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BIOLOGICAL SCIENCES

TAXONOMIC STRUCTURE OF ENDEM PLANTS SPREADING ONLY IN NAKHCHIVAN AUTONOMOUS REPUBLIC FLORA OF AZERBAIJAN

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Abstract

Flora of Nakhchivan AR is rich from species point of view. The reason of this is various ecological medium and relief of the area. From ecological factors – heat, humidity, light, wind and tee, including to climate factor are of great importance in plants development. Soil condition, its mechanical, physical and agrochemical. Structure being edaphic factors, as well as height, slope aspect, inclined feature and surface being orographic factors play important role in plants gravity.

These factors met in the nature of Nakhchivan AR differ from other botanic-geographical regions. From species, point of view mountainous zone of Nakhchivan has great advantages comparing with other botanic-geographical regions of Azerbaijan.

Keywords: endemic, Nakhchivan Territory, ecological, climate factor, status

Introduction

Located in 38°31'–39°47' northern latitude and 44°46'–46°10' eastern longitude of the southwestern part of the lesser Caucasus Nakhchivan Autonomous Republic has severe continental climate. The lowest field in Arazboyu plain (about 600–800 m), the highest peak is Gapijig (3906 m). State border of the Nakhchivan AR is bounded with Islamic Republic of Iran from the South by Araz river, Turkey Republic from the west, Zangazur and Daralayaz ranges and Armenia from the north and east. The main factors forming severe continental climate in the Nakhchivan AR were change of average annual weather temperature: 8–5° C–14–12° C positive, in the coldest months of the year 6–10° C negative minus 30° C frosty days during some years (Babayev S. Y., 1999).

Climate change or stability plays an important role in the formation of endemism center. (Susan Harrison and Reed Noss., 2017). Endemic species have been identified in the study of the flora biodiversity of the Transilvanian plain. (Abramova I.V., 2013, Ishmuratova M.Yu., Tleukenova S.U. et al., 2015, Mihaela Samarghitan, Silvia Oroian, Corneliu Tanase, 2017). The types of endemic plants in danger of extinction in the Mediterranean Sea, it was noted. (Fenu G., Mattana E.S., 2011)

Of the 78% of endemic flowering plants growing in Iran, 42% are bordered by mountainous areas. Thus, at altitudes above 1400 m, the complexity of the microclimate and relief affects high biodiversity and endemism. (Jalil Noroozi, Amir Talebi, Moslem Dosost-mohammadi, Sara Manafzadeh, Zahra Asgarpour and Gerald M., 2019)

In the Brazilian state of Ceppa-gys-Caracas, 38 species of tuberous plants, 31 genera and 7 endemic species of 22 family were identified from 856 seed plants. (Gulietti A.M et al., 2019). According to the size of the distribution conditions in the Carpathians, endemic taxa are divided into 4 main groups: eurychoric (pancarpathic), mesochoric, stenochoric, microchoric. (Jan Kliment, Peter Turis & Monika Janisova, 2018).

Due to the complex climate and high mountainous areas of the study area, the diversity of endemic plants has been formed. (Julio Penas, Francisco J. Perez Garcia & Juan F., 2005; Gulbanu Aueskhanovna, Duman Kulakhmedovich Baizhyigitov et al., 2017). Information has been provided on the importance of migration in the protection of endemic plants due to climate change that may occur in the mountainous areas of Tibet. (Yujing Yan and Zhiyao Tang 2019). A number of endangered endemic plants have been identified on Mount Cameroon (Martin Cheek, Isla Causon et al., 2019)

Being surrounded by high mountains in the north and bordered on Araz river in the south, in the territory of the Nakhchivan AR no transitional species are found from neighboring states and specific endemic plant species belonging here are spread.

Materials and methods

For the study of endemic species, plant samples were collected during about 40 expeditions in 2018–2020, starting from the “Arazboyu” plain of the Nakhchivan Autonomous Republic to the areas covering the middle, high mountains and alpine belt. The collected plant samples were herbariated and put into use. Literary data, flora of Turkey, Iran and Armenia were used to clarify that the species is endemic to the Nakhchivan Autonomous Republic. Endemic species of the Nakhchivan Autonomous Republic have been identified using the flora of neighboring countries Turkey, Iran and Armenia. The identified species are divided into systematic groups.

Endemic plants collected during expeditions from the plains of the Nakhchivan Autonomous Republic to the areas covering the middle and high mountain belt were identified through literature data, identifiers and atlas (Lazkov G.A. and Umralina A.R., 2015; Asgarov A. M., 2016)

The first flowering plants had been known since the Cretaceous period of the Mesozoic era. Flowering plants cover species more than 350 families; they spread throughout the world (the Earth). Being rich in characteristic species, a variety of flowering trees,

shrubs, grass which has grown in the flora of Nakhchivan. Among flowering plants *Liliopsida* or *Monocotyledon* class, constitute more than grasses. 73 species collected in 36 genera of 12 families of the class *Monocotyledons* grow only in the territory of Nakhchivan, one of the 5 largest botanical-geographical regions of Azerbaijan. Another class of flowering plants, *Magnoliopsida* – 467 species belonging to 47 genera, 9 subfamilies, 214 genera of *dicotyledons* are only in the flora of Nakhchivan AR (Asgarov A.M., 2011, 2016; Talibov T.H., Ibrahimov A.S. 2008, 2010; Seyidov M.M., Ibadullayeva J.S., 2014; Aliyeva A. M., 2019). However, yet information was provided on endemic species and their status in the flora of Nakhchivan AR.

Results and discussion

For the first time, information provided on endemic plant species included in the flora of Azerbaijan, growing only in the territory of Nakhchivan AR. The taxonomic composition of endemic plants in the flora of Nakhchivan Autonomous Republic is as follows:

Liliopsida (*Monocotyledones*)

Familia: *Poaceae* Barnhart

Genus: *Elytrigia* Desv.

Elytrigia Heidemanianae Tzvel.

Genus: *Bromus* L.

Bromus Tzvelevii S.G.Mussajev

Genus: *Koeleria* Pers.

Koeleria bitzenachica (Tzvel.) Tzvel.

Genus: *Stipa* L.

Stipa Issaevii S.G.Musajev et Sadychov

Stipa Karjagininii S.G.Musajev et Sadychov

Magnoliopsida

Familia: *Ranunculaceae* Juss.

Genus: *Delphinium* L.

Delphinium Lomakinii Kem.-Nath.

Familia: *Chenopodiaceae* Vent.

Genus: *Salsola* L.

Salsola futilis İljin

Familia: *Hypericaceae* Juss.(Guttiferae auct.)

Genus: *Hypericum* L.

Hypericum atropatanum Rzazade

Familia: *Brassicaceae* Burnett

Genus: *Thlaspi* L.

Thlaspi armenum N.Busch

Genus: *Apterigia* Galusko

Apterigia rostrata (N.Busch) Galushko

Genus: *Peltariopsis* N.Busch

Peltariopsis Grossheimii N.Busch

Genus: *Cymatocarpus* O.E.Schultz

Cymatocarpus Grossheimii N.Busch

Genus: *Crambe* L.

Crambe Grossheimii İ.Khalilov

Familia: *Rosaceae* Juss.

Subfamilia: *Maloideae*

Genus: *Crataegus* L.

Crataegus Cinovskisii Kassymova

Familia: *Fabaceae* Lindl.

Subfamilia: *Papilionoideae* or *Faboideae*

Genus: *Astragalus* L.

Astragalus badamliensis Chalilov

Astragalus conspicuus Boriss.(*A.aduncus* Willd.)

Astragalus karakuschensis Gontsch

Genus: *Lathyrus* L.(*Orobus* L.)

Lathyrus atropatanus (Grossh.) Sirj. (*Orobus atropatnus* Grossh.)

Genus: *Trifolium* L. s.str.

Trifolium Biebersteinii Chalilov

Familia: *Rubiaceae* Juss.

Genus: *Galium* L.

Galium achurense Grossh.

Galium atropatanum Grossh.

Galium bullatum Lipsky

Familia: *Scrophulariaceae* Juss.

Genus: *Verbascum* L.(*Celsia* L.)

Verbascum erivanicum E. Wulf.

Genus: *Scrophularia* L.

Scrophularia nachitscvanica Grossh.

Familia: *Lamiaceae* Lindl.

Subfamilia: *Scutellarioideae*

Genus: *Scutellaria* L.

Scutellaria darriensis Grossh.

Scutellaria Karjagininii Grossh.

Scutellaria rhomboidalis Grossh.

Subfamilia: *Lamioideae*

Genus: *Marribium* L.

Marribium nanum Knorr.

Genus: *Nepeta* L.

Nepeta noraschenica Grossh.

Genus: *Stachys* L.

Stachys Fominii Sosn.

Genus: *Salvia* L. (*Schraderia* Medik.)

Salvia suffruticosa Montbr. et. Auch. ex Benth. (S.Alexandri Pobed.)

Familia: *Asteraceae* Dumort - Asterçiçeklilər or *Compositae* Giseke

Genus: *Carduus* L.

Carduus atropatanucus Sosn. ex Grossh.

(*C.onopordioides* Fisch. et Bieb.)

Genus: *Centaurea* L.

Centaurea araxina Gabr.

Genus: *Crepis* L.

Crepis karakuschensis Gzer.

5 species to 4 genera belonging to the class of monocotyledons (all of them belong to the family *Poaceae* Barnhart), 10 genera belonging to the class of *Dicotyledons*, 29 endemic species belonging to 23 genera spread in only Nakhchivan's flora, Azerbaijan. Among the endemic plants, *Lamiaceae* Lindl, a family of *Dicotyledons*, is dominated by 5 generas and 7 species.

Among the endemic plants spread only in Nakhchivan's flora, there are species included in the "Red Book" of Azerbaijan and the Nakhchivan Autonomous Republic. Information on these species has given in the following table:

**Rare and endangered endemic species included in the “Red Book”
of the Nakhchivan Autonomous Republic and Republic of Azerbaijan**

№	Latin names of plants	Its status (“Red Book” of Nakhchivan Autonomous Republic)	Its status (“Red Book” of Azerbaijan Republic)
<i>Liliopsida (Monocotyledones)</i>			
1.	<i>Stipa Issaevii</i> S.G.Musajev et Sadychov	CR B1ac(i)	
2.	<i>Stipa Karjaginii</i> S.G.Musajev et Sadychov	VU Acd; B1b(ii,iii)c (ii,iii)	
<i>Magnoliopsida</i>			
1.	<i>Astragalus badamliensis</i> Chalilov	CR B1ac(ii,iv); C2a(i)	
2.	<i>Astragalus badamliensis</i> Chalilov		CR A2c+3c; B1ac(i)+2ab(i,ii,iii)
3.	<i>Hypericum atropatanum</i> Rzazade		VU D2
4.	<i>Salsola futilis</i> İljin		VU D2
5.	<i>Marribium nanum</i> Knorr.		NT

The analysis of the table shows that the Red Book of the Nakhchivan Autonomous Republic includes both monocotyledonous and dicotyledonous species of endemic plants, and the Red Book of the Republic of Azerbaijan includes only species belonging to the dicotyledonous class.

Discussion

Only in the flora of Nakhchivan Autonomous Republic of Azerbaijan there are 5 endemic species belonging to 4 genera of the Poaceae Barnhart family of the monocotyledonous class, 10 genera belonging to the dicotyledonous class, 29 endemic species belonging to 23 genera of 4 subfamilies. Among the endemic plants, *Lamiaceae* Lindl family, belonging to the class of dicotyledons, is dominated by 5 genera and 7 species. Among the endemic plants, the "Red Book" of the Nakhchivan AR includes representatives of both monocotyledons and dicotyledons, and the "Red Book" of the Republic of Azerbaijan includes only species belonging to the class of dicotyledons.

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CHEMICAL SCIENCES

FEATURES OF FORMATION OF GAS HYDRATES IN GAS PIPELINES

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ОСОБЕННОСТИ ОБРАЗОВАНИЯ ГАЗОГИДРАТОВ В ГАЗОПРОВОДАХ

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Abstract

The article describes various conditions and mechanisms for the formation of hydrates in a pipeline.

Аннотация

В статье описаны различные условия и механизмы образования гидратов в трубопроводе.

Keywords: methane, gaseous methane, hydrates, temperatures, pressures, gas pipeline, thermobaric conditions.

Ключевые слова: метан, газообразный метан, гидраты, температуры, давления, газопровод, термобарические условия.

Гидратообразование характерно для всех магистральных газопроводов, за исключением тех, по которым транспортируют осушенный газ с точкой росы паров воды ниже минимальной рабочей температуры. В условиях недостаточной осушки газа от паров воды, как правило, образуются гидраты. Их образование представляет собой реакцию кристаллизации молекул воды и углеводородов. Эта реакция происходит при транспортировке нефтяных отходов и происходит в многофазной среде, состоящей из газа, жидких или растворенных углеводородов, жидкой воды и иногда твердых (например, песчаных) частиц [1].

Газогидраты представляют собой тип вставочного соединения, в котором молекулы воды, связанные водородными связями, создают сеть полостей, достаточно больших для захвата молекул газа. При определенных условиях давления и температуры эти молекулы газа, захваченные взаимодействиями сил типа Ван-дер-Ваальса, способны термодинамически стабилизировать структуру, которая в противном случае была бы разрушена силами притяжения между молекулами воды [2].

При добыче природного газа могут образовываться и другие гидраты. Чем больше увеличивается длина молекулы углеводородов (бутан, пентан

и др.), тем менее устойчивыми становятся образующиеся гидраты. Гидраты природного газа характеризуются более низким давлением (25 МПа, компрессия 1/170) и более высокой температурой, чем сжиженный природный газ или природный газ для транспортных средств (сжатый природный газ [3]).

Низкие температуры и высокие давления в технологических системах способствуют образованию процессу гидратообразования. С увеличением давления и снижением температуры в сети сбора скорость образования гидратов на стенках трубопроводов только увеличивается. Обычно гидраты представляют собой крупинки, которые рассредоточены по стенкам трубопровода, однако они могут быть и перемешаны с жидкостью, или представлять собой большие кластера, что значительно осложняет работу трубопровода [4].

