of the population of most regions of the Arctic Zone of the Russian Federation, including ZATOs and ONP. The availability of services in this area is also reduced by the remoteness of the Arctic territories from the federal centers of science and education. To solve the problem of accessibility to high-quality higher education and eliminate inequality in this area, we consider it appropriate to allocate budget places for residents of these regions, introduce preferential educational loans, subsidized flights and other measures that will allow young people from the regions of the Russian Arctic to receive higher education and return to their small homeland ,

strengthen its labor potential. The implementation of the proposed measures will create conditions for improving the quality of life of people living in such difficult climatic conditions and will contribute to the sustainable development of these territories that are strategically important for the country.

Thus, for the development of the economy of the Arctic zone of Russia, the implementation of large-scale investment projects, and the functioning of priority development territories, it is necessary to pay close attention to the training and development of youth as the main social group for the reproduction of the current and potential human capital of the region. Because of this, it is necessary to approach this issue systematically, considering the demographic situation, the situation of young people in the labor market and the vocational education system.

The systemic all-Russian demographic crisis also affected the number of youth in the Arctic regions, demonstrating a steady downward trend. The situation of youth in the labor market of the Arctic regions generally reflects the all-Russian trend, while there are fewer unemployed youth in the Arctic regions.

A condition for the success of the formation of current and future staffing for the Arctic economy is the ability of the vocational education system to provide regional school graduates with a profession. The network of the vocational education system in the Arctic regions is unevenly represented: in some regions there is no training in higher education programs at the expense of the budget, and in some Arctic territories (in municipal areas) there are no educational organizations for vocational education at all.

The vocational education system of most Arctic regions cannot provide the entire volume of school graduates with mastering the educational program in their native region. The exceptions in this case are the Arkhangelsk region, the Republic of Sakha (Yakutia) and the Krasnoyarsk Territory.

However, even in these regions, the territories belonging to the Arctic zone of Russia lag behind the general regional trend.

The vocational education system needs to be modernized and put into practice new approaches to providing the economy of the Arctic regions with in-demand qualified personnel through the opening of new areas of training / specialties in existing educational organizations that meet the needs of the region's leading employers. In this case, an integrated approach to targeted training is needed not only in educational organizations of the native region, but also in organizations of other Russian regions, which would allocate quotas for admitting applicants from the Arctic regions.

At the same time, it is not practical to fully provide school graduates with vocational education through targeted training in other regions due to the uncompensated nature of educational migration and the imperfection of the institution of targeted training itself.

Maintaining the vocational education system at the expense of budgetary funds is expensive for the state. The level of estimated budgetary provision for 2020 shows that the index of budgetary expenditures for the subjects of the Arctic zone of Russia significantly exceeds the average Russian value, and for a number of regions of the Arctic (Republic of Sakha (Yakutia), Chukotka and Nenets Autonomous Okrugs) the difference ranges from 3 to 8 times. This means that training qualified personnel in universities and colleges in the regions of the Arctic zone is significantly more expensive than in other regions of the Russian Federation. At the same time, achieving the stated national priorities for the development of the Arctic through the development of natural resources simultaneously with the socio-economic development of the Arctic territories is impossible without large investments in the creation and development of a vocational education system.

The countries of Northern Europe show successful experience in the integrated development of Arctic territories. For example, in the province of Lappi in Finland (Lapland), where about 200 thousand people live, there are the University of Lapland and 5 colleges that have branches even in small northern cities and towns. In Norway, in the Arctic province of Nordland with a population of 240 thousand people, Nord University has been operating since 2009, where students study 12 thousand students, including many citizens of other countries.

A priority in the creation and development of a vocational education system in the Russian Arctic may be training in the most in-demand social professions - nurses, paramedics, doctors, kindergarten teachers, secondary school subject teachers, and managers. It is relevant to train qualified workers for representatives of indigenous peoples of the North (reindeer herders, fishermen, plague workers, artisans).

Also, the capabilities of the information (digital) society will make it possible to significantly reduce the costs of organizing vocational education in closed administrative towns and educational units of the Arctic territories of the Russian Federation, since it is possible to attract qualified teaching staff through remote technologies.

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Issue Article

Elena Dmitrievna Zorina
Institute of Service Sector and Entrepreneurship (branch) DSTU
bachelor

Ekaterina Aleksandrovna Ilchishina
Institute of Service Sector and Entrepreneurship (branch) DSTU
bachelor

Artur Aleksandrovich Blagorodov
Institute of Service Sector and Entrepreneurship (branch) DSTU
master's degree

Vladimir Timofeevich Prokhorov
Institute of Service Sector and Entrepreneurship (branch) DSTU
Doctor of Technical Sciences, Professor
Shakhty, Russia

Galina Yurievna Volkova
LLC TsPOSN «Ortomoda»
Doctor of Economics, Professor
Moscow, Russia

ON THE CONTRIBUTION OF THE HIGHER EDUCATION SYSTEM TO ENSURING THE SOCIAL AND ECONOMIC DEVELOPMENT OF CATUS AND ONP REGIONS OF THE ARCTIC ZONE OF THE RUSSIAN FEDERATION

Abstract: *in the article, the authors examined the need to resolve issues of national security, economic and other strategic issues facing the Arctic zone and are of great importance for the whole of Russia, place increased demands on the quantitative and qualitative composition of the Arctic labor force, and explored the potential of universities located in the Arctic zone Russia, in the context of staffing strategic priorities for the development of the Arctic macroregion. The study is based on a comparative analysis of the forecast values of the need for personnel with higher education, calculated taking into account the established priorities for the development of the Arctic and the graduation rates of universities and their branches. Based on this, two methods assess the possibility of covering the needs of the economy through university graduates, both in general and in the context of specialties/areas of training. The impact of graduate migration on the human resources potential of the regions is taken into account. The importance of interregional cooperation with territories adjacent to the Arctic zone from the point of view of staffing is shown using the example of the Republic of Karelia. Based on the results of the study, disparities in the staffing of Arctic development priorities were identified in terms of the quantitative and qualitative composition of graduates. Conclusions and proposals for universities and executive authorities show specific ways to overcome the emerging structural imbalances in ensuring the strategic development of the Arctic with personnel with higher education. Issues of demand for university graduates and their employment prospects in the labor market have already been repeatedly covered in the pages of the magazine. However, an analysis of the potential of universities in the context of staffing the development priorities of the Russian Arctic zone is presented for the first time. The sources of data were documents on the strategic development of territories belonging to the Arctic zone of Russia, state statistical reporting*

on the economy, the labor market and the higher education system, results of monitoring the employment of university graduates according to the Pension Fund of the Russian Federation, Rosobrnadzor and educational organizations.