Термобарические кривые для гидратообразующих веществ показаны на рисунке 1. Во всех случаях линии равновесия у трехфазных систем, включающих две жидкие фазы, имеют сильный наклон. При небольших изменениях температуры наблюдаются очень значительные изменения значений давления. У метана такой картины не наблюдается.

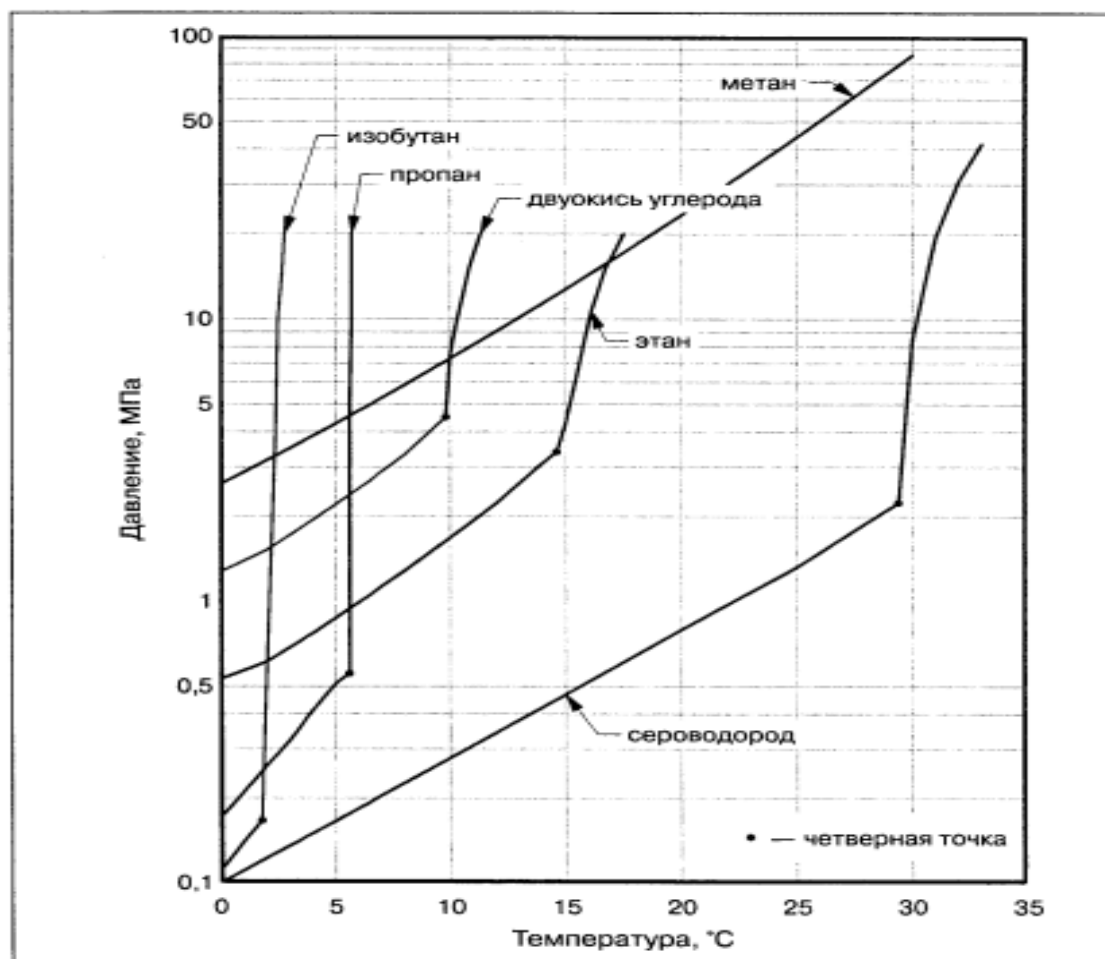


Рисунок.1. Кривые гидратообразования для некоторых компонентов природного газа

Гидраты состоят из двух компонентов: «хозяина» и «гостевой» молекулы. Молекулой-«хозяином» является вода, а «гостем» — углеводороды с низким молекулярным весом, такие как метан, этан, пропан, а также диоксид углерода, азот, кислород и сероводород. Образованию гидратов способствуют «гостевые» молекулы, которые в определенный момент закупориваются внутри молекул «хозяина». Процесс образования гидратов на самом деле более сложный. Если в нефтяном флюиде преобладает маслянистая фракция, то вся жидкость оседает в

нефтяном потоке в виде капель. Устойчивость полученной смеси достигается благодаря наличию природных веществ, содержащихся в нефти. Если посмотреть последовательно процесс образования гидратов, то сначала формируется гидратный налет, обволакивая каждую частицу воды, затем происходит утолщение замерзшей оболочки до полного заполнения частицы воды гидратом, то есть образуется некая пробка (рисунок 2). В дальнейшем образуется все больше гидратов твердой структуры, что затрудняет их удаление из трубопроводов [4].



Рисунок.2. Образование гидрата

Для условий гидратообразования необходимы компонент, который выступит катализатором для образования гидратов (природный газ содержащий, влагу), низкая температура и высокое давление

газа. Образование гидрата происходит только при условии, если температура стенки трубопровода меньше температуры гидратообразования [4].

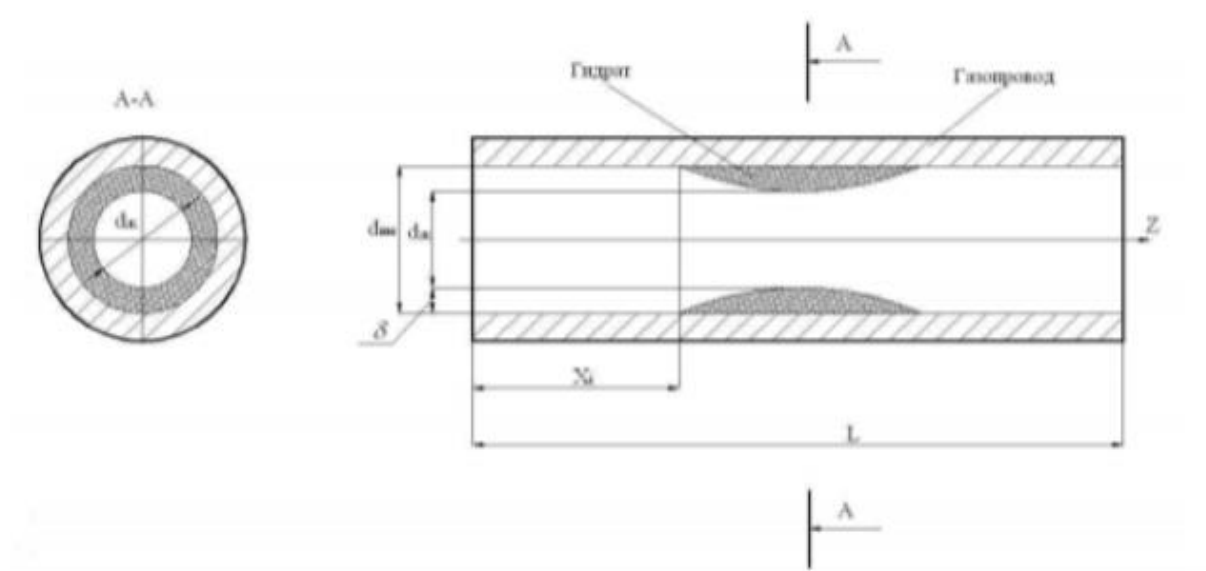


Рисунок.3. Схема газопровода с газогидратным слоем на внутренних стенках

Ускоренному образованию гидратов способствуют следующие явления:

Турбулентность, высокие скорости потока: Образование гидратов активно протекает на участке с высокими скоростями потока среды. Это делает дроссельную арматуру особенно чувствительной к образованию гидратов. Во-первых, температура природного газа при прохождении через дроссель, как правило, значительно понижается вследствие эффекта Джоуля-Томсона. Во-вторых, в уменьшенном проходном сечении клапана возникает большая скорость потока [5].

Перемешивание. При перемешивании газа в трубопроводе, технологическом резервуаре, теплообменнике и т. п. интенсивность гидратообразования возрастает [5].

Центры кристаллизации. Центр кристаллизации представляет собой точку, в которой имеются благоприятные условия для фазового превращения, в данном конкретном случае – образование твердой фазы из жидкой. Центрами кристаллизации для образования гидратов могут быть дефекты трубопроводов, сварные швы, фасонные детали и арматура трубопроводов. Включения шлама, окарины, грязи и песка также являются хорошими центрами кристаллизации [5].

Свободная вода: Наличие свободной воды не является обязательным условием для гидратообразования. Это продемонстрировано на фазовой диаграмме давление состава для системы метан + вода. Например, в равномолярной смеси метана и воды

при 10°C и 10 МПа присутствуют только гидратная и газовая фазы – свободная вода отсутствует [5].

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EARTH SCIENCES

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ORGANIZATIONAL MEASURES FOR EVACUATION OF THE POPULATION DURING EMERGENCY EVENTS

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Abstract

The article involves information on the relevance of the topic, research object, purpose, material methodology and organizational work for the resettlement of the population in the period of negative natural disasters and war emergencies in the autonomous republic. First of all, the research reflected negative natural processes, war disasters, severe consequences of technogenic disasters, material damage, as well as an increase in the intensity of many processes in human health and the natural environment.

As a result, several proposals and recommendations were made in order to prevent negative natural processes and war emergencies in the autonomous republic, and to carry out organizational work for the removing of the population.

Keywords: flood, war, engineering, natural, anthropogenic, geographical factors, erosion, environmental assessment

Introduction

The actuality of the paper. In recent years, there has been an increasing trend of negative natural processes and war emergencies around the world. Our autonomous republic is also a mountainous area, so it is necessary to take these issues seriously, because of intensity zone, including natural disasters and war. For the reason that negative natural processes and war disasters develop, they become an integral part of modern society. As the danger of these processes increases, the amount of social and material losses are also rise, depending on their scale and consequences. Social losses are determined primarily by the number of dead and injured (injured, as well as those with physical and mental troubles), while economic losses are determined by direct or indirect material losses. The problem of prevention and elimination of the consequences of emergencies in the Nakhchivan Autonomous Republic should always be in the focus of attention, and research in this area is suitable.

Object of research. It involves the areas of negative natural and war emergencies in the Nakhchivan Autonomous Republic.

The purpose of the study. The research work carried out in the Autonomous Republic consists of taking measures by examining the conduct and implementation of organizational work for the resettlement of the population in the event of adverse natural and war emergencies.

The methodology of the research. Literature on the subject, field materials were collected and work methodology was developed. During the development of the topic, monographs, methodological aids, map materials and work experience of scientists conducting research in foreign countries, including Azerbaijan and Nakhchivan AR at different stages of history were used [2, 5, 6, 7, 9].

Analysis and discussion. As a result of the analysis of the researches, it was determined that the most likely natural disasters in the settlements and the most

important facilities that stopped working during the war were the organized evacuation of workers and employees to safe zones and shelters. The evacuated population must remain in a safe zone during the war and is one of the ways to protect the population from nuclear weapons (during the war). Thus, due to timely evacuation and dilution measures carried out on the instructions of government agencies, it is possible to save the vast majority of the population from possible nuclear strikes (modern conventional means of destruction) and thus minimize the damage.

In cities (settlements) production, education, culture, transport, communication, etc. The resettlement of workers and employees and their family members who are not related to enterprises, who do not work, is also organized on a territorial basis (at the place of residence) and on the principle of production (at the workplace of the head of the family). The evacuation is organized by all CD (civil defense) headquarters and chiefs. Resettlement agencies are being set up to assist them in this area. In peacetime, earthquakes and the collapse of water sources temporarily evacuate people from settlements that may be flooded [4].

Dilution is the organized removal of workers and employees from the enterprises and organizations operating in the area of the probable strong collapse zone in settlements, as well as the most important facilities outside these settlements, and their placement in a safe zone. Workers and employees of such enterprises and organizations work in shifts at facilities (plants, factories) and are taken to a safe zone after work.

The safe zone is the area outside the probable destruction zones of cities (settlements) and the most important facilities divided into groups according to the CD.

The evacuated and sparsely populated population, as well as the Civil Defence forces intended for rescue and emergency response operations, are located in the safe zone. For this purpose, the development of

transport roads, existing communication lines, the creation of the necessary housing stock, utilities, medical, cultural and household facilities, the discovery of facilities suitable for sheltering the population, increasing water sources, etc. Precautions must be taken. A safe zone is sometimes called a safe zone. The conditional line between the safe zone and the probable destruction zone is called the zone boundary (zone boundary).

In this case, the places where the buildings, structures and industrial facilities in the area are destroyed during the floods are considered. People living in such zones are evacuated to a safe zone 4-6 hours before the first wave of floods reaches that zone.

Evacuation and thinning of the population is carried out only on the basis of the decision of government agencies. Evacuation and dilution should be carried out as soon as possible. For this purpose, all action plans are prepared ahead of time. A combined approach should be used to solve such a complex and responsible task. The essence of this method is that all types of transport and pedestrian methods must be used.

First of all, groups transported by vehicles: - Workers and employees of public administration (with their families); -Persons working in important research institutions; -Persons working in the design bureau; - Hospitals; -Personnel of highly trained teams; -People who are unable to walk; Women with children under 1 year.

Those relocated on foot:-Employees and employees of enterprises (with their families); -Organizations that will continue their work in the suburbs; -Organizations that ceased their activities during the war; -Requirements of higher, secondary and technical schools, as well as persons able to walk.

Combined evacuation of the population should be carried out on a territorial-production basis. This means that workers, employees, students and their family members must be registered and transferred to the account of the enterprise where they work and study. Other members of the family who do not work or study are registered and relocated by local housing and communal services. Dilution and resettlement are considered complete after the evacuation of the entire population, except for those working in areas of probable collapse during the war.

A safe zone is a zone that meets all the requirements during the military period. In this zone, the population evacuated from the settlements in danger of collapse is protected, and at the same time, the resting queues of the facilities, which continue their work during the military period, also rest in this zone [8].

The safe zone is chosen for such zones that are excluded from shock waves and light radiation. Such zones should be excluded from the radiation of the settlement. Such zones are determined by the size of the settlement, the population and, most importantly, the power of the nuclear weapon to be used by the enemy. During the war, queues at important facilities rested in the suburbs. In this case, it should be calculated that the time spent on their transportation will not exceed 4-5 hours. For this reason, the camps set up for rest should be close to railways, transport, rivers and sea routes, depending on the conditions. Whenever possible, they are

placed with the families of workers and employees. The basic scheme of evacuation and dilution is still planned and developed in peacetime in enterprises, departments and organizations. The accommodation area is created in a safe zone. Displaced people and MM forces are provided with the necessary tools and materials. This is being developed by the Executive Power (municipalities) in peacetime. Accommodation areas are selected by agreement with the military leadership.

Conclusion. The following results were obtained in our research on the negative natural processes and the state of emergency caused by wars in the Nakhchivan Autonomous Republic.

In addition to the severe consequences and material damage caused by negative natural processes and wars, the study examines environmental, socio-economic and other negative events, global climate change and the increase in the intensity of these events, which cause great damage to human health, the environment, the economy and society as a whole. As a result, several proposals and recommendations were made in order to implement organizational, engineering, information technology and systemic measures to prevent and resolve the emergencies caused by negative natural processes and wars in the autonomous republic.

Offers. The main problem of prevention and minimization of the consequences of emergencies in the Autonomous Republic is the implementation of organizational, engineering, information technology and systemic measures to solve it.

Monitoring of earthquakes, floods, droughts, landslides, avalanches, floods, etc. from natural processes forming emergencies, forecasting its probable scale, establishing a system of shore protection devices, informing the population about the situation on roads and their evacuation from possible floodplains, as well as it is necessary to prepare the forces and means involved in the elimination of the consequences of the emergency.

In our war-torn autonomous republic, along with shelters, it is important to take medical, clothing, food and other necessary measures for the resettlement of the population.

In recent years, preventive measures have been taken in this direction in the autonomous republic, repair of shelters under buildings, annual shore protection works in the floodplains of the Araz River, construction of dams in rivers and streams to minimize the risk of floods.

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EVALUATION OF FILTRATION PARAMETERS OF OIL FIELD RESERVES

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ОЦЕНКА ФИЛЬТРАЦИОННЫХ ПАРАМЕТРОВ ЗАЛЕЖИ НЕФТЯНОГО МЕСТОРОЖДЕНИЯ

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Abstract

The wellbore formation zone is considered the most important element and determines the productivity and efficiency of production wells.

Аннотация

Прискважинная зона пласта считается самым главным элементом и определяет производительность и эффективность эксплуатации добывающих скважин.

Keywords: well, method, pressure, result, coefficient

Ключевые слова: скважина, метод, давления, результат, коэффициент

Процессы фильтрации жидкостей и газов в реальных пластах из-за значительной изменчивости их гидродинамических свойств чрезвычайно сложны. Поэтому для изучения и управления процессами добычи необходима информация не только о начальном состоянии залежи, но и о закономерностях изменения указанных параметров при разработке месторождения.

Прискважинная зона пласта (ПЗП) является важным элементом гидродинамической системы пласт — скважина при разработке нефтяной залежи. Состояние прискважинных зон во многом определяет производительность и эффективность эксплуатации добывающих скважин [1].

Оценка состояния прискважинных зон продуктивных пластов - одна из основных задач, решаемых при обработке данных гидродинамических исследований скважин. Достоверная оценка гидродинамического состояния ПЗП позволяет принимать обоснованные решения по проведению геологических мероприятий, направленных на восстановление и увеличение продуктивности скважин и нефтеотдачи пластов. На практике оценку состояния ПЗП выполняют при обработке индикаторных диаграмм и кривых восстановления давления с использованием различных методов. При этом результаты обработки зачастую не соответствуют фактическому состоянию ПЗП. Определение условий достоверного применения, совершенствование методов обработки КРД и КВД, а также разработка

методики комплексной оценки фильтрационных характеристик ПЗП является актуальной проблемой, требующей детального рассмотрения.

На нефтяном месторождении Казахстана гидродинамические исследования выполнялись методами установившихся отборов (МУО), восстановления давления (КВД) и падения давления (КПД), также проводились замеры забойных и пластовых

давлений, пластовой температуры. Исследования были выполнены сервисными компаниями [2].

Результаты исследования на установившихся режимах (методом МУО) приведены в таблице 1. Для получения исходных гидродинамических характеристик объектов разработки (продуктивность, удельная продуктивность), были использованы результаты всех имеющихся гидродинамических исследований [3].

Таблица 1.

Результаты гидродинамических исследований МУО

№скв	Объект	Дата исследования	Диаметр штуцера, мм	Дебит нефти, м³/сут	Давление, МПа		Депрессия, МПа	Продуктивность, м³/сут*МПа
					Рпл	Рзаб		
262	IV	22-27.01.09	10	81,6	24,2	18,8	5,4	14,90
			8	60,0		20,1	4,1	
			6	37,4		21,5	2,7	
241	II	17-19.06.10	16	60,96	19,2	6,69	12,56	4,8
			8	28,8		13,29	5,95	

Предлагаем использовать следующую методику обработки результатов исследований на МУО [4] для условий месторождения Каракудук.

1. Определяем коэффициент продуктивности:

$$Ki = \frac{Qi}{\Delta Pi}. \quad (1)$$

2. По результатам исследования строим индикаторную кривую $Q = f(\Delta P)$.

4. Определяем вспомогательные коэффициенты А, В, С по этим формулам:

$$A = Q_2 Q_3 (Q_3 - Q_2); \quad (2)$$

$$B = Q_1 Q_3 (Q_3 - Q_1); \quad (3)$$

$$C = Q_1 Q_2 (Q_2 - Q_1). \quad (4)$$

5. Определяем постоянные коэффициенты а, б, с:

$$a = \frac{2(B\Delta p_2 - A\Delta p_1 - C\Delta p_3)}{B\Delta p_2^2 - A\Delta p_1^2 - C\Delta p_3^2}; \quad (5)$$

$$b = \frac{\mu}{2\pi h r_0} \left(\ln \frac{R_h}{r_-} + c \right); \quad (6)$$

$$- = \frac{1}{4\pi h^2 r_{0r-p}} \quad (7)$$

а, б, с – постоянные коэффициенты для исследования скважины (а – характеризует изменение проницаемости пласта и упругость жидкости при изменении давления; б – коэффициент, обратный продуктивности; с – учитывает роль инерционных сил при фильтрации).

Коэффициенты б и с (при найденном значений а) находится путем совместного решения системы двух уравнений.

Например для двух первых точек:

$$\frac{1 - H^{-\alpha \Delta K^1}}{a} = bQ_1 + cQ_1^2 \quad (8)$$

$$\frac{1 - H^{-\alpha \Delta K^2}}{a} = bQ_2 + cQ_2^2 \quad (9)$$

$$\frac{rh}{\mu} = \frac{\eta \omega}{2\pi \rho^{JbHc}} \left(\ln \frac{R_h}{r_c} + c \right) \quad (10)$$

$$r = \frac{\pi \mu_n \cdot \omega_n}{2\pi \rho_{deg}'} \left(\ln \frac{R_k}{r_c} + c \right) \quad (11)$$

6. По величине коэффициента б рассчитываем гидропроводность

$$\frac{kh}{\mu} = \frac{\ln \frac{R_k}{r_c}}{2\pi b} \quad (12)$$

7. Зная h и μ_n определяем проницаемость нефтяного пласта

$$k = \frac{\mu \cdot \left(\ln \frac{R_k}{r_c} \right)}{2\pi b h} \quad (13)$$

Далее приведем результаты расчетов фильтрационных параметров залежи по результатам исследования скважины №145. Скважина исследована при установившихся отборах нефти со следующими показателями: $L = 3500$ м, $h = 15$ м, $P_{буф} = 3,4 \cdot 10^6$ Па, $P_{пл} = 4,13 \cdot 10^6$ Па, $\rho_{дег.н.} = 0,82$ г/см³, $\mu_n = 0,3$ мПа·с, $\omega_n = 0,3 \cdot 10^{-3}$ Па·с, $\omega_n = 1,9$, $r_c = 0,128$ см, $R_k = 312$ м.

Результаты исследования скважины приведены в таблице 2.

Результаты исследования скважины

Режим	Qн, т/сут	ΔP, МПа
1	49	ΔP=4,1
2	51	ΔP=1,47
3	59	ΔP=1,98
4	72	ΔP=2,3

1. Коэффициент продуктивности:

$$K_1 = 34,8 \cdot 10^{-6}$$

$$K_2 = 34,7 \cdot 10^{-6}$$

$$K_3 = 29,8 \cdot 10^{-6}$$

$$K_4 = \frac{72}{2,3 \cdot 10^5} = 31,3 \cdot 10^{-6}$$

2. По данным таблицы 2 построена индикаторная диаграмма, которая приводится на рисунке 1.

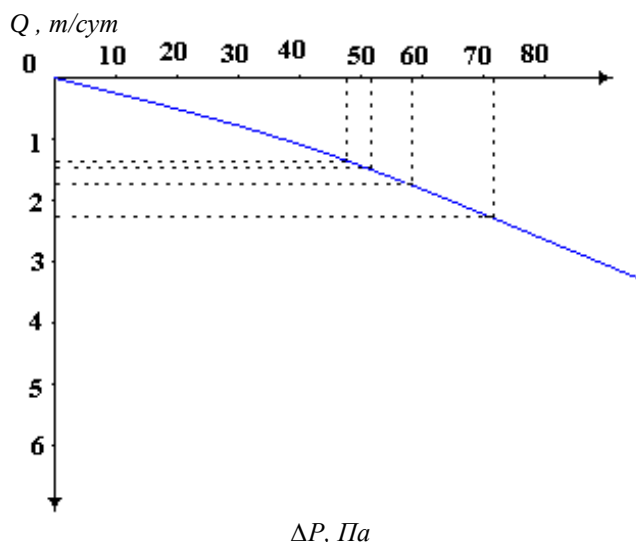


Рисунок 1- Индикаторная диаграмма.

3. Для выбранных для расчетов точек, лежащих на кривой, имеем.

$$Q_{H1} = 131,4 \cdot 10^{-6} \text{ м}^3 / \text{с}$$

$$Q_{H2} = 136,8 \cdot 10^{-6} \text{ м}^3 / \text{с}$$

$$Q_{H4} = 193 \cdot 10^{-6} \text{ м}^3 / \text{с}$$

4. Коэффициенты A, B, C:

$$A = 1,48 \cdot 10^{-9}, B = 1,56 \cdot 10^{-9}, C = 0,097 \cdot 10^{-9}$$

5. Постоянные коэффициенты a, b, c:

$$a = 0,44 \cdot 10^{-5}, b = 0,655 \cdot 10^8, c = 1 \cdot 10^{12}$$

6. Гидропроводность пласта:

$$\frac{kh}{\mu} = 0,187 (\text{мкм}^2 \cdot \text{м}) / (\text{мПа} \cdot \text{с})$$

7. Проницаемость пласта:

$$k = 0,4 \cdot 10^{-12} \text{ м}^2 = 0,4 \text{ мкм}^2$$

Итак, определены фильтрационные параметры залежи месторождения Каракудук. Гидропроводность пласта составляет $0,187 (\text{мкм}^2 \cdot \text{м}) / (\text{мПа} \cdot \text{с})$, а

проницаемость пласта составила $0,4 \text{ мкм}^2$. Полученные значения приблизительно совпадают с промысловыми данными.

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Казахский Национальный Университет им. аль-Фараби, г. Алматы*<https://doi.org/10.5281/zenodo.6539854>**Abstract**

The article explores the possibility of using CHOPS technology in the Karazhanbas heavy oil field, where there is a frequent occurrence of high-viscosity, resinous and sandy oil plugs. When using this method, relatively high oil recovery coefficients can be achieved due to the destruction of the reservoir and the formation of macroscopic wormholes, which leads to an increase in reservoir permeability.

Аннотация

В статье исследуется возможность использования технологии CHOPS на месторождении тяжелой нефти Каражанбас, где наблюдается частое проявление нефтяных высоковязких, смолистых и песчаных пробок. При использовании этого метода могут быть достигнуты относительно высокие коэффициенты нефтеотдачи за счет разрушения коллектора и образования макроскопических каналов (wormholes), что приводит к увеличению проницаемости пласта.

Keywords: CHOPS, sand plugs, wormholes, macroscopic canals.**Ключевые слова:** CHOPS, песочные пробки, червоточины, макроскопические каналы, wormholes.

CHOPS - (Cold Heavy Oil Production with Sand) является нетрадиционным способом первичной добычи, при котором нефть специально добывается песком, водой и газом. Chops изначально разработан для участка Ллойдминстер, в Западной Канаде, где значительное количество нефти добывается специально вместе с песком, водой и газом. С его помощью в Западной Канаде добывается около половины вязкой нефти в 230 000 баррелей в день [2].

Этот подход эффективен для извлечения высоковязкой нефти. Технология успешно внедрена на месторождениях с песчаными пробками на западе Канады. Для достижения достаточных темпов промышленного производства требуется относительно высокая вязкость нефти [3].

Хотя холодный способ добычи был закреплён в качестве успешной промышленной технологии для добычи вязкой нефти на западе Канады, он был

реализован в нефтяных пластах Калифорнии (таких как Мидуэй, Сансет, Кошачий каньон) до Первой мировой войны. Даже по технологии винтовых насосов кавитационного типа отдельные скважины за 40-летний срок службы выдали несколько тысяч кубометров песка. Производители по всему миру с интересом следят за достижениями добычи холодным способом в Западно-канадском осадочном бассейне с высоковязкими нефтяными пластами [4]. Основными параметрами нефтяного пласта, необходимыми для успешного применения технологии холодной добычи, являются: чистые пески (с очень низким содержанием мелких фракций); минимальная вязкость нефти; движение нефти; минимальный

начальный газовый состав нефти и т.д. Такие условия можно встретить в нефтяных пластах за пределами Канады (например, на Аляске, в Албании, Калифорнии, Колумбии, Казахстане, Кувейте, Омане, России, Венесуэле). Поскольку этот метод добычи является одной из новых эффективных технологий, на сегодняшний день его применение растет [9].