***Key words**: Arctic zone of Russia, youth, vocational education system, region, humanitarian development, population, education, personnel training, university graduates, economic needs, strategy, structural compliance, in-demand specialties.*

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Introduction

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The crisis phenomena that have accompanied the socio-economic development of Russia in recent years are both negative and positive factors. Negative - because we are losing individual positions and achievements, positive - because we are getting rid of "weak links" and looking for new opportunities. One of these opportunities, undoubtedly, must be recognized as the decision of the President of Russia on the development and implementation of the "Strategy for the development of the Arctic zone of the Russian Federation and ensuring national security for the period until 2035." The importance and timeliness of this decision is explained from the point of view of staffing using the example of the Republic of Karelia. Based on the results of the study, disparities in the staffing of Arctic development priorities were identified in terms of the quantitative and qualitative composition of graduates. Conclusions and proposals for universities and executive authorities show specific ways to overcome the emerging structural imbalances in ensuring the strategic development of the Arctic with personnel with higher education. Issues of demand for university graduates and their employment prospects in the labor market have already been repeatedly covered in the pages of the magazine. However, an analysis of the potential of universities in the context of staffing the development priorities of the Russian Arctic zone is presented for the first time. The sources of data were documents on the strategic development of territories belonging to the Arctic zone of Russia, state statistical reporting on the economy, the labor market and the higher education system, results of monitoring the employment of university graduates according to the Pension Fund of the Russian Federation, Rosobrnadzor and educational organizations. It turns out that the Arctic has enormous resources: here are the largest deposits of coal, gold, rare metals, as well as huge reserves of aquatic biological resources, hydropower, forestry, recreational and other natural resources. The Russian Arctic creates 12–15% of the country's GDP and provides about a quarter of exports. The country's unique hydrocarbon potential is concentrated here: a fifth of oil and 62% of gas resources. It is obvious that such resources should become the basis for successful socio-economic development and prosperity of Russia. The effectiveness of regional scientific, technical and personnel policies largely depends on how correctly development guidelines are chosen, what are the mechanisms for selecting sectoral and personnel priorities, and what tools are used for their implementation. Under these conditions, the importance of personnel and scientific support for the socio-economic development of the Arctic zone of Russia increases. The main link in ensuring the development of the economy with personnel with higher education remains universities and their branches operating in the regions. Training in-demand specialists with the necessary competencies is the main task of educational organizations, especially in times of crisis. The purpose of the article is to analyze the potential of universities, located in the Arctic zone of the Russian Federation (AZRF), in terms of staffing the development priorities of the macroregion. Achieving the goal involves assessing the forecast values of the need for personnel with higher education in the Russian Arctic and considering the possibility of covering it with university graduates in quantitative and qualitative aspects, taking into account the impact of migration on the personnel composition of the regions, searching for possible ways to overcome the emerging imbalances in ensuring the implementation of Arctic development priorities by personnel with higher education. The issues of demand for university graduates and their employment prospects in the labor market have already been repeatedly covered in the press. However, an analysis of the potential of universities in the context of staffing the development of the Arctic zone of Russia and the established priorities is presented for the first time. According to the Decree of the President of the Russian Federation of 2020 No. 296 "On the land territories of the Arctic zone of the Russian Federation", the territory of the Arctic zone includes 8 northern regions of the country, of which 4 regions are assigned entirely to the territories of the AZ of the Russian Federation (Murmansk region, Yamal-Nenets Autonomous Okrug, Nenets Autonomous Okrug, Chukotka JSC), and others - partially (Arkhangelsk Region, Krasnoyarsk Territory, the Komi Republic and the

Republic of Sakha (Yakutia). The educational network of universities in the Arctic zone of Russia is quite extensive, since, taking into account branches, it includes: 34 state organizations of higher education and 24 non-state ones. With In this regard, it is important to note that training is carried out in 45 enlarged groups of specialties/directions (UGSN) out of a possible 55. Of the regions that are part of the Russian Arctic, the most extensive network of universities and branches is characterized by the Murmansk and Arkhangelsk regions, as well as the Yamalo-Nenets Autonomous Okrug. state organizations of higher education - Northern Arctic Federal University, Northern State Medical University, Norilsk Industrial Institute, Murmansk State Technical University, etc. Among the branches of the Russian Academy of Sciences is the largest - the Kola branch of Petrozavodsk State University, which in 2015 had 6 faculties and 19 departments, 2080 students, 120 educational programs. To analyze the educational potential of universities in the Arctic zone in the context of implementing the assigned state tasks, a forecast of the economy's need for personnel with higher education was formed. For this purpose, a combined approach was used, involving a combination of macroeconomic forecasting techniques and surveys of employers. Due to the fact that surveys of leading employers in the Arctic in the fall of 2021 did not confirm the launch and implementation of numerous announced investment projects due to the financial crisis, the personnel forecast for most regions mainly takes into account the need only for “replacement” and “for growth”, then there is no investment component. The need for “replacement” is associated with the inevitable natural age-related retirement of workers (retirement, loss of ability to work, etc.), the need for “growth” - with the growth/decline of current production with the corresponding opening/closing of jobs. An important feature of the methodology used is that the forecast values of the need for personnel with higher education are calculated in accordance with the current strategic development programs of each of the subjects included in the Arctic zone and the macroregion as a whole, and the development strategies of industries and industrial clusters are also taken into account. This indicates that the forecast takes into account the priorities of economic and social development of the regions (Table 1).

Table 1. Forecast of the annual additional need of the economy for personnel with higher education in the subjects of the Arctic zone of Russia

AZ RF subjects	2015	2018	2020	2025	2030	2035
Total for AZ RF:	13 520	13 475	13,565	13 470	13,645	13 620
Murmansk region	3 780	3 770	3,790	3 770	3 800	3 820
Yamalo-Nenets Autonomous Okrug*	4 230	4 230	4 280	4 310	4 360	4 400
The Republic of Sakha (Yakutia)	105	105	90	90	90	85
Komi Republic (Vorkuta)*	495	485	475	465	450	435
Krasnoyarsk region	1 630	1 620	1 660	1,590	1 630	1 620
Nenets Autonomous Okrug	245	250	245	255	265	270
Chukotka Autonomous Okrug	225	225	245	230	240	230
Arhangelsk region	2 810	2,790	2 780	2760	2 810	2 760

Thus, due to the fact that in a large number of regions the implementation of investment projects is not taken into account, the presented values of the forecast demand can be characterized as “moderate”. When launching investment projects, the demand values will increase by the number of new jobs created. At the same time, to take into account the investment component it is necessary to overcome the following difficulties, namely:

— *investor employers are not interested in providing information about the need for personnel to implement investment projects;

— *the parent companies implementing individual investment projects for the RF AZ are located outside the RF AZ (Moscow, St. Petersburg);

— *lists of investment projects are constantly adjusted in connection with crisis phenomena in the Russian economy. Currently, a significant part is suspended.