Метод CHOPS- реализуется с использованием винтового насоса кавитационного типа в вертикальных, наклонных или наклонно направленных скважинах. До сих пор используется в резервуарах ($\phi \approx 30\%$), насыщенных песчаным потоком с вязкой нефтью ($\mu > 500$ сП). Он используется только в районах с канадской вязкой нефтью и с небольшой глубиной (< 800 м) [8].

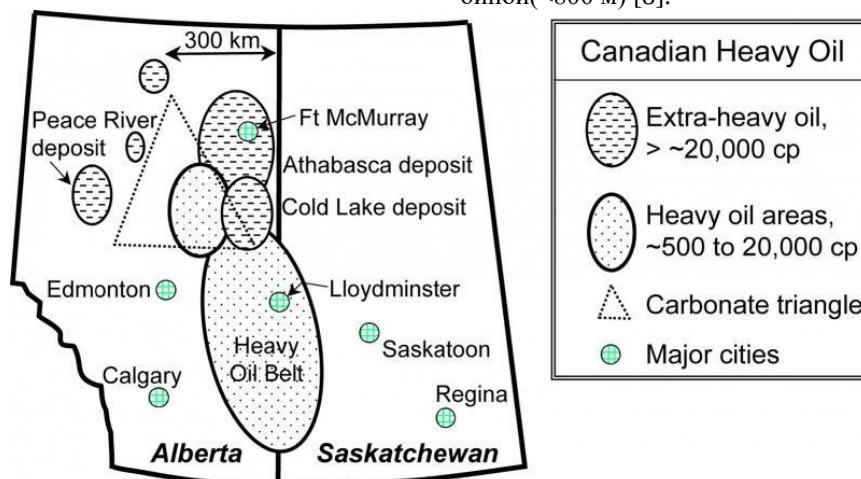


Рисунок – 1. Месторождения канадской высоковязкой нефти

Управление песчаными потоками, как показано на рисунке 1, производится по технологии CHOPS, так как на месторождениях с высокой вязкостью нефти этот метод является экономически и ситуационно эффективным. Главная цель: повышение производительности прилегающей скважины за счет увеличения потока жидкости в районе ближайшей скважины [2].

При добыче песка внутри нефтяного пласта образуются длинные каналы ("червоточины"), выходящие из скважины на расстояние от 200 м и более. Основным свойством данного подхода является образование и перекачка нефти в длинном русле внутри нефтяного пласта. Длинные каналы обеспечивают высокую проницаемость слоя (рис. 2) [10].

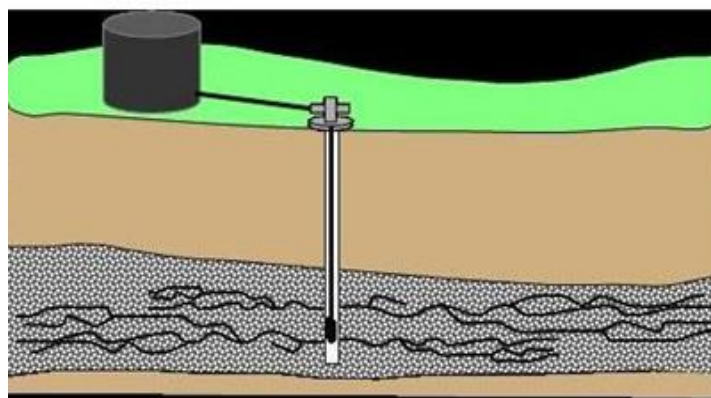


Рисунок – 2. Ход работы технологии Chops

Холодный способ добычи применяет холодный способ, связанный с непрерывной подачей песка по всей длине длинных каналов, от его края до ствола скважины. Некоторые скважины эксплуатируются в течение 8-10 лет и более, но по истечении этого времени работы некоторых скважин прекращаются. Основная причина невозможности дальнейшей работы заключается в том, что уровень

увлажнения становится высоким из-за попадания воды внутрь слоя. Как только вода подается в сеть длинных каналов, она может быстро распространяться в скважину, связанную с ней, и затем в другие соседние скважины с общим соотношением. Второй причиной невозможности эксплуатации является отсутствие потока жидкости в сети "червоточины", расположенной вблизи скважины, в связи

с недостаточной дальнейшей герметизацией и вытеснением [10]. Продолжаются работы по разработке технологий, направленных на восстановление эксплуатационной пригодности и интенсификацию добычи из скважин с применением

холодного подхода, однако результат ниже ожидаемого учеными.

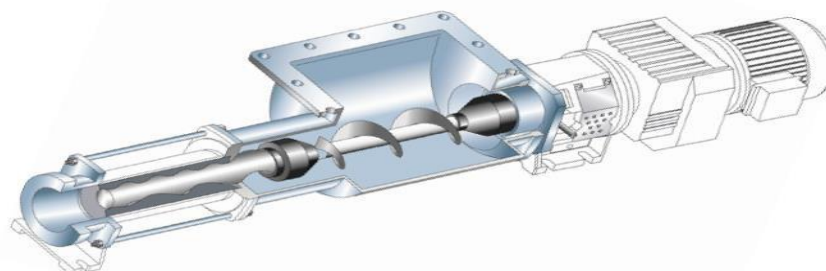


Рисунок-3. Применение метода CHOPS с винтовым насосом

Процесс применения метода Chops с помощью винтового насоса, представленного на рис.3, представляет собой технологию, применяемую с 1980-х годов. Для управления скважинным насосом необходимо следить за штангой в нем. Эта технология может производить жидкость вместе с песком. Применение данной технологии в процессе новых современных методов холодной добычи является наиболее эффективным [1].

Основными параметрами нефтяного пласта, необходимыми для успешного применения технологии холодной добычи, являются: чистые пески в

нефтяных пластах (с очень низким содержанием мелких фракций); вязкость нефти; подвижность нефти; и содержание исходного газа в нефти. В настоящее время, придавая значение этим параметрам, сфера его применения расширяется, так как холодная добыча становится все более эффективным. Для ускорения отбора перспективных нефтенасыщенных районов с целью применения холодной добычи необходимо выполнить ее технико - экономическое обоснование, используя в сочетании каждое отдельное исследование и полевые испытания [2].

Таблица-1.

Значения параметров основного пласта.

Глубина, м	Толщина пласта, м	Давление, МПа	Пористость, %	Проницаемость, мД	Температура, С	Плотность нефти, кг/м ³	Sw, %	Количество газа, м ³ /м ³	Вязкость 30С, МПа*с
258	10	4	28	445	26	939	28	5,58	410
290	16,2	4,5	30	472	27	940	26	6,86	364

CHOPS успешно испытан в Китае на нефтяных месторождениях Наньян, Хэбэй, между 1997 и 2000 годами, но еще не введен в действие. Также на нефтяном месторождении Ляохэ, провинция Ляонин, испытания проводились в сложных условиях. Добыча нефти на нефтяном месторождении Цилинь через CHOPS осуществлялась на глубине 300 метров [7]. Несмотря на то, что объем добычи в

Канаде в 2000 году превысил 70000 м³ в сутки, добыча песка в качестве эффективного способа увеличения добычи не была широко использована. Это связано с нетрадиционным характером производственных механизмов, сложностью прогнозов добычи, сложностью правильного внедрения CHOPS, а также необходимостью стратегий управления песком и его утилизации.

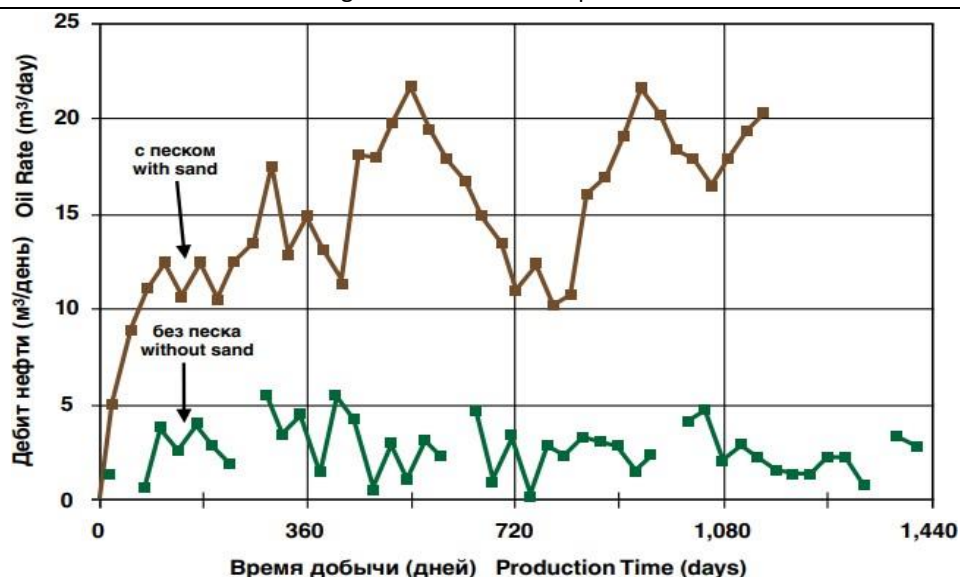


График-1. Изменение дебита после внедрения технологии (с песком и без песка)

Технология холодной добычи является значительно более эффективной, чем традиционный путь добычи нефти в первоначальном освоении. Коэффициенты рентабельности, а также дебит часто высоки.

В процессе применения метода CHOPS большой приток песка увеличивает дебит скважин, но есть риск, что могут возникнуть проблемы с работой насоса и потребуются капитальный ремонт. Насос срабатывает, когда жидкость, называемая загруженной жидкостью, обычно легкая нефть вводится в пространство трубы. При наличии свободного течения в системе песок должен поступать в ствол скважины. Слив и расход рабочей жидкости могут быть выровнены для обеспечения эффективной работы насоса, но в конечном итоге подача рабочей жидкости прекращается (в течение одного или двух дней). Если производительность скважины достаточна, насос работает на максимальной скорости для вращательного момента с контролируемым выходом на головку привода. И если добыча песка будет прекращена, то добыча нефти будет замедлена и прекращена. В процессе сепарации

нефти необходимы специальные сепараторы, так как нефть содержит песок, механические примеси, ее необходимо обрабатывать специальной, дорогостоящей, качественной техникой.

Месторождение Каражанбас, расположенное на полуострове Бузачи в Мангистауской области Западного Казахстана, характеризуется высокой вязкостью и смолистостью нефти. Газонефтяное месторождение Каражанбас было открыто в 1974 году. В 1977 году были подсчитаны его запасы нефти и газа. Характерны глубина залегания продуктивных пластов Каражанбасского месторождения (230–460м), малоамплитудные тектонические нарушения и литолого-фациальная изменчивость пород, их слоистость, широкое развитие трещин, низкие пластовые температуры и давления [1]. Борьба с разрушением коллекторов и добыча песка в процессе эксплуатации скважин является одной из основных проблем при разработке месторождения Каражанбас. Поэтому мы сравниваем характеристику скважины Каражанбасского нефтяного месторождения с состоянием месторождения в Канаде.

Таблица-2.

Геофизическая характеристика месторождения Каражанбас

Параметры	Пласт Г
Средняя глубина залегания, м	366
Тип залежи	пластовая
Средняя толщина пласта, м	6
Нефтяная площадь, га	2677
Средняя проницаемость, мкм ²	160,1
Средняя пористость, %	28
Первоначальная нефтеотдача, %	67
Балансовые запасы нефти, млн.т	12818
Балансовые запасы растворенного газа, млн.м ³	102
Начальное давление пласта, МПа	4,5
Температура пласта, °С	26

Мы можем знать, что нефть месторождения Каражанбас очень вязкая и коллектор насыщен пес-

ком. Исходя из этих причин, применение технологии CHOPS на месторождении Каражанбас является эффективным [6]. CHOPS - это экономическая

выгода, позволяющая увеличить коэффициент извлечения нефти на месторождении Каражанбас на 8-15% по сравнению с участками, где тепловые технологии не планируются с экономической точки зрения в течение многих лет. Теоретическое рассмотрение способа холодной добычи на месторождении Каражанбас началось с 2000 года. Пласты здесь состоят из песчаников мелового и юрского возраста [5]. В ходе исследований было предусмотрено разделение месторождения Каражанбас на несколько регионов. Скважины в каждой зоне, т. е. скважины, в которых ранее использовались и не использовались тепловые методы, располагаются в

других районах. Таким образом, эти области не подвергаются термическим изменениям. Месторождение было разделено на 3 зоны в ходе испытаний метода. Для каждого случая I, II и III объектов толщиной 10 м, 16,2 м и 22 м в интервале скважин было получено 3 зоны 150 М, 250 м и 400 м. Работы проводились до получения 20% исходной нефти (ООИР). Предполагалось, что после достижения коэффициентов нефтеотдачи 30%, 23% и 30% для объектов I, II и III скважины преобразуются в процессы IOR. В процессе применения метода повышается уровень смачивания, что помогает нам добывать дополнительную нефть.

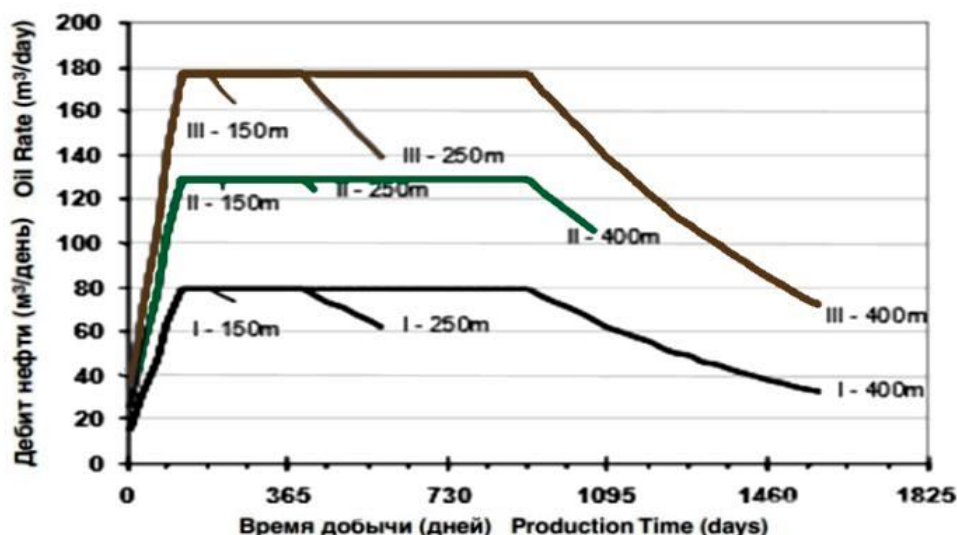


График – 2. Изменение дебита нефти во времени (объекты Каражанбаса)

Темпы добычи нефти увеличатся до 30-60 т/сут, что лучше, чем в Канаде со скважинами с нормальным уровнем 15-20 т/сут. Если применить холодный способ добычи к месторождению Каражанбас, то будет увеличен дебит нефти [2].

Так как Каражанбасское нефтяное месторождение обладает вязкой нефтью, то вопросы до сих пор рассматриваются. CHOPS-это экономический доход, который позволяет увеличить коэффициент нефтеотдачи месторождения Каражанбас до 8-15%, в отличие от регионов, где тепловые технологии экономически не планируются на много лет. Поскольку метод CHOPS не используется, это развитие метода увидеть результаты из него одна из наших целей.

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HISTORICAL SCIENCES

ANALYSIS OF RESEARCHES ON THE SPREAD OF ISLAM IN EAST ASIA

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Abstract

The article analyzes the history, culture, religious and philosophical teachings and sources of East Asia, the study of the spread and development of Islam in the region. This article summarizes the spread of Islam in East Asia, the adaptation of the Muslim population to the local lifestyle and culture in various historical situations and social processes.

Keywords: The Silk Road, “One Belt One Road”, “Central Asian Islam”, “Eastren Asian Islam”, Goryeosa, The Hân Kitāb, hui.

Introduction. Now the need to address the global social problems facing the world makes it an important task to study the history of the spread of Islam and the tendency of converting it by various nations. In addition to the creative ideas inherent in Islam, the study of the common human values, traditions in the region and the similarities between them, can help to live the ethnic groups in the region with peace and harmony.

Many historical chronicles and travel letters in the archives of China, Korea, and Japan are preserved, along with the works of history, geography and astronomy of medieval Muslim scholars on the spread of Islam in the East Asian region. These sources differ with rich in information about the historical, socio-political, and cultural context related to the dissertation's theme. Based on them many research works have been carried out on the spread of Islam in East Asia, the formation of Muslim communities among the teachings of Buddhism, Confucianism, Daoism and Shintoism which are widely practiced in the region. At the same time, reasons of minority of Muslims in this region and the spread of Islamophobia under the influence of some fanatical groups are considered to be dependent to the difference between religious contradictions and cultural identities. This case implies the need for an objective approach to the history of East Asian and Muslim peoples' relations.

Material and methods. The methods of comparative-historical, typological, hermeneutic and complex analysis of the literature were used to study the spread of Islam and the formation of Muslim communities in East Asia.

Results. The spread of Islam in East Asia is linked to the ancient Chinese-Arabian trade relations that existed by the sea in the 7th century AD. However, this relationship started long before Islam entered to East Asia. For example, according to the book “Kitab al-tanbih wal-ishraf”, authored by Muslim-Arab historian al-Mas'udi, in the fifth and sixth centuries AD, Chinese ships sailed to the harbors of the Euphrates and the Persian Gulf [4, p. 57]. Another Muslim source in this regard, according to Dinawari's “Kitab al-Akbar al-

Tibal”, is that the history of Arab-Chinese trade relations dates back to 636 (A.H. 14). Masudi's work, “Muruj al-Zahab” also describes how Chinese merchants moved with their commercial goods to several ports in East Arabia, Basra and Oman [12, p. 308]. Ibn al-Kalbi also provided information on the Chinese trade in Oman markets [18, p. 313].

From European and Asian researchers – David G. Atwill, Ildiko Beller-Hann, Zvi Ben-Dor Benite, Gardner Bovingdon, Marshall Broomhall, Wen-Djang Chu, Michael Dillon, Maris Boyd Gillette, Raphael Israeli, Karl W. Luckert and Lee Shujang, Boris I. Marshak, Abdul Wahid Radhu, Justin John Rudelson, Henry G. Schwarz, Frederick Starr, Cuiyi Wei and Luckert Karl [9, p. 254] have been researching on chosen theme. In their research, they have presented not only the spread of Islam in East Asia, but also the analytical conclusions on the adaptation of Muslim populations to the local lifestyle and culture in various historical situations and social processes.

Contemporary islamic and religious studies scholars have been interested in the study of the spread of Islam and its successes and challenges of muslims in the process of adapting Islam to local conditions. A studying of these researches has shown that first, result of the chronological and geographical spread of Islam and adaptation in various regions, formed such as concepts of “Central Asian Islam” [4, p. 4] and “East Asian Islam” [4, p. 57-74]. Second, the scope of the studies in researched scientific sources on the theme varies in size and volume. For example, the subject of “Islam in China” is one of the most widely researched areas, and this is reflected in the weight of sources and literature. Some of these publications have objectively analyzed the penetration of Islam into China, the formation of Muslim communities, and the adaptation of certain Islamic traditions with local culture [2, p. 75; 5, p. 205; 6, p. 102]; another group of them reviewed the problems that Muslims have faced from the earliest history of Islam in China to the present [1, p. 231].

The history of Islam in the Korean peninsula and Japan is mainly covered by ancient chronicles, travel

letters of trippers and intellectuals, various international scientific conferences and journals. At Koryosa, *Goryeo dynasty*' chronicle reflected the first relationship between Korean and Muslims; at travel letters described Japanese views about Islam [10, p. 85-109]. In addition, such as articles and thesis – "The Maritime Spread of Islam in Korea and Its Growth" [13, p. 174], "The Spread of Islamic Culture to the East Asia Before the Era of Modern European Hegemony" [4, p. 57-74], "Marriages lead women into Islam in Japan" [8, p. 26], "Islam in Japan" [11, p. 26] were provided analytical information on the dissertation topic.

In the first years of independence, Uzbekistan started its economic relations with the outside world in cooperation with East Asian countries. The history of relations between the two countries, which now has a reliable and important partnership, goes back to the distant past, the Great Silk Road. Significant events and information that testify to the multilateral friendship and mutual respect between the peoples of the two regions are preserved in historical sources. "One Belt – One Way", designed to develop and maintain the spirit of the ancient Silk Road, also calls for the pursuit of regional economic cooperation, and scientific research that promotes cooperation among various civilizations. "Our historical and cultural heritage, similarity of goals and objectives, and common aspirations allow us to look to the future with confidence". From this point of view, as the practical importance of the Great Silk Road grows, the spread of religious beliefs, in particular the role of Islam in the development of inter-regional cultural ties, is one of the pressing issues of our day.

During the years of independence Uzbekistan has done a great deal of work in this area. In particular, researches have been completed on the history, religious beliefs and culture of East Asia, especially, ancient China, Korea and Japan [15, p. 135]; relations between East Asian and Central Asian peoples and ancient countries [16, p. 145; 17, p. 201]; historical and modern relations between the peoples of Korea and Central Asia [14, p. 148]. In turn, the study of the history of the spread of Islam in East Asia, the formation of the first Islamic communities and the adaptation of Muslim peoples to the cultural environment of the region is developing as one of the new directions of religious studies in Uzbekistan [4, p. 90-98].

Discussion. It should be noted that research on the spread of Islam in East Asia has focused on the following aspects:

- the historical, social, cultural and religious environment on the eve of the entry of Islam into East Asia;
- the process of spreading Islam in China and its adaptation to the local environment;
- issues of education in the context of the adaptation of Muslims in China to the local culture;
- the history and stages of the first relations between the Korean and Muslim peoples;
- the formation of Islamic communities in Korea and their assimilation into the culture of the country;
- the spread of Islam in Japan and its features;

- the influence of syncretic views on the development of knowledge about Islam in Japan.

The following conclusions have been drawn from scientific research on the spread of Islam in East Asia and its regional characteristics.

1. East Asia is historically a region of interconnected and culturally distinct groups of states and it reflects the religious beliefs, history and culture of the Chinese, Korean and Japanese peoples as the basis of civilization in this region. During the period when the countries of the region entered into a close neighborly relationship, the international spirit was of paramount importance and cultural harmony was sought. In addition to these positive cultural developments, the countries of the region have focused on using the unifying power and thinking of local religious beliefs to ensure political stability within their countries and prevent foreign monopolies in foreign trade.

2. During the rule of the Tang, Song, Yuan and Ming dynasties, Muslim communities emerged in different parts of China. During this time, Muslim communities in the country were formed on land by the Great Silk Road and by the sea, which historically has been described as the "spice path". Intense economic, political, military, architectural and crafts activities in China in the 9th-16th centuries led to an increase in the number of Muslims and the emergence of a new ethnic group, "hui".

3. Adaptation of Muslims to independent and distinct state policies during the Tan, Sun, Yuan and Min Empires gave rise to new legal concepts related to the regulation of their daily lives and the compilation of books "Han Kitab" that combined the common aspects of Islam and Confucianism.

4. The spread of Islam in Korea took place in three stages. The history and communities of the early Muslims' interactions with the Korean peninsula were recorded on the history and geography of Muslim scholars' works who lived from 9th to 16th centuries. The induction conclusion of medieval Muslim sources and events in the Korean chronicles can be obtained by summarizing indigenous views on the penetration of Islam into the Korean peninsula, early Muslim settlements, and participation in public life.

5. Under the rule of the Unified Silla and Koryo kingdoms, Muslims of high social and economic status in Korea were forced to abandon the traditional costumes, customs and rituals that had been pursued under the assimilation policy of the Choson Empire. Neo-Confucianism, which had a dominant position in society greatly influenced the involvement of Muslims in the policy of cultural assimilation. In the Middle Ages, the acculturation of Muslims to Korea in exchange for forcing them to embrace two distinct cultures in a single race helped enrich the Islamic culture and local traditions in the region.

6. The history and peculiarities of the spread of Islam in Japan have been periodically investigated into four stages – Before World War I, the interval between the two world wars, the post-World War II oil crisis and the post-September 11, 2001. The period between the two world wars is marked by significant realities in Japanese-Muslim relations. During this period, first of all,

the Japanese imperial government was active in formalizing relations with the Muslim world. In turn, Muslims, especially Turks, have broadly covered Japanese intellectuals' visits to the Islamic world.

7. As Japanese people gain more knowledge about Islam and converting it also influenced the notions of Shintoism. At the same time, the understanding of Islam through Confucian concepts in the lives of Chinese Muslims has become a natural phenomenon for Japanese intellectuals by comparing Islam's differences with East Asian religious and philosophical teachings.

Conclusion. As a general conclusion that today, Muslims in the East Asian region are underrepresented and the spread of Islamophobia under the influence of some Protestant groups is not related to religious differences or cultural differences; but as a result of the cultural isolation or assimilation policy of empires that dominated the region at different times, ignorance of the history of the relationship between East Asian and Muslim peoples remains a key factor. In this regard, it is hoped that the future of the Muslim world's relations with the countries of East Asia will be not only in terms of economic benefits, but also in the spirit of tolerance at the core of Islam and local religious beliefs.

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PEDAGOGICAL SCIENCES

CLT ACTIVITIES DEVELOPING SPEAKING AND FLUENCY

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Abstract

This study attempts to discuss a variety of CLT activities contributing to oral production. CLT approach is the main tool for fostering near-authentic atmosphere in EFL classrooms. The goal is to study CLT approach using a literature review and to identify more useful activities to improve speaking fluency. This article considers information gap activities and fluency techniques as the most effective ones to develop productive skills and improve fluent speech in English.

Keywords: CLT activities, fluency, information-gap activities, opinion-gap activities, reasoning-gap activities.

Speaking is an important aspect of learning and teaching a second language. Despite its importance, teaching speaking has been devalued for several years, and English language teachers have remained teaching speaking as a series of drills or dialogue memorization. However, nowadays the purpose of teaching speaking must be to increase students' communicative abilities, because only then will students be able to express themselves and learn how to obey the social and cultural rules that apply to each communicative situation.

For humans, the most important role of language is to communicate meaningfully with one another; people should first grasp the language spoken among themselves in order to transmit their content and intention. Because humans are social creatures, they require communication. This communication might take place in two ways: orally and in writing. The emphasis on spoken form, which is the primary interest of the researchers in this study. Because speaking is the most fundamental necessity of human interaction, majority individuals view the capacity to speak a language to be equivalent with understanding the target language (Celce-Murcia, 2001). Speech is the essential initial instrument of communication for expressing information, sentiments, ideas, emotions and opinions, hence it is the primary skill in the language arts. When learning the second language, this suggests that speaking comes first, much before writing or reading. According to Abdallah and Mansour (2015), second language acquisition necessitates a focus on oral communication, actual usages, and contextual-pragmatic procedures. Reading and writing are also crucial in advanced language level since they improve eloquence and understanding, but speaking takes priority. EFL students find it particularly challenging to speak a language because successful verbal communication necessitates the capacity to utilize the language effectively in social relationships. Not just verbal communication, but also paralinguistic components of speech like tone, stress, and

intonation contribute to interaction richness. Nonlinguistic aspects such as body language, gestures and facial expression, may either support speech or transmit signals directly without speech (Brown, 1994: quoted in Cunningham, 1999).

Overall, we can infer that speaking ability is noteworthy of bringing up the newly created problem of task-based approach, information-gap activities and opinion-gap activities that have the potential to have a significant impact on the development of speaking skills.

Speaking skill includes fluency and accuracy, but this study deals with defining the importance of improving fluency in FLT. The term "fluent" means a speaker is able to use the correct structures of a language at normal speed, which means speaking naturally with concentration on the content delivery, rather than focusing on the form or structure of a language. Fillmore (1979) defines four abilities of speaking fluently:

- a) the ability to talk at length with few pauses;
- b) be able to state the sentences coherently and semantically;
- c) have appropriate expressions in a wide range of contexts;
- d) be creative and imaginative in language use.