Table 1 presents the forecast values of the need for personnel with higher education for the Arctic zone of Russia. As follows from the data presented in Table 1, the constituent entities of the Russian Federation, which have the most developed

educational network of universities and their branches, as well as the largest population and employees, are characterized by the maximum values of the need for personnel with higher education. The leader in demand is the Yamalo-Nenets Autonomous Okrug, the following values are in the Murmansk and Arkhangelsk regions. The minimum requirements for the Republic of Sakha (Yakutia) are explained by the fact that only 5 of the 36 uluses of the republic belong to the Arctic zone. Having a forecast of the economy's need for personnel is important not in itself, but from the point of view of planning the development of a personnel training system, making management decisions about "who to train?", "how much?", "are the internal resources of the region sufficient to cover the need? "

It is important to note that there are two approaches to assessing the coverage of staffing needs through graduates, namely:

The first approach involves taking into account only full-time graduates, based on the assumption that all part-time students are already working. In this regard, it is difficult to consider the entry of "correspondence" graduates into the labor market as an additional source of labor;

the second approach takes into account the needs of all graduates when covering the needs, based on the assumption that working students, after receiving a diploma, will occupy other positions in the labor market.

In this regard, they will be able to fill empty vacancies at higher levels, but at the same time, often freeing up vacancies that do not require a higher education diploma. Taking into account the fact that there is no consensus on this issue, we will consider both options. The data presented in Figure 2 shows the role of universities and their branches located in the Arctic zone in covering the need for personnel with higher education through full-time graduates. Data for the Nenets Autonomous Okrug and the Republic of Sakha (Yakutia) are not presented in the figure due to the absence of higher education institutions in the territories of these subjects belonging to the Russian Arctic. According to the data presented, the most favorable situation in terms of covering the need for personnel with higher education is in the Arkhangelsk region. The share of covering the need through full-time graduation is 80%, while in other regions of the Russian Arctic - from 5% (Yamalo-Nenets Autonomous Okrug) to 34% (Murmansk region). It should be noted: such indicators are explained by the fact that in the Arkhangelsk region the share of full-time education in the total output is 68%, while, for example, in the Yamal-Nenets Autonomous Okrug - 16.4%, in the Murmansk region - 42%. Thus, using the first option for assessing the coverage of needs - at the expense of full-time graduates, we find that the share of the needs of the economy by the higher education system in the territories of the AZ RF subjects is about 30%. Considering the second option - covering the need through graduation from all forms of education (Table 2) - we see a different picture. The share of covering the needs of the Arctic zone economy for personnel with higher education through university graduates is on average 65% for the macroregion. In terms of subjects, the Murmansk and Arkhangelsk regions (two of the three regions with the maximum need for personnel with higher education) cover it completely. For the Republic of Sakha (Yakutia), the absence of universities and their branches on the territory of 5 out of 36 uluses belonging to the Arctic zone is not critical, since in general Yakutia is a large educational center. Covering the need for personnel with higher education in the amount of 85–100 people in the indicated uluses is solved by training graduates in Yakutsk. For the Nenets Autonomous Okrug, which is both a separate subject of the Russian Federation and an integral part of the Arkhangelsk region, the annual need of the economy for personnel with higher education is 240–270 people. is ensured through training in universities of the Arkhangelsk region (Table 2).

Table 2. Covering the economy's need for personnel with higher education through university graduates (all forms of education) in the AZ RF subjects

AZ RF subjects	2015	2018	2020	2025	2030	2035
Total for AZ RF:	76%	73%	67%	63%	62%	62%
Murmansk region	100 %	96%	85%	84%	83%	82%
Yamalo-Nenets Autonomous Okrug	25%	25%	28%	22%	20 %	20 %
The Republic of Sakha (Yakutia)*	0%	0%	0%	0%	0%	0%
Komi Republic (Vorkuta)	33%	23%	24%	35%	34%	29%
Krasnoyarsk region	38%	37%	34%	31%	32%	32%

Nenets Autonomous District*	0%	0%	0%	0%	0%	0%
Chukotka Autonomous Okrug	20 %	24%	27%	39%	33%	35%
Arhangelsk region	162%	159%	143%	131%	131%	135%

Thus, it is important to emphasize that the regional education system is not faced with the task of meeting 100% of the staffing needs. There are a number of objective reasons for this. This includes the presence of other sources - the unemployed, migrants, institutional population, etc., and the possibility of intersectoral flow of labor resources, etc. At the same time, the main source of covering the economy's need for personnel with higher education and ensuring the selected priorities for the socio-economic development of the Russian Arctic zone are graduates of the higher education system. Continuing to assess the coverage of the economy's needs for personnel in the Arctic zone, it is important to consider the migration flows of the population. Migration flows are an important tool for the rational distribution and use of the labor potential of the population with both higher and secondary vocational education. However, Russian and world practice indicate that migrants choose "better" conditions compared to their current place of stay. Considering the harsh climatic conditions and the specifics of the socio-economic development of the Arctic macroregion, one would expect a significant outflow of the population in general and graduates in particular to territories with more favorable living conditions. Data from state statistical reporting, containing general results of population migration in the regions of the Russian Arctic, indeed confirm the trends in population outflow - in 2021, there was a negative balance of migration at the level of 35 thousand people. Presumably, these trends are related to the fact that people of retirement age, after finishing their working career, leave the territories classified as the Arctic zone and move to places with more favorable climatic conditions. At the same time, statistical data on interregional labor migration indicate the opposite trend: the number of employed people moving to work in the AZ RF subjects exceeds the number of those leaving for work in other subjects, i.e. there is a positive balance of interregional labor migration in 2021 this figure was 118 thousand people. Moreover, considering the migration indicators of graduates with higher education, we see a positive balance of migration. For all seven regions that are part of the Russian Federation and for which information on migration flows is provided, the incoming flow of graduates is either equal to the outgoing flow (Arkhangelsk region) or exceeds the outgoing flow (the other six regions). The undoubted leaders here are the Yamalo-Nenets Autonomous Okrug and the Chukotka Autonomous Okrug, where the arrival of graduates from other regions significantly exceeds the departure. This indicates low motivation for graduates of the Arctic territories to move and good employment rates in their specialty. Moving from the aggregated values of the number of graduates - interregional migrants with higher education to the specialties they received, the following should be noted. For the Arctic regions there is no general pattern of "entry-exit" in relation to enlarged groups of specialties (UGSN). For example, in the Arkhangelsk region, graduates in the specialties "service and tourism", "fundamental medicine", "economics and management" had the greatest exit rates. From the Murmansk region, the first three values for departure are graduates with UGSN "mathematics and mechanics", "political sciences and regional studies", "industrial ecology and biotechnology". A similar situation arises with visiting graduates. If in the Arkhangelsk region the top three are graduates in the specialties "industrial ecology and biotechnology", "cultural studies and sociocultural projects", "information security", then in the Murmansk region these are "mechanical engineering", "cultural studies and sociocultural projects", "linguistics and literary studies" " Thus, at the level of integral values, the positive balance of interregional migration of graduates with higher education covers a significant part of the needs of the AZ regions of the Russian Federation. The integral values of the need for personnel with higher education in the Arctic zone of Russia and the possibility of covering them were presented above. An important issue is the qualitative and structural compliance of university output with needs. To solve this problem, an analysis of strategic development documents is required, as a result of which the main development priorities by industry are identified and compliance with the required specialties/areas of higher education is established. According to strategic development documents in the medium term, the priority directions for the development of the Arctic zone of the Russian Federation are: effective use and development of the resource base; modernization and development of infrastructure of Arctic transport systems; development of science and technology; creation of a modern information and telecommunications infrastructure; ensuring environmental and military security; international cooperation in the Arctic. In accordance with the identified priorities, promising projects in the Arctic Zone of the Russian Federation are diverse and cover a wide range of economic sectors that provide both the greatest increase in added value, as well as industries aimed at ensuring a high