The most effective approach in teaching speaking fluency of foreign language is CLT. Communicative language teaching can be interpreted as a series of activities which involve interaction between learners, develop learner's autonomy, connect different subject curriculum and strive to search for meaning through content. Teachers become co-learners and use multiple forms of assessment like observation, interviews, journals, portfolios may be invoked to construct a comprehensive picture of what learners can do in second language acquisition studies. The following types of CLT activities are the most popular types among English language teachers (Richards, 2006).

In CLT, one of the most important aspects of communication seems to be the idea of gathering clarification. It means that in real-life communication, people typically encourage conversation in order to gain information, and this is referred to as an information gap. An information-gap task is a technique in which learners are missing the needed information to complete a task or solve a problem, and they have to communicate with their classmates to fill in the gaps (Larsen-Freeman, 2003). If students use language structures for their own purposes and utilize their speaking and listening abilities with the goal of obtaining information, more real conversation may occur in the classroom. As a result, they will use suitable language, grammar, and communication techniques to complete a task.

The concept of information gap is an important part of communication in CLT. This relates to the reality that most individuals communicate in real life to obtain information they do not possess. If students utilize their linguistic and communicative resources to get information rather than practicing language forms, more real conversation is likely to occur in the classroom. They will use available language, grammar, and communication skills to perform a task in this way. The information-gap principle is used in the following exercises:

A-B pairings of students are formed. Two sets of pictures have been duplicated by the teacher. A group of people is presented in one set (for A students). The other set (for B students) has an image that is comparable to the A-picture but with a few minor variations. Students must sit back to back and ask questions to determine the number of differences between the two pictures.

Information-gap activities include jigsaw activities. The class is usually divided into several groups that each have a set of content needed to perform a task. To complete an assignment, students must fit the parts together. As a result, individuals should put their language skills to good use in order to communicate effectively and engage in meaningful effective communication.

In pairs, students do a role play. One student is provided the information she or he needs to play the position of a tourist agent who possesses information about suggested tours to different countries and other details. The other requires information about tourist destinations, what activities they offer, how to reach that destination, costs, and so on. They act out the scene without ever looking at each other's cue cards.

Harmer (2012, quoted from Anna Kuśnierek, 2015) divides information gap activities into open and closed information activities. The open information gap activities enable learners to apply variety of linguistic structures while the second one have some restrictions in employing certain language items. These activities are focused on meaningful language use where teachers are supposed not to interfere the speaking that is in progress, thus they do not get learners confused and encourage them to communicate freely.

Kowalska, (1991, quoted from Anna Kuśnierek, 2015) studied the importance of role-plays and came to conclusion that role-plays much more contributed to

speaking fluency owing that this activity required rehearsals beforehand. Moreover, learners' creativity and imagination skills could be enhanced in parallel as well as facilitating to build good interactions between learners which prepare them to future life. Role-plays are closely related to information gap activities for the reason that role-cards are derived from them enabling learners to plan their conversation drawing on the information given in cards. Therefore, we cannot deny the benefits of information gap activities as well as role-plays in improving speaking fluency.

Task completion tasks such as puzzles, games, and map reading are linked to objectives that emphasize on how students use their linguistic knowledge. Students' ability to collect information is required for activities such as student-led surveys, interviews, and investigations.

Considering values, attitudes, and thoughts is an example of an opinion-sharing activity in which students evaluate tasks in order of significance that they are inclined to consider. Participants are asked to give knowledge in a different form from the initial form when completing information-transfer activities. Opinion-gap task requires the learners to give their own personal preference, feeling, or attitude to complete a task (Fallahi, Aziz Malayeri, & Bayat, 2015). For example, a social problem such as "unemployment" can be given to the learners and be asked to give their ideas on how to tackle it. Also they should read instructions on how to get from point A to point B and then construct a map or building based on the given data to illustrate a graph.

Opinion-gap activities contribute to learners' oral production as they have opportunities to express thoughts to complete tasks. For example, teachers pose challenges closely related to most people's lives and ask learners to find suitable solutions discussing them in groups. Another activity may be to write a letter of advice to a friend who has to seek for help for his problem. The opinion-gap task requires students to provide their own ideas in addition to the information provided. The opinion gap exercise, which challenges students to communicate their own meanings and is open-ended and shared, has proven to be effective in developing negotiation (Ellis, 2003, p. 89).

Getting some information from provided information through practical reasoning and the decision-making process are examples of reasoning-gap tasks. For example, arranging a teacher's schedule in accordance with class schedules. Reasoning-gap task refers to the new information that are derived by the students through inference, deduction, practical reasoning, or perception of relationships or patterns (Prabhu, 1987). He believed that tasks should involve learners in "reasoning"-making connections between the information. Through requiring the learners to provide reasons while learning new materials we as teachers can help them to learn English language better.

The majority of language teaching methods may be classified as 'form-based.' Task-based learning (TBL) differs from form-based learning in that it specifies a sequence of communicative activities to be completed in the target language rather than a sequence of

language lessons (Nunan, 2002). A task-based approach strives to give students a realistic setting in which to utilize language. Learners have several opportunities to interact while they strive to finish a task. Learners must try to comprehend one other and communicate their own ideas in this type of contact, which is considered to aid language development (Candlin & Murphy, 1987: cited in Bygate, 1999). Task-oriented lingo Instruction is amongst the most successful and meaningful ways to language teaching in recent decades, focusing on learning via doing and doing things with language. Task-based language instruction is advocated by communicative language teaching (Freeman, 2003).

Based on the type of cognitive activity, Prabhu (1987: quoted in Rod Ellis) differentiates three main categories of tasks:

1. Activities that need students to exchange pieces of information in order to accomplish a task are known as information gap tasks.
2. Opinion gap activities require students to consider and express individual preferences, sentiments or attitudes in order to perform a task.
3. Learners must infer new information from previously supplied material in order to complete reasoning gap tasks

Fluency is an integral part of speaking, so they should be considered as a whole. Nation, (1989) took a high interest in researching fluency. Amount of pauses and fillers in a speech characterize about to what extent the speech is fluent. Having done several researches he came to conclusion that repetitions and rehearsals were the best way to improve speaking for the reason that familiar content and familiar structures repeated for several times increased the speed of speech. His famous activity is known as 4-3-2 technique which is regarded as the effective one. The first time learners tell their partners familiar story in a period of 4 minutes and then change their roles to listen to each other. During the second circle learners recount that story to each other in turns for 3 minutes. The third time it should be done in a period of 2 minutes. Thus, fluency can be gained efficiently. Furthermore, working in pairs boost learners' confidence fostering a safe environment in language classrooms. Since, fluency activities are mostly oriented in developing oral production as well as flow of speech, accuracy here is not the main focus. When talking about speaking fluently some grammatical mistakes can be made in any case.

Another activity recommended by Nation and Newton, (2009) is called "Pyramid procedure" which contributes to public speaking skills. This activity can be used at any level of learning a foreign language. The first thing what learners need to do is preparation of

speech for a certain topic and to present it before his/her peer which is followed by getting feedback from that peer. Secondly, they deliver a speech in groups and they provide feedback in order to improve speaking fluency. Third cycle contains delivering a speech in front the whole class using only a few notes, and as a result, this activity increases learners' abilities to speak a foreign language confidently.

In short, implementing various tasks in the language classroom (opinion-gap, reasoning-gap, information-gap and fluency activities) can expose EFL learners to near-authentic language practice. As previously stated, EFL learners' speaking fluency improves when they are exposed to information-gap activities and fluency techniques. EFL learners receive more language input and produce more output as a result of applying these activities. That is, they strive to use their language skills to communicate their intentions in order to improve their speaking fluency.

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PHILOLOGICAL SCIENCES

IRANIAN AND HITTITE-LUWIAN PARALLELS OF THE ARMENIAN WORDS *TAPAST*-‘CARPET’ AND *TAPAST*- ‘A KIND OF DEADLY PAIN, DISEASE’

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Abstract

The author discusses etymology of the Armenian word ‘*tapast*’ ‘cover, carpet’ and ‘*tapast*’ ‘a kind of deadly pain, decease’, that generally are considered to be Iranian loanword or of unknown origin.

We would like to indicate to the word ‘*tapašpa*’ in Hittite with meaning ‘a type of cloth or cover’ and *tapaš*- ‘fever, heat, an unknown decease’ that have no clear etymology in Hittite. We suppose that the Armenian words may have etymological connection with the Hittite ones as they have similar meaning, however Avestan *tapasti*- and Middle Persian (Pahlavi) *tapasta*- ‘carpet’ parallels cannot be ignored. As we see from semantic point of view there are three lexical parallels in Armenian, Hittite and Iranian with comparable sounding and meaning: Iranian *tapasti*- (‘fever’) - *tapasta* (‘carpet’), Armenian ‘*tapast*’ (‘fever, unknown decease’) and *tapast* (‘carpet, cloth’), Hittite *tapaš* (‘fever’, decease’ and *tapašpa*, *tapišša*, *tapašša*- (‘a type of clothing or cover’).

Both Armenian and Iranian parallels enable us to identify their matches in Hittite and other IE languages (Armenian and Iranian in this case) that have not been made so far and specify their meaning.

Keywords: Armenian, Iranian, Hittite-Luwian, *tapast*, *tapasti*, *tappiša*, ^{TUG}*tapašpa*, *Spring Tapas*

Preface

We discuss in this article the etymology of the words *tapast*- ‘cover’, and *tapast*- a kind of deadly disease’, which in general have been considered Iranian loanwords in Armenian or of unknown origin. It should be noted that there are a number of words in the Armenian language, the Iranian origin of which has long been circulated in science, but the latter also have their Hittite-Luwian parallels. The above-mentioned words in the Armenian language belong to this stratum.

Linguistic Analysis

The Armenian has a word ^{TUG}*tapast* meaning ‘cover, carpet’, one of the oldest versions of which is *tapastak* ‘sofa’, fixed in ancient Armenian sources [2:374; 4:541].

The word *tapast* is considered to be an Iranian loanword by the Armenian linguists Hrachya Acharyan, Gevorg Jahukyan [6:548], Anahit Perikhanian and others. According to Perikhanian, Armenian has no suffix -ast, the Indo-European suffixes *-es-ti, *-os-ti become -est, -ust in Armenian. The researcher notes that in Indo-Iranian languages these two variants are reflected as -asti, and this suffix occurs very rarely as it lost productivity at a very early stage, indicating that this suffix occurs only in a few cases such as *gābhasti* ‘hand, trunk’ in Sanskrit, *tapasti* ‘fever’ in Avestan, from which derives the Armenian *tapast* with the same meaning, considered a Parthian loanword, as well as the Indo-Iranian -asta, found in the word *karasta*- ‘leather’ and *tapasta*- ‘carpet’ that also is present in Armenian as *tapast* meaning ‘carpet’ (considered to be a Parthian loanword in Armenian either) [10:58]. We would like to indicate here that according to our observations, there is a word *tapašpa* in Hittite meaning ‘a type of cloth or cover’, while the Hittite word *tapaš* ‘heat, fever, disease’ is believed to be its possible root. Both

the root *tapaš* and *tapašpa*- do not have an exact etymology in Hittite. *tapašpa* is found in Hittite inventory texts when listed among other pieces or types of clothing. For example as in the following passage: “five dresses, one of which *šuhru*, one *tapašpa*, two *kuašštu*, one *kušši*”. We also come across to the forms *tappiša*, *tapašša*, *tapiššan* in the texts. Grammatically, *tapašpa* can be interpreted as a word having collective meaning [13:124; 12:621f]¹. As known, this word *tapast* in Armenian is of Iranian origin, however, we would like to draw attention to the Hittite parallel of this word.

The next Armenian word is *tapast*- ‘a kind of deadly pain, disease’, the origin of which is unknown, according to G.Jahukyan [7:721], while A. Perikhanian believes that it can be traced back to the Avestan language [10:58]. In Armenian, there is also a form *tapas*, ‘possibly meaning a kind of child's skin decease possibly having connection with *tapast*- [1:1015; 9:375]; even a hydronym *Spring Tapas* [2:374] curing this decease *tapas* [1:1015] has been preserved. *Spring Tapas*[11:21] was located in town *Arabkir* [5:42], province of Kharberd (Eastern Armenian, Ottoman Empire), where it existed, among several other springs such as *Doł*, *Kat nalbyur*, *Khalil Chavush*. To add, springs with curing waters related with names of diseases, e.g., *Kosi albyur* [3:100] ‘Itchspring’, *Akanjac avi albyur* [3: 107] ‘Ear pain spring’, etc. are also recorded in Armenian.

The Hittite has a word *tapaš* ‘fever, heat, an unknown disease’, again without an exact etymology [13:124]. We assume that the Armenian *tapas* is related to the Hittite word, as they are semantically identical, however the Avestan parallel *tapesti*- ‘fever’ cannot be ignored. Besides, it is known that the word *tap* ‘heat, warmth’ is considered an Iranian loanword [2: 371; 6: 548] in the Armenian language.

¹ Siegelová J., KUB XLII59Rs.16.

Conclusion

In conclusion, it can be noted that in the case of these semantically related words, in Armenian, Hittite-Iranian languages, it is possible to group identical word pairs with the same meaning. Iranian: *tapasti*- 'fever', *tapasta*- 'carpet' - Armenian: *tapast*- 'fever' and *tapast*- 'carpet, cover', Hittite: *tapaš*- 'fever, heat, disease' and *tapašpa*, *tapišša*, *tapašša*- 'a type of cloth or cover'. These parallels in Armenian and Iranian languages give us a possibility not only to find out their parallels of Hittite words existing in other Indo-European languages, which have not been discussed so far, but also to clarify the meaning of the latter.

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STRUCTURAL-SEMANTIC ANALYSIS OF ETHNO-TOPONYMS OF KANGARLI DISTRICT

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Abstract

At present one of the main problems that toponymy face with is the study of ethnonym-based place names spread in different regions of the world. The structural analysis of such toponyms, as well as the study of the features of their formation is actual in terms of studying the ethnogenesis of nations and the historical ethno-demographic composition of the population in different regions. The article deals with the Kangarli region, located in the northwest of the Nakhchivan Autonomous Republic, located near the most ancient centers of civilization in the Middle East and distinguished by its unique features

In order to reveal scientific truths, both toponyms were analyzed in depth, both structurally and semantically, and comparative analyzes and analogies were made between them. A multidisciplinary approach to the issue was put forth for a more in-depth analysis of ethno-toponyms. Such analyzes make it necessary to study ethno-toponyms not only in terms of linguistics, but also in the historical context of ethnogenesis.

Keywords: Azerbaijan, Nakhchivan Autonomous Republic, Kangarli, ethno-toponyms, etymology, structural-semantic analysis.

INTRODUCTION

After Azerbaijan Republic gained freedom and Nakhchivan Autonomous Republic stepped into socio-economic development Kangarli district was established on March 19, 2004 on the basis of a number of settlements which were previously part of Sharur district. Givrag settlement is the administrative center of the district. However, it should be noted that historically, administrative units such as Garabaghlar township, Garabaghlar sultanate, Xok township, Givrag district were existed in the territory of Kangarli district [2].

When analyzing the ethno-oikonims spread in the territory of Kangarli district the first toponym we have to talk about is the name of Kangarli district. In general, being one of the oldest inhabitants of Nakhchivan, governing this land for a long historical period has led to the emergence of numerous ethno-toponyms related to this tribe and its branches in the territory of Nakhchivan, including its north-western region. From this perspective, Kangarli is one of the most interesting and analyzed toponyms and ethnonyms for researchers.

Undoubtedly, the horonym of Kangarli district is also related to the names of Kangarli tribes, and historical, historical-geographical and ethno-demographic factors were taken into account when deciding on such naming of the district. The district was established in 2004.

I. The etymology of Kangarli ethno-toponym

It should be noted that in F. Rashiddaddin's "Oghuzname" [18, p. 13], in the work of Abulgazi Bahadir khan "Shecereyi Tarakime" [22, p. 30] the ethnonym kangarli was mentioned. In both sources, the ethnonym kangarli is explained in the sense of "those with carts, those who have carts".

While explaining the ethnonym, E.Seyidbeyli divided it into three components in the form of "kang-ar-as". He correlated the component "Kang" with the toponym of the river Kang, and showed that the component "ar" means "man", "male". The "as" component was explained as a plural suffix, thus the ethnonym means "men of the Kang River" [21, p. 32-58].

While carrying out lexical-semantic analysis of Kangar, Kengeres and Kangli ethnonyms, A.Gasimov identified the kang // keng component in the word with kun // xun / hun and wrote that it means sun [1]. F.Rzayev explained the word Kangarli in the sense of "old men" and "chief men" [19, p. 161].

II. Place and research directions of ethno-toponyms of Kangarli district in historical sources

The names of ethno-toponyms spread in the territory of modern Kangarli district can be found in various historical sources. At the same time, there are such toponyms that have historically been part of various administrative units in this territory, and today they have passed into a passive background and are almost forgotten.

As early as the 5th century, the Christian author Parbli Lazar spoke of the Kangarlis living in Nakhchivan, South Azerbaijan and surrounding areas, he mentioned the area where they lived as "the country

of the Kangarlis" and the mountain in that area as "Kangarli Mountain" [8, p. 65].

The famous Turkish traveler Evliya Chalabi, who lived in the 17th century, mentioned the city of Garabaghlar in his "Book of Travels".

The "Review Book of Iravan Province" also contains a number of ethno-oikonims that were existed and still exist in the territory of the present-day Kangarli district. It is known from the book that Garabaghlar region that existed at that time have included 8 villages in the territory of today's Kangarli district [11, p.71]. The name of Garabaghlar ethno-toponym was also mentioned in the Review Book as one of the ethno-toponyms that existed in the territory of Kangarli district.

The Russian author of 19th century V.Grigoirev listed the names of present-day Kangarli tribes in his work "Statistical description of Nakhchivan province", many of which are identical with the ethno-oikonims that exist in the Kangarli district today. Among these names mentioned in V.Grigoirev's work, such names as Yurtchu-Girdasar, Garabaghlar should be specially noted [26, p. 32].

I.Chopin also mentioned names of some ethno-oikonims, which are located in the territory of Kangarli district, in his work and one of them is Yurtchu-Girdasar [28, p. 208].

The 19th century Russian author K.N.Smirnov's work "Materials on the history and ethnography of the Nakhchivan land", which is considered a report, mentioned the names of Garabaghlar, Yurtchu toponyms, which are undoubtedly ethno-names, and Xok, Givrag, Shahtakhti toponyms that are described by a number of researchers as ethno-oikonims and settlements are mentioned as villages inhabited by the Kangarlis [27, p. 31].

III. Structural-semantic analysis of ethno-toponyms of Kangarli district

Garabaghlar is one of the most common ethno-oikonim in historical sources. It should be noted that toponyms that are identical and similar to these ethno-oikonims were also registered in Goychay, Khanlar, Agsu, Salyan, Fizuli, Masalli, Khachmaz and Tovuz. Historically, there was a village called Garabaghlar in the territory of Western Azerbaijan (Republic of Armenia). The same place names have been registered in Turkmenistan, Afghanistan, the North Caucasus and Turkey. There are various opinions among the people about the explanation of the toponym of Garabaghlar. The meaning of this word is explained in folk etymology in the forms of "a place with large and numerous gardens", "those who tie a black shoelace to their shoes" and other forms.

Researcher A.Akhundov, while analyzing the structure of the word and giving its meaning, preferred the considerations of "a place with many gardens" and "black garden" [6, p. 47]. M.Seyidov explained the place names "Garabagh" by dividing them into two components "black" and "garden" and wrote that it means "head of the great clan" [20, p. 36]. I.Jafarsoylu correlated the word Garabagh with the "karabek" tribe of Turkic-speaking pecheneg tribes living in the steppes of Eastern Europe in the Middle Ages. In Ajdar

Farzali's researches, the explanation of Garabagh and Garabaghlar toponyms as ethnonyms and anthroponyms was completely denied, the explanation was preferred as a theonym and explained in the sense of "great sacred garden" [5]. In the encyclopedic dictionary "Toponyms of Azerbaijan" the toponym was explained in connection with the name of the Garabaghlar tribe, a branch of the Kangar-Pechenegs [3, p. 125].

A.Bagirov carried out the structural-semantic analysis of the Karabakh toponym and wrote that it was formed from the combination of black, garden parts and plural suffix -s, meaning "big, mighty, strong part" and used to denote a large part of Kangarli [8, p. 73].

We can attribute the Karabakh ethno-oikonim to the group of astonyms, given the size of this settlement and the fact that it has functioned as a city and urban-type settlement in many periods of history.

XIX century Russian authors V. Grigoriev and I.Chopin registered this ethno-oikonim as Yurdchu-Girdasar [26, p. 208.]. Mentioning the meaning of the toponym Yurdchu, R.Aliyeva writes that the word "yurd/yurt" means "house, hearth, nest" in Turkish languages [10, p. 74]. Budagov and G.Geybullayev considered this toponym ethno-oikonim and connected it with the name of Yurtchu branch of Poladli tribe of Shahsevens. And as an ethnonym, they explained "Yurtchu" in the sense of art and profession [9, p. 114]. A.Bagirov also described Yurtchu as an ethno-oikonim, but connected this ethno-oikonim with the name of the tribe of Kangarlis of the same name [8, p. 73]. He has written that this tribe lived in the villages of Jahri and Uzunoba, later gathered together and founded the village of the same name in the present-day Kangarli district.

Historian E.Kalbizadeh showed that the toponym Yurdchu was formed in connection with the occupation period of Nakhchivan by the Mongols [12, p. 52].

One of the ethno-oikonims that appeared in the north-western region of the Nakhchivan Autonomous Republic in the late twentieth century is the toponym New Karki. It is known that after the occupation of Karki village of Nakhchivan Autonomous Republic by Armenian armed forces in the 90s of the XX century, New Karki village was established for the population who moved from the village. The name of Karki village is formed in connection with the name of Karki tribe. Sources indicate that the Karkis came to Azerbaijan in the early Middle Ages as part of the Kipchaks. At the beginning of the 19th century, it is reported that there is a branch called Kerkibashli within the Kazakhli tribe. A branch of the Turkmens' Ersari tribe was also called Karki. The Karki tribes were also registered in Turkey and Uzbekistan. There are a city, district, settlement called Karki and a mountain called Karkidagh in the territory of Turkmenistan [4, p. 278].

The probability that the Qabilli ethno-oikonim originated with the name of the Qabilli branch of the Kangarli tribe has been suggested by various researchers [8, p. 155].

Khok oikonim is also considered ethno-oikonim by a number of authors. Thus, researchers who show that the name of this place is associated with the Gogar

and Gargar tribes, believe that the initial spelling of the name was Gog. Later, the phonetic substitution of k = x took place [15, p. 456] and the word became Khok.

IV. Analysis of ethno-urbanonyms located in the territory of Garabaghlar village

Urbanonym *Beydili neighborhood* is also an ethno-oikonim. The name of this neighborhood is formed in connection with the name of Beydili tribes.

One of the urbanonyms registered in the territory of Garabaghlar village, which is undoubtedly an ethno-toponym, is the ethno-urbanonym Kurds neighborhood.

One of the most interesting ethno-oikonims – godonyms in the territory of Kangarli district is the name of Garagoyunlu neighborhood in Gabilli village. According to our research and oral surveys carried out in the village, the families living in the neighborhood moved from the south of the Araz River, from the village of Garagoyunlu in present-day Iran. Another ethno-godonym is Gajaris again in Gabilli village.

One of the important places in the system of names of Kangarli district is occupied by station names. It is interesting that some ethnonyms that do not live in the names of villages and settlements are reflected in the names of stations. 4 out of 18 railway stations in the territory of Nakhchivan Autonomous Republic (Bashbashi, Gargalig, Shahtakhti and Givrag stations) are located in Kangarli district, the first two names of which are more interesting for our subject.

V. Structural-semantic analysis of ethno-oronyms of Kangarli district

Among the ethno-oronyms in the territory of Kangarli district, the toponym of Kangarli plain has a special place. It should be noted that even before the establishment of the district as an administrative unit, this area was known among the people as the Kangarli plain.

In addition to the Kangarli plain, another toponym that has an ethno-oronym character in this region is Boyukduz or Bekduz. S.Babayev considered Boyukduz an anthroponym with the name of Bekduz Aman mentioned in the epos "Kitabi Dada Gorgud", and suggested that the name of the Bekduz tribe - ethnonym - was taken from the name of such a tribal leader [7, p. 90-91]. However, we believe that, on the contrary, the Oghuz hero named Aman in the epos was named as Aman from the Bekduzs because he was from the Bekduz tribe. In Mahmud Kashgari's "Divani-lugat-it-Turk", Bugduz is mentioned as one of the 22 Oghuz tribes [24, p. 56]. Most researchers agree that Boyukduz is a transformed version of Bekduz [7, p. 91].

As for the lexical-semantic analysis of the word, it should be noted that in F. Rashiddaddin's "Oghuzname" it is shown that Bukduz, which is a tribe of Uchokhs, means "gentle, mild-mannered, kind" [18, p. 67].

Ottoman Plain Height - At first glance, the Ottoman Plain Height, which looks like an anthroponymic toponym, is located in the eastern part of the Boyukduz [7, p. 92]. Although S.Babayev connects the Ottoman plain with the Ottoman dynasty of kayis, it is impossible to accept it as a convincing version. In our opinion, the initial form of this toponym

was in the form of Asman (As + m + an) and the toponym means "belonging to Ases".

The ethno-oronym yurd Billicy, registered in the territory of Garabaghlar village, was formed in connection with the name of one of the Kangarli tribes. The oronym consists of two components: "Billici" and "yurd". It should be noted that the Billici or Bilici tribe was one of the most influential tribes in the Kangarli tribal union. Researcher M.Guliyev has written that both khan and bey Kangarli cavalries of Nakhchivan belonged to Bilici branch of Kangarli tribe [14]. And "yurd" is a geographical nomen and means "land". Thus, the oronym means "the land belonging to the bilici tribe." It is possible that during the period when Garabaghlar had the status of a sultanate, this area was a separate land where the Bilicis lived, and later it remained in the memory of the people as an oronym.

The toponym of Gazlar gorge in the territory of Garabaghlar village is an ethno-oronym related to guzs / Oghuzs.

Although the area of Beydili spring is an oronym based on a hydronym, it has an ethnonymic character. Beydilis is the name of a tribe that once settled in the territory of Garabaghlar.

The oronym of Sharilgol kovshan has undergone a more complicated development. Thus, first of all, an oikonim-based hydronym Sharilgol appeared on the basis of the word Sharur / Sharil, which has no doubt that it is an ethno-oikonim. Later, on the basis of this hydronym, a new oronym appeared with the participation of the word kovshan.

VI. Structural-semantic analysis of ethno-hydronyms of Kangarli district

Kangarli ethno-hydronyms are also among the names that have been little studied and have not been comprehensively analyzed. The district on the bank of the Araz River is not well supplied with water resources. The density of the river network is weak. The names of a number of natural and artificial lakes and ponds have been registered in the territory of Kangarli district. Among them Ulu Lake, Ghosha Lakes, Ag Lake, Lake Salman, Boyukgol, Lake Zargana, Lake Goyala, Lake Tat, Uch Goze Lake, Lake Gochaga, Lake Mammadali, Lake Haji Huseyngulu, Lake Haji Bakshali, Ghara Lake, Lake Shivil, Lake Bosta, Lake Abdin (Garabaghlar), Lake Sharur (Shahtakhti) can be named. Two of these lakes attract attention as ethno-hydronyms. One of them is Lake Tat and the other is Lake Sharur.

Lake Tat is also one of the rare ethno-hydronyms registered in the Kangarli district in connection with the names of non-Turkic-speaking tribes. It is possible that this ethno-hydronym was formed in connection with the names of Tat workers who came to Nakhchivan from Iran to work in the summer. If we agree with Bahaddin Ogal, we can note that Tat was a single name used to refer to the people living in the Turkic lands, but speaking Persian [23, p. 3].