quality of life for the indigenous population and industries ensuring Russia's military-strategic presence in the Arctic. Key among them are the mining industry, oil and gas industry, fisheries and agriculture (reindeer husbandry), electric power, civil and military shipbuilding, transport infrastructure, information and telecommunications infrastructure, industrial and civil construction, tourism, environmental protection and environmental improvement, healthcare, education, scientific activity. In this regard, the main documents of strategic development appeared in 2018–2020, An analysis was carried out of the structure of admission to educational organizations of higher education in the context of the State Educational Institution for 2021 for all forms of education for compliance with priority sectors of development (Table 2). As can be seen from the presented data, in the structure of admission to educational organizations of higher education in the context of the State University of Social Sciences for 2014, the largest contingent of university students in the AZ of the Russian Federation are in economics and legal specialties - the total graduation rate of universities in the corresponding groups of specialties was about 40%. However, it is worth noting that this problem is of a nationwide nature. According to government statistics, for many years the higher education system has been "re-graduating" specialists in economics and humanities, which persists due to the perception among applicants of a university diploma as a means of expanding opportunities in the labor market. At the same time, for such UGSNs as "18.00.00 - Chemical Technologies", "43.00.00 Service and Tourism", corresponding to the priority areas of development of the Russian Arctic, the acceptance rate did not exceed 1%. Thus, due to significant inertia, the education system does not have time to quickly respond to changes in the external environment. The proclamation of priority directions for the development of the AZ RF did not have a significant impact on the admission structure of universities located in the AZ RF territories. From the point of view of a comprehensive assessment of the staffing potential, it is important not only to focus the personnel training system on the priority areas of development of the Russian Federation, but also to determine the sufficiency of staffing to implement these priorities. In connection with the above, of particular importance is the analysis of covering the needs of the economy of the Russian Arctic in personnel with higher education in the context of the State Educational Service, which makes it possible to assess how much the capabilities of the higher education system correspond to the needs of the economy of the macroregion in terms of providing the necessary number of specialists in a professionally qualified context. Due to the general insufficient coverage of the need by graduates of the higher education system as a whole in the Russian Federation, in detail for the majority of State Educational Institutions there will also be a shortage of university graduates. At the same time, UGSN are significantly differentiated in terms of the share of covering the needs of the economy of the Russian Arctic in personnel with higher education through university graduates who studied in all forms of education (Table 3).

Table 3. Grouping of the State Tax Service by the share of covering the needs of the economy of the Russian Arctic in personnel with higher education through university graduates, 2021.

Share of covering the needs of the Russian Arctic economy in personnel with HE at the expense of university graduates	Enlarged groups of specialties/directions preparation	including those providing training for priority areas
More than 100%	37.00.00 - Psychological sciences, 39.00.00 - Sociology and social work, 40.00.00 - Jurisprudence, 38.00.00 - Economics and management, 42.00.00 - Mass media and information and librarianship	

60–90%	45.00.00 - Linguistics and literary criticism, 49.00.00 – Physical education and sports, 33.00.00 – Pharmacy 29.00.00 - Light industry technologies, 54.00.00 - Fine and applied arts, 46.00.00 - History and archeology, 51.00.00 - Cultural studies and sociocultural projects	13.00.00 — Electrical and thermal power engineering 06.00.00 - Biological sciences, 19.00.00 - Industrial ecology and biotechnology, 34.00.00 - Nursing, 14.00.00 - Nuclear energy and technology, 43.00.00 - Service and tourism, 44.00.00 - Education and pedagogical sciences, 09.00 .00 – Informatics and computer technology, 31.00.00 – Clinical medicine
30–60%	25.00.00 - Air navigation and operation of aviation and rocket and space technology, 04.00.00 - Chemistry, 32.00.00 - Health sciences and preventive medicine, 16.00.00 - Physical and technical sciences and technologies, 41.00.00 - Political sciences and regional studies ,, 01.00.00 – Mathematics and mechanics	26.00.00 - Engineering and technology of shipbuilding and water transport, 21.00.00 - Applied geology, mining, oil and gas engineering and geodesy, 05.00.00 - Geosciences, 23.00.00 - Engineering and technology of land transport, 35.00.00 - Agriculture , forestry and fisheries, 18.00.00 - Chemical technologies, 15.00.00 - Mechanical engineering, 20.00.00 - Technosphere safety and environmental management
Less than 30%	27.00.00 - Management in technical systems, 12.00.00 - Photonics, instrumentation, optical and biotechnical systems and technologies, 30.00.00 - Fundamental medicine, 28.00.00 - Nano technologies and nanomaterials, 22.00.00 - Materials technologies, 03.00. 00 - Physics and astronomy, 11.00.00 - Electronics, radio engineering and communication systems, 36.00.00 - Veterinary and animal science	08.00.00 – Construction equipment and technologies, 02.00.00 – Computer and information sciences

The data in Table 3 indicates that 5 out of 46 State University of State Sciences, related to the social sciences and humanities, are characterized by an overabundance of graduates (the coverage rate is more than 100%). Taking into account the availability of other sources of covering staffing needs, for the State Tax Service with a coverage share of 60–90%, the situation is not critical and will not cause a serious shortage of personnel. For the rest of the State Tax Service, on the contrary, there is a significant lack of training of personnel with higher education. Thus, the analysis of covering the need for personnel in the context of the State Educational Service at the expense of university graduates once again confirms the fact that the higher education system is insufficiently focused on the priority areas of development of the Russian Arctic. The situation with the imbalance between staffing needs and the output of the higher education system according to the State University of Social Sciences in different regions of the Russian Arctic is different and is associated with the characteristics of their industrial potential and economic priorities. For example, in the Murmansk region, one of the most dynamically developing Arctic regions, as well as in the AZ of the Russian Federation as a whole, there is an oversupply of university graduates in specialties/areas of training in the social, humanitarian and economic fields. The largest ice-free port in Russia is located on the territory of the Murmansk region, and the region accounts for 16.2% of all-Russian fish production. In this regard, in specialties related to the engineering and technology of shipbuilding and water transport, a stable shortage of personnel with higher education remains at the level of 30%. It is worth noting for a number of UGSN - “21.00.00 - Applied geology, mining, oil and gas engineering and geodesy”, “19.00.00 - Industrial ecology and biotechnology” - for the Murmansk region the share of covering the need exceeds 100%. This fact should be considered positive due to the fact that the Murmansk region is the largest educational center and trains personnel for the entire Arctic zone of Russia. At the same time, for a number of other significant UGSNs, universities in the Murmansk region do not train specialists with higher education at all, which causes a significant shortage of personnel in the region. Among these UGSN are specialties and areas of medical training that are widely in demand in the Murmansk region. In the current situation, the role of interregional cooperation with territories adjacent to the Murmansk region is increasing in terms of training to meet the need for medical workers with

higher education. Thus, according to monitoring data on the employment of university graduates, the need for personnel in the State Educational Standards "31.00.00 - Clinical Medicine" and "33.00.00 - Pharmacy" is 30% met by graduates of Petrozavodsk State University - the largest university in the European North of Russia, located in the Republic of Karelia . In addition, the Kola branch of Petrozavodsk State University operates in the Murmansk region, which is the third largest university in the Murmansk region and provides training in areas and specialties that meet the needs of almost all sectors of the economy and production of the Murmansk region. The results of the analysis of the qualitative and structural compliance of university graduates with the needs of the economy indicate that for universities, first of all, it is necessary to resolve the issue of structural compliance of admission and graduation with the chosen priorities of economic development. Due to the insufficiency of graduates to cover the need in absolute terms for some regions of the Arctic, additional training and retraining of existing labor resources, including the unemployed, and motivating the unemployed population to work are of particular importance. In addition, there remains the possibility of attracting personnel from other regions as an additional source. The need to resolve issues of national security, economic and other strategic issues facing the Arctic zone and of great importance for the whole of Russia places increased demands on the quantitative and qualitative composition of the labor resources of the Arctic Zone of the Russian Federation. At the level of integral values, the potential of Arctic universities currently provides on average about 60% of the need for personnel with higher education. On average, another 10–20% is covered by the positive balance of interregional migration of graduates. A detailed analysis of covering the needs of the economy in the context of State Budgetary Educational Institutions showed a more complex situation: for some State Educational Institutions not directly related to priority sectors, there is an overtraining of university graduates. For other OGSN, for which training of specialists is necessary to implement the chosen path of strategic development of the Arctic, a lack of personnel training has been identified. In addition to the identified structural imbalances, there are added objective limitations to the development of the educational network of the Arctic: low population density, harsh climatic conditions, reduced demographic indicators, etc. In this regard, within the framework of university development programs, programs for the development of human resources in the regions to overcome, first of all, structural disproportions in the training of personnel of the AZ RF, it is advisable to implement the proposals considered.

Conclusion

Features of the development of the education system in CATUs and ONPs of the Arctic regions of the Russian Federation - consideration of this issue seems extremely relevant, since currently the issues of development of the Arctic regions and the Far East are coming to the fore and acquiring special importance. In his message to the Federal Assembly on January 15, 2020, President of the Russian Federation Vladimir Vladimirovich Putin voiced proposals for improving demographic policy, including the development of the social sphere and education. In particular, it was proposed to ensure a phased transition until 2023 to the organization of free healthy hot meals for primary school students; cover at least half of the country's teachers with a professional development system; continue to create new places in nurseries; modernize the material base for additional education for children; annually increase the number of budget-funded places in universities, and also, as a priority, transfer budget-funded places to regional universities in those territories where there is a shortage of doctors, teachers, and engineers. This specifically applies to the Arctic territories, where the personnel requirement in the social sphere is somewhere around 25–30 percent. The set of proposed measures will make it possible to increase the availability of quality education, of course, in the Arctic and the Far East, and also to respond more flexibly to the needs of the labor market in this macro-region. However, in order to achieve the goals set—bringing the indicators of social development of the territories of the Arctic zone (this task, as you know, was set by the president) to and above the Russian average—requires serious consolidation of the efforts of both federal and regional authorities. This is why we have gathered today to discuss these issues; in the Arctic zone, the following problem is still acute - the migration outflow of the population: more than 300 thousand people in 15 years. Among the main characteristics it is necessary to mention the outdated material and technical base of educational institutions, many emergency schools, kindergartens - up to 30-40 percent, and in some regions even higher. The proportion of emergency and dilapidated housing is high – up to 40–50 percent. It is also necessary to mention the lack of an effective system for predictive assessment of personnel needs for specialists with higher and secondary vocational education - we specifically considered these issues at the council, and if you remember, very seriously. According to forecasts from the Ministry of the Arctic, by 2035 we must create 200 jobs there. But we do not have a unified system for assessing the quality of Arctic programs and a methodology for determining the professions that are necessary to work in the Arctic regions. In fact, the situation is as follows: 80 percent are mid-professional specialists, and only 20 percent are with higher education. This is also forecast data,

but in reality it turns out the other way around: there are more personnel with higher education, and, unfortunately, there are more people with secondary and secondary vocational education.

Monitoring, analysis and decision-making for more precise "tuning" of the structure of admission to universities in accordance with the development priorities of both each region individually and the entire macro-region as a whole. Establishing close contacts with leading employers in the regions who could correctly transmit personnel orders by level of education and by areas/specialties of training. This information is important for setting up regional models for forecasting personnel needs and for assessing structural changes in the composition of the regions' labor potential.

Development and coordination of a unified scenario for the development of the region to provide a unified information field for decision-making by executive authorities, educational organizations, employers, and citizens. Application of the concept of creating a "transparent information environment" aimed at timely informing all interested users (government, business, education, individuals) about the past, present and future of the labor market in an understandable and accessible form.

Using tools to visually inform applicants and graduates about in-demand professions in the region in the format of professional charts and "employment barometers."

It should be noted that an important element in improving the staffing system of the economy is not only the formation of a scientifically based forecast of the need for personnel, but also the creation of effective mechanisms for transmitting this information to all interested participants in the labor market of applicants and their parents, graduates, employers, representatives of executive authorities. One of the most effective ways to disseminate information nowadays is web systems. Examples of effective dissemination of information about the labor market in the public domain on the Internet on thematic federal web portals:

— "staffing for the development of the Arctic zone of the Russian Federation" at http://arctic.labourmarket.ru/prognosis;

- "my career" at http://mycareer.karelia.ru/

Development of similar studies to clarify the qualitative composition of the needs of the economy in accordance with the established priorities for the development of regions separately and the macroregion as a whole. An important and little-researched issue is the issue of forecasting structural changes in the economy, and as a consequence, the economy's need for personnel with higher and professional education.

Thus, the educational network of the Arctic zone of Russia has the potential to resolve personnel issues through graduates of higher education. At the same time, given the significant inertia, the education system does not have time to quickly respond to changes in the external environment. The results of the analysis indicate that for universities, first of all, it is necessary to resolve the issue of structural compliance of admission and graduation with the chosen priorities of economic development.

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Issue Article

A.G. Kozhevnikova
Tashkent State Agrarian University
Doctor of Biological Sciences, Professor

Kh.K. Yakhyaev
Tashkent State Agrarian University
Doctor of Agricultural Sciences, Professor
Tashkent city
gnadezhda03@gmail.com

CICADA FAMILIES CICADELLIDAE MODERN COTTON PESTS

Abstract: *The article presents the results of a study of pests of cotton fields from the family Cicadellidae, species composition, harmfulness, nature of the damage caused, natural enemies and recommends modern control measures. The issues of developing mathematical models of the development and spread of pests of agricultural crops, built on the basis of the specifics of populations and the nature of their reactions to environmental factors, are considered, which makes it possible to simulate the dynamics of pest populations and effectively manage them.*

Key words: *cycad pests, species composition, development and prevalence, harmfulness, natural enemies, cotton.*

Language: *Russian*

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ЦИКАДОВЫЕ СЕМЕЙСТВА CICADELLIDAE СОВРЕМЕННЫЕ ВРЕДИТЕЛИ ХЛОПЧАТНИКА

Аннотация: *В статье представлены результаты изучения вредителей хлопковых полей из семейства Cicadellidae, видовой состав, вредоносность, характер наносимого вреда, естественные враги и рекомендованы современные меры борьбы. Рассмотрены вопросы разработки математических моделей развития и распространения вредных организмов сельскохозяйственных культур, построенных на основе специфики популяций, характера их реакций на факторы среды, что дает возможность моделировать динамики популяций вредителей и эффективно управлять ими.*

Ключевые слова: *цикадовые вредители, видовой состав, развитие и распространенность, вредоносность, естественные враги, хлопчатник.*

Введение

УДК 632.7.753

Разработанные, рекомендованные научными учреждениями и находящиеся на вооружении сельскохозяйственного производства защитные меры обеспечивают достаточно эффективную борьбу с комплексом вредных организмов.

Нет вредных объектов, против которых сельскохозяйственное производство было бы бессильно. Задача заключается в правильном и организационном применение имеющихся рекомендаций, защитных и технических средств. По всем рекомендованным защитным средствам отработаны технология и тактика их применения.

В последние годы в республике Узбекистан сложилась сложная фитосанитарная обстановка, связанная с увеличением посевных площадей зерновых культур в орошаемом земледелии и изменения в системе хозяйствования возделывания сельскохозяйственных культур, в основном хлопчатника и зерна [1-3].

Важнейшей задачей сельского хозяйства Узбекистана является рост производства высококачественного зерна и хлопка. Однако в силу целого ряда объективных и субъективных причин урожайность и валовой сбор зерна хлопка-сырца существенно колеблется по годам. В отдельные годы на снижение валового сбора высококачественного зерна пшеницы и хлопчатника отрицательно влияет массовое размножение различных видов вредных организмов [1-3].

Год за годом расширяется ареал распространения таких опасных вредителей, как цикадовые.

В условиях Узбекистана цикадовые встречаются в самых разнообразных биотопах. Они предпочитают полевые культуры, травянистые сообщества, их много на кустарниках и деревьях. Цикадовых много на излюбленных ими культурных и диких растениях.

Цикадовые многочисленная в современную эпоху группа насекомых, поэтому общее число цикадовых ещё полностью не выявлено, исследования в этой области в мире продолжаются.

В Узбекистане цикады распространены по-разному.

В Северном Узбекистане встречается 208 видов цикадовых, в Зеравшанской долине 207 видов, в Южном Узбекистане 173 вида [4]. И по сведениям Г.К. Дубовского в Ферганской долине 236 видов [5].

Всего на хлопковых полях обнаружено 72 вида цикадовых, из которых 50 видов повреждают различные сельскохозяйственные культуры. [4].

Определять цикад довольно сложно, по последним данным определение идёт не только по морфологическим признакам, но, главное, по строению генитального аппарата самца, поскольку по этим морфологическим и анатомическим особенностям отличаются многие роды и виды.

На хлопковых полях обитают разные виды цикад, но не все являются вредителями.

Некоторые виды являются нейтральными, их количество не доходит до экономического порога вредоносности, или они обитают на встречающихся сорняках среди полей или в их окружении.

Интересы развития сельскохозяйственного производства требуют проведения постоянной, планомерной борьбы с вредителями сельского хозяйства. Эта борьба проводилась и проводится механическими, химическими и биологическими способами.

Самый естественный, а потому и разумный, биологический способ борьбы. Его применение наиболее рационально учитывает необходимость сохранения энтомофагов, акарифагов и насекомых-опылителей.

Кроме того, этот способ приобретает особо важное значение еще и потому, что часто при этом решается задача не полного уничтожения какого-либо вида, но поддержания его на некотором постоянном по численности уровне в целях сохранения равновесия в биоценозе.

Следовательно, выявление и уточнение видового состава вредителей хлопчатника, определение их вредоносности наиболее опасных видов, изучение естественных врагов и рекомендация современных мер борьбы в условиях Узбекистана и являлось целью исследований.

Материалы и методика работы.

Материалом для настоящей работы явились 5 летние исследования, проведённые в Узбекистане.

Проводились сборы, наблюдения, эксперименты и учёты.

Использовались общепринятые в энтомологии методики и специальные методики [5].

Результаты исследований:

Всего на хлопковых полях в 2018-2022 обнаружено 72 вида цикад, из которых 50 видов повреждают различные сельскохозяйственные культуры

Исследования проведенные в естественно-исторических зонах выращивания хлопчатника показали, что хлопчатник сильно повреждают только 6 видов цикад, четыре вида из них из семейства Cicadellidae и два вида из семейства Cicadidae.

Вред от видов, вредоносных на хлопчатнике заключается в следующем: питание клеточным соком на культуре ослабляет растение, но оно не только ослабевает, вызывается угнетение растений, но и снижает урожайность на 10-12%.

Два крупных вида цикад из семейства Cicadidae повреждают растения хлопчатника при откладке яиц. Повреждения, вызываемые самками цикад при откладке яиц бывают существенными и могут доходить до 20-25%.

Цикадовые – это насекомые с колюще-сосущим ротовым аппаратом, поэтому многие виды являются переносчиками вирусных заболеваний.

Еще в 2000 году, в своей докторской диссертационной работе Кожевникова А.Г. указывала три наиболее вредоносных вида цикад из семейства Cicadellidae [4]. Это *Empoasca meridiana* Zachv., *Kyboasca bipunctata* Osh., *Austroagallia zachvatkini* Vilb.

Ситуация не изменилась и до настоящего времени. Эти три вида и в настоящее время

встречаются повсюду на полях и являются наиболее вредоносными.

Исследования показали, что это многоядные виды.

Все три вида цикад из семейства Cicadellidae небольшие цикады, очень подвижные, хорошо прыгающие формы.

При появлении человека на хлопковом поле они взлетают в большом количестве и в таком состоянии их трудно узнать. Хотя характерные особенности представителей семейства Cicadellidae это наличие прыгательных задних ног, колюще-сосущего ротового аппарата и характерное компактное строение тела.

Наблюдения показали, что *Empoasca meridian* Zachv. высасывает растительные соки, питаясь на нижней стороне листьев хлопчатника, в результате на верхней стороне листья имеют мраморный бело-пятнистый вид.

С появлением всходов культурных растений *Empoasca meridian* Zachv. переходит на них с сорняков и питается на культурных растениях, предпочитая хлопчатник.

Наибольшее количество этих вредителей на хлопчатнике наблюдается в конце мая, в июне и сентябре.

При повреждении *Kyboasca bipunctata* Osh. листья хлопчатника обесцвечиваются, скручиваются и нередко опадают, иногда покрываются вдоль жилок бурыми пятнами.

Austroagallia zachvatkini Vilb. отличается от предыдущих двух видов размерами, она крупнее от 3,7 до 3, 9 мм. и заметными четырьмя чёрными округлыми пятнышками на темени и переднеспинке.

Все три вида полифаги.

В качестве мер химических борьбы, при превышении экономического порога вредоносности можно рекомендовать 20% эм.к. Пиларкинг 0,15 л/га и 20% эм.к. Энтолучо 0,2 л/га, эффективность которых составила соответственно 92,3% и 93,1%.

Цикадовые из семейства Cicadellidae также как и другие насекомые, подвергаются нападению естественных врагов, которые снижают их численность. Обнаружены паразиты из семейств Tromididae, Dryinidae, Dorilidae. Более эффективными были Dryinidae [4].

На современном этапе специализации и интенсификации земледелия, в связи с необходимостью общего совершенствования стратегии и тактики защиты растений, резко возросло значение прогнозов распространения и развития вредителей сельскохозяйственных культур, в том числе цикадовых. Использование математических методов, построенных на основе специфики популяций, характера их реакций на факторы среды, дает возможность моделировать динамики популяции цикад и эффективно управлять ими [6].

Более того, математическое моделирование процесса динамики популяции вредителей представляет собой сложный многофакторный комплекс, где наряду с существенными факторами действуют менее существенные и незначимые. Очень часто математическая модель и эмпирическая кривая не совпадают из-за того, что наличие незначимых факторов затемняют основные стороны исследуемого процесса и некоторые существенные факторы, придающие данному процессу определенный характер, могут быть не учтены.

Кроме того, многочисленность факторов способствует резкому возрастанию объема работ, связанных со сбором и обработкой информации. Работы в этом направлении имеют большое практическое значение, поскольку районирование выступает в качестве существенного элемента во многих исследованиях, в частности при прогнозировании численности динамики популяции цикадовых вредителей, размеров зараженных площадей вредителем, даты (сроки) появления вредителя, планирование мероприятий по борьбе с вредителями, при анализе причин вспышек размножения вредителей и т.п. [2,6].

Математические методы прогнозирования динамики популяции цикадовых вредителей хлопчатника заключается в использовании имеющихся данных о характеристиках прогнозируемого объекта, обработке этих данных математическими методами, в получении зависимости связывающей эти характеристики со временем и вычислении с помощью найденной зависимости характеристик изучаемого объекта в заданный момент времени. Популяцию цикадовых вредителей хлопчатника, согласно [2,6] можно рассматривать как некоторый процесс, представленный схемой, изображенной на рисунке. Совокупность параметров $(V_1, V_2, \ldots, V_n)$ и $(Z_1, Z_2, \ldots, Z_m)$ образует вход объекта исследований и совокупность $(Y_1, Y_2, \ldots, Yk)$ - выход. Очевидно, что входы и выход объекта могут рассматриваться как некоторые многомерные векторы в пространстве параметров. Так, для вектора V пространство имеет n измерений, для вектора Z - m измерений, а для вектора Y - k измерений.

Выход объекта связан с его входами определенным образом, например, с помощью оператора F,

$$Y = F(V, Z) \qquad (1)$$

который характеризует структуру данного объекта.

Рисунок 1. Взаимодействия объекта исследования и влияющих на него факторов

Отыскание количественной связи параметров (1), т.е. полное раскрытие оператора *F* и составляет сущность задачи рассматриваемого объекта. В результате моделирования получается математическая модель этого объекта.

В выражении (1) множество *V* образует (в терминах экологии) совокупность биотических факторов, *Z* - совокупность абиотических факторов, а *Y* - совокупность факторов, характеризующих популяцию вредителей. Ими могут быть такие показатели, как численность (плотность) вредителей, размеры зараженных площадей сельскохозяйственных культур вредителями, даты появления вредителей и т.д.

Допустим, что в выражении (1) векторы *Y, V, Z* доступны наблюдению и компоненты их могут быть измерены. Тогда, если структура оператора *F* известна, то задача математического моделирования динамики популяции сельскохозяйственных вредителей, заключающаяся в установлении влияния факторов биотической и абиотической среды на динамику популяции сельскохозяйственных вредителей, сводится к отысканию неизвестного вектора параметров $A = (a_1, a_2, \ldots, a_s)$, компонентами которого являются величины, зависящие от факторов *V* и *Z*.

Решение этой задачи позволяет перейти к кругу проблем, связанных с решением задач прогнозирования динамики популяции цикадовых вредителей хлопчатника и выработки оптимальных планов борьбы с ними.

Допустим, что для некоторого экологического процесса найдена аналитическая форма выражения (1) т.е. определены значения параметров вектора *A*. Предположим, что полученная модель, описываемая выражением (1), адекватна исследуемому процессу. Тогда определение значения Y_t на выходе модели некоторого будущего момента $t+1$ и составляет сущность задачи прогнозирования для вектора *Y*.

Для нахождения аналитической формы выражения (1) используются различные методы. Поскольку факторы биотической и абиотической среды можно рассматривать как подмножества множества входных факторов, т.е.

$$X = V \cap Z$$

тогда выражение (1) примет вид:

$$Y = F(X) \qquad (2)$$

Выражение (2) запишем в виде

$$y_m = f_m(x_{m1}, x_{m2}, \ldots, x_{nm}) \qquad (3)$$

где индекс *m* показывает вид вредителя.

Таким образом, выражение (3) в общем виде показывает взаимосвязь динамики популяции цикадовых вредителей с влияющими на него факторами.

Как было сказано выше, прогнозируемыми параметрами популяции вредителей (y_m) могут быть такие ее характеристики, как численность (плотность), размеры зараженных площадей сельскохозяйственных культур, даты появления вредителей и др., а их измерители (факторы биотической и абиотической среды) устанавливаются специалистом, хорошо знающим объект прогнозирования.

Для выявления аналитического вида выражения (3) применяются различные методы идентификации. Мы остановимся на методе группового учета аргументов (МГУА).

Целью МГУА является получение результата полного перебора по критерию селекции. МГУА относится к группе методов, основанных на математической обработке данных предыстории и предназначена для решения так называемых интерполяционных задач технической кибернетики. Примерами таких задач являются задачи распознавания образов, прогнозирования случайных процессов, идентификации структуры и параметров сложных объектов по результатам наблюдения их работы, оптимального управления с оптимизацией прогноза. Эти перечисленные задачи в принципе могут быть решены при помощи полного перебора всех вариантов по

критерию, называемым критерием селекции. Выбор такого критерия является эвристическим, т.е. принадлежит программисту и определяется целью решения задачи.

Полный перебор происходит в процессе постепенного усложнения математического описания или модели. При этом усложнение идет дискретно, т.е. в каждом ряду добавляются новые члены, либо повышается степень полинома, либо то и другое происходит одновременно. Постепенно увеличивая сложность математической модели и задавая ряд дискретных значений ее коэффициентов с некоторым небольшим шагом, можно организовать полный перебор всех возможных вариантов модели по указанному критерию селекции и таким образом найти самую хорошую модель (из просмотренных). Наличие минимума критерия селекции дает возможность нахождения единственной модели оптимальной сложности. Методом поиска является поочередное апробирование моделей (перебор).

Имеются различные алгоритмы МГУА [7, 8], которые отличаются друг от друга по виду аппроксимирующей функции. Одним из алгоритмов являются полиномиальные алгоритмы МГУА. Эти алгоритмы используются для осуществления многорядной селекции при решении задач поиска оптимальной модели, задаваемые в виде степенного полинома.

Согласно полиномиальным алгоритмам МГУА полное описание объекта (3) заменяется некоторым набором, так называемых частных описаний, которые являются функциями двух аргументов. В первом ряду селекции частные описания имеют вид:

$$Y_{1k} = f_k\,(X_{kj}\,,\,X_{kl})\ ,$$

во втором и последующих рядах:

$$Y_{ik} = f_k\,(Y_{i-1,k}\,,\,Y_{i-1,k+1})$$

В качестве апроксимирующих функций f_k используются полиномы не выше второй степени относительно двух аргументов, на первом ряду селекции:

$$Y_{1k} = a_{1k}^{(0)} + a_{1k}^{(1)}X_{jk} + a_{1k}^{(2)}X_{lk} + a_{1k}^{(3)}X_{jk}X_{lk} + a_{1k}^{(4)}X_{jk}^2 + a_{1k}X_{lk}^2$$

на втором и последующих рядах:

$$Y_{ik} = a_{ik}^{(0)} + a_{ik}^{(1)}Y_{i-1,k} + a_{ik}^{(2)}Y_{i-1,l} + a_{ik}^{(3)}Y_{i-1,k}Y_{i-1,l} + a_{ik}^{(4)}Y_{i-1,k}^2 + a_{ik}^{(5)}Y_{i-1,l}^2$$

Здесь i - число рядов селекции, $i = 2,3, \ldots, N$; k - число частных описаний, $k = 1, 2, \ldots, C_n^2$;

$$j = 1, 2, \ldots, N\text{-}1;\ \ l = j+1, j+2, \ldots, N$$

где N - число аргументов.

Коэффициенты частных описаний определяются по данным обучающей последовательности (ОП), для чего применяется метод наименьших квадратов. Следует отметить, что с целью получения устойчивых решений имеющийся набор данных разделяется на обучающую и проверочную последовательности (ПП).

Степень регулярности оценивается по величине среднеквадратической ошибки на отдельной проверочной последовательности (ищется минимум этой ошибки).

Для получения наиболее регулярного математического описания в качестве критерия селекции можно использовать либо коэффициент корреляции, либо величину среднеквадратической ошибки измерений на отдельной проверочной последовательности.

Критерий регулярности имеет преимущество в том, что он весьма плавно изменяется при увеличении сложности модели, что дает возможность отказаться от полного перебора моделей и применить многорядные алгоритмы МГУА, при которых по критерию сравнивается только часть моделей.

Из ряда в ряд селекции, при помощи пороговых отборов, из всех частных описаний пропускают самые регулярные переменные, называемые промежуточными переменными. С увеличением сложности промежуточных переменных увеличивается сложность модели и на каком-то ряду она станет равной сложности объекта, при этом значение критерия само отбора достигает своей экстремальной величины. В качестве окончательного решения выбирается одна из промежуточных переменных последнего ряда. Полное описание объекта получается в виде набора промежуточных переменных.

В качестве примера ниже приводятся результаты исследований по определению плодовитости цикад. Установлено, что по размерам головных капсул, по весу личинок вредителя можно судить о ее жизнеспособности и плодовитости. Следовательно, плодовитость цикады P является функцией таких показателей, как размер (X_p) и вес личинок (X_m), т.е.

$$P = f\,(X_m\,,\,X_p) \qquad (4)$$

Для выявления вида этой функции использовали данные, полученные в полевых условиях хозяйств Сурхандарьинской области (таблица 1.). Для выявления вида выражения (4) применен метод группового учета аргументов, основанный на принципе эвристической самоорганизации и стандартная программа из фонда алгоритмов и программ [8].

В результате получено вид выражения (4), в виде следующего набора промежуточных переменных:

$P = -587{,}77 + 1{,}345\ Y_{11} + 1{,}14\ Y_{12} - 0{,}0009\ Y_{11}Y_{12}$,

где

$Y_{11} = -23287{,}67 + 1194{,}68\ X_p\ 81{,}98\ X_m - 4{,}047\ X_mX_p$;

$Y_{12} = 2155{,}81 - 356{,}21\ X_k - 109{,}25\ X_p + 27{,}578\ X_kX_p$;

При этом коэффициент корреляции очень высокий R = 0,94; а ошибка аппроксимации составила 14,5 штук яиц.

Таблица 1. Сравнение размера, массы и плодовитости личинок цикад *Empoasca meridiana* Zachv.

№ пп	Плодовитость (количество яиц), в шт. фактические ! расчетные		Масса личинок, мг	Размер личинок, мм
1.	385	345	275	17,5
2.	292	318	260	17,5
3.	300	317	260	16,0
4.	331	339	280	18,5
5.	405	386	296	19,0
6.	298	276	280	17,5
7.	356	341	285	18,0
8.	238	293	280	17,5
9.	290	311	265	17,0
10.	340	383	285	18,0

Выводы и рекомендации:

Исследования показали, что на хлопковых полях и их окружении обитают 72 вида цикад, непосредственно на хлопчатнике питаются и повреждают его 6 видов цикад, достоверное определение которых основывается на строении генитального аппарата, согласно современной систематике.

В качестве химических мер борьбы можно рекомендовать 20% эм.к. Пиларкинг 0,15 л/га и 20% эм.к. Энтолучо 0,2 л/га, эффективность которых составила соответственно 92,3% и 93,1%.

Изучение и разведение паразитов цикад, обитающих на хлопчатнике, дают возможность, рекомендовать использование естественных популяций природных энтомофагов наиболее эффективных паразитов из семейства Dryinidae, заражение которыми колеблется по годам и зонам Узбекистана от 15 до 18%.

На современном этапе специализации и интенсификации земледелия резко возросло значение прогнозов распространения и развития вредителей сельскохозяйственных культур, в том числе цикадовых. Использование математических методов, построенных на основе специфики популяций, характера их реакций на факторы среды, дает возможность моделировать динамики популяции цикад и эффективно управлять ими.

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