Most of the springs registered in the territory of Kangarli district, including mineral springs (Baydilbulagi, Asnichay spring, Garabaghlar, etc.) are of ethno-hydronymic nature.

One of the interesting ethno-hydronyms is Beydili spring ethno-hydronym. It should be noted that this ethno-hydronym was registered in the territory of Garabaghlar village of the district and is connected with the name of Beydili, one of the 22 tribes of Oghuzs. This name was first encountered in M.Kashgarli's "Divani-lugat-it-turk" [25, p. 56]. I.Chopin wrote that the Beydilis were also a branch of the Kangarli tribes [28, p. 477].

It should be noted that both the name of the neighborhood and the name of the tribe are registered in the territory of Garabaghlar village in connection with the Beydili tribe. A number of authors write that the Beydilis first settled in Galajik, located near the territory of Garabaghlar, and later moved to the territory of the village [13].

Toponymist Adil Bagirov writes about the meaning of Beydili ethno-oikonim, which took a passive form in the territory of Sharur district: "It can be said without hesitation that Beydili is one of the Oghuz tribes, and in the lexical sense it is used in the sense of "one who cherishes the groom", "dear as adults" and keeps the name of the ancient Turkic tribe alive to this day" [8, p. 78].

Three hydronyms have been identified under the name Asni in the territory of Kangarli district: Asnichay, Asni spring and kahriz Asni. The Asnichay hydronym is associated with the names of the As tribes. When analyzing the toponym from the structural-semantic point of view, it is possible to distinguish three parts: As + ni + chay. As mentioned above, As is associated with the names of the As Turks, who were widespread in the Arazchayi coastal areas of Nakhchivan in the centuries before Christ and chay (river) nomen has been added to the end of the word.

The names of kahrizs also play an important role in the ethno-hydronyms system of the district. In the past, 169 kahriz were recorded only in the Kangarli inclined plain and about 60 in the Boyukduz inclined plain [17, p. 253]. Kahriz names such as Asni, kahriz Tat, Agh su, which currently exist in the district, are ethno-hydronym.

Kahriz Agsu is located in the territory of Yurdchu village of Kangarli district. Another name for Kahriz is "Boyuk Chay". Studies show that the Agsu hydronym is not a descriptive toponym. From the structural-semantic point of view, the toponym consists of two components: ag (white) + su (water) components. We see the "white" component in the names of many medieval Turkic tribes, including the White Huns, the White Sakas, the White Caspians, and others. The "water" component is associated with the names of Su (water) Turkic tribes. It can be assumed that the second component was formerly in the form of "sak", and later, as a result of phonetic changes, Agsak became Agsu.

The ethno-hydronym of kahriz Tat was registered in Garabaghlar village of the district. As mentioned above in the explanation of the hydronym of Lake Tat, this toponym was also formed in connection with the names of Iranian-speaking groups who came to the region to work seasonally.

Conclusion

The lexical structure of toponyms of Kangarli district consists of Turkic names. As a result, we believe that the origin of toponyms here was created in connection with this country, this land, the life experience, way of thinking, traditions of our ancestors and the names of various tribes and tribal associations involved in the formation history of our people.

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SOCIAL SCIENCES

CONCEPTUAL APPROACHES TO REGIONAL TRANSPORTATION PLANNING IN OCCUPIED TERRITORIES

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Abstract

After the glorious victory of the Azerbaijani Army and the end of the 30-year occupation, organizational planning of regional transport infrastructure in the liberated territories is very crucial, which will provide comprehensive development of the territories, revive the territories completely plundered by Armenia and restore decent accommodation.

In this regard, in addition to the restoration of large and strategically important cities and settlements, in accordance with the "Strategic Action Plan to address socio-economic, humanitarian, solving organizational and other urgent issues in the liberated territories of the Republic of Azerbaijan", reconstruction of the general transport infrastructure of the liberated territories have also begun.

Considering the need for a comprehensive and systematic approach to the restoration of transport infrastructure and organization of services in the liberated territories, the article prepares proposals for the organization of regional transport infrastructure in the liberated territories of Azerbaijan Republic and conceptual approaches to regional transport planning in Karabakh.

The article identifies key issues in the process of building regional transport infrastructure and organization of services in Karabakh, as well as requirements and approaches, and reflects the measures of goal-oriented planning of available resources.

Keywords: liberated territories, Zangazur corridor, development vectors, cluster, regional development alternatives, transport infrastructure, logistics centers, regional transport planning.

1. Available information - by region.

During the preparation phase, topographic map data of the project area at a scale of 1: 25000 (for 2015-2020) was obtained and data catalogs were created in the geographic information system (GIS).

1.1. Economic and administrative regions - by region.

The total area of the project area is about 1.36 million hectares, which covers 15.7% of the country's territory. According to the Classification of Administrative Territorial Distribution (AZS 882: 2020), which is officially published by the State Statistics Committee and is the State Standard of the Azerbaijan Republic, 1041 Territorial Units for 400 Administrative Territorial Districts are covered in the liberated territories. Considering the Administrative Territorial Districts, 13 of them are urban, 38 are settlements, and 339 are rural

Administrative Territorial Districts. On the other hand, as the Territorial Units, 14 of them are urban, 47 are settlements, and 980 are rural Territorial Units. The number of administrative territorial districts covered by the Karabakh economic region is 210, and the number of territorial units is 491. 8 of the Administrative Territorial Districts are urban, 35 are settlements, and 167 are rural Administrative Territorial Districts. Moreover, 9 of the territorial units are urban, 36 are settlements and 446 are rural. 550 Territorial Units of 180 Administrative Territorial Districts of East Zangazur economic region are covered. From the Administrative Territorial Districts, 5 of them are urban, 3 are settlements, and 172 are rural Administrative Territorial Districts. 5 of the territorial units are urban, 11 are settlements and 534 are rural.

Table 1.

Administrative division of the project area, (unit)

District		İÖD				İÖV				Area (hectar)
Economic districts	Administrative districts	City	Town	Village	Total	City	Town	Village	Total	
Karabakh	Aghdam	1	13	34	48	1	14	123	138	115812.4
	Fuzuli	2	16	27	45	2	16	82	100	138926.3
	Shusha	1	1	12	74	1	1	37	39	30896.9
	Tartar	2	1	39	42	2	1	74	77	126966.9
	Khojaly	1	1	17	19	1	1	50	52	91615.6
	Khojavend	1	2	38	41	1	2	80	83	149800.3
	Khankendi	0	1	0	1	1	1	0	2	1490.9
	Total	8	35	167	210	9	36	446	491	655509.3
East Zangazur	Jabrayil	1	0	22	23	1	4	92	97	102360.3
	Kalbajar	1	1	53	55	1	1	145	147	269380.5
	Lachin	1	1	47	49	1	1	125	127	183176.0
	Gubadli	1	0	30	31	1	0	93	94	79515.6
	Zangilan	1	1	20	22	1	5	79	85	70035.7
	Total	5	3	172	180	5	11	534	550	704468.1
Grand Total		13	38	339	390	14	47	980	1041	1359977.4



Figure 1. Project area

1.2. Population - By region

The current population of cities and villages in the liberated territories was obtained from the updated report on 01.12.2020. Despite to the official report of the State Statistics Committee stating that the total population of the project area is 952.3 thousand by the end of 2020, according to the investigation of interdisciplinary

governmental organizations family, the registered population and family counts were stated as 880194 and 230 thousand which covers 8.7% country population. In more detail, 563.9 thousand people or 64% fall to the Karabakh economic region, 316.3 thousand people or 36% to the East Zangazur economic region. The population of the project area as of 01.12.2020 date is shown in the table below.

Table 2.

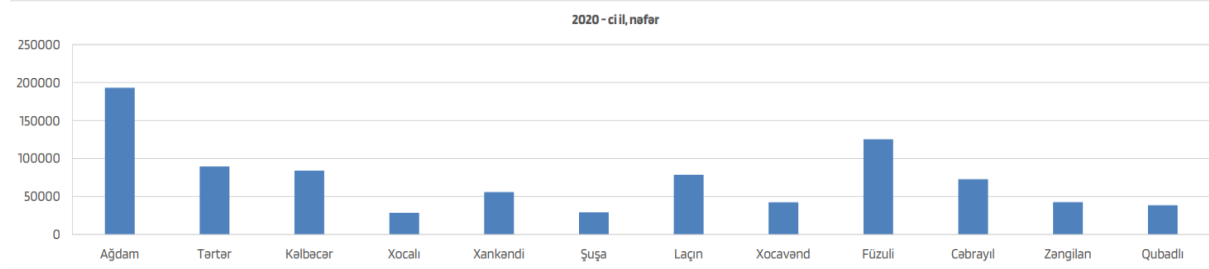
Population of the project area

Economic districts	Administrative districts	2020 year
East Zangazur	Aghdam	193116
	Fuzuli	125256
	Shusha	29144
	Tartar	89524
	Khojaly	28644
	Khojavend	42312
	Khankendi	55900
	Total	563896
Karabakh	Jabrayil	72668
	Kalbajar	83994
	Lachin	78535
	Gubadli	38572
	Zangilan	42529
	Total	316298
Grand Total		880194

Approximately, 81.2% of the estimated population or 714,456 people for the project area are the population of the liberated regions and settlements. The remaining 165,738 people live in the unoccupied territories of Aghdam, Fizuli and Tartar regions. 29.5% or 259,243 people registered in the project area are urban

population, 70.5% or 620,951 people are of rural population. 49.7% of the population or about 438,000 people are men, and 50.3% or 442,000 people are women.

Aghdam region is the most populated region in the project area and its share in the total population is about 22%. Next ones in the line are Fizuli (14%), Tartar (10%) and Kalbajar (9.5%).



(*) Qeyd: Qarabağ iqtisadi rayonunun işğaldan azad edilmiş rayonları üzrə

Figure 2. Populations of administrative districts included in the project area

(*) Note: according to the liberated regions of the Karabakh economic region.

In 2020, the birth rate of the population in the project area was 13.4 on average in the Karabakh economic region and 13.8 in the Eastern Zangazur economic region. During the same period, the death rate was 7.4 for the Karabakh economic region and 7.6 for the East Zangazur economic region, averaging 7.5, and the natural population growth rate was 6.2, averaging 6.1 and 6.3, respectively. Between 2000 and 2020, the population of the project area increased by about 20%, indicating that the average annual population growth rate was about 1%.

The prospective population of urban and rural settlements to be built in the considered areas should be forecasted for a period of 20 years, considering the

above-mentioned demographic processes in the country and measures should be taken for the development of the territories. According to the estimates, in 2040 the population of the project area is expected to increase by about 29.1% to 1,136,740 people. When forecasting the perspective population of settlements (towns), only natural increase in rural areas and both natural and mechanical growth in cities was considered. The largest population growth is expected in the Aghdam region, where the city of Aghdam, which will play the role of regional center, is located. The population of the region is expected to increase by about 38.5% from 193,000 to 267,500 by 2040.

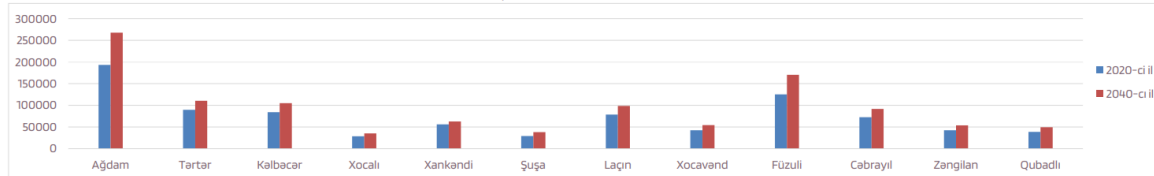


Figure 3. Population growth bar chart - 2020-2040

The next big increase is expected in Fizuli. The population of the region is expected to increase by 35% as a result of development measures carried out. In more detail it is expected to increase from 125,000 to

170,000 by 2040. Shusha region ranks third in terms of expected population growth. The population is expected to increase by 30.4% from 29,000 in 2020 to 38,000 by 2040.

Table 3

Population growth for 2020-2040.

Districts	2020	2040	Population growth between 2020-2040, count	Population growth between 2020-2040, %
Aghdam	193,116	267,540	74,424	38.5
Fuzuli	125,256	170,240	44,984	35.9
Shusha	29,144	38,000	8,856	30.4
Tartar	89,524	110,510	20,986	23.4
Khojaly	28,644	35,060	6,416	22.4
Khojavend	42,312	54,410	12,098	28.6
Khankendi	55,900	62,680	6,780	12.1
Jabrayil	72,668	91,490	18,822	25.9
Kalbajar	83,994	104,930	20,936	24.9
Lachin	78,535	98,680	20,145	25.7
Gubadli	38,572	49,500	10,928	28.3
Zangilan	42,529	53,700	11,171	26.3
Grand total of project area	880,194	1,136,740	256,546	29.1

The design also envisages the inclusion of villages that are virtually adjacent to the city as part of a separate neighborhood (including the construction of individual houses with backyards). For this reason, in accordance with the adopted approach of territorial settlement groups, the population of adjacent villages was taken into account in forecasting the prospective population of cities. Considering the population of the villages envisaged for joint development, the urban population is expected to increase by 58.7% by 2040, from 259,000 in 2020 to 412,000 in 2040, and to 36.2% of the total project area. The development of villages is also planned within the territorial settlement groups. In general, the rural population is expected to increase by 16.8% from 621,000 to 725,000 by 2040 and will account for 63.8% of the total project area.

1.3.Digital elevation model (DEM) - by region

The relief of the Karabakh economic region is mainly mountainous. The northern part of the economic region is the north-eastern foothills of the Karabakh Range and the southern slopes of the Murovdagh Range (the highest peak of the Lesser Caucasus is Camish Mountain at 3724 m), the central, western and southern parts are the eastern slopes of the Karabakh Range (Gizgala Mountain - 2843 m, Kirghiz Mountain - 2827 m, Great Kirs Mountain - 2725 m), the north-eastern and eastern parts are occupied by the western edges of the Karabakh and Mil plains. It is bordered by the Islamic Republic of Iran to the south and southeast. The Murovdagh and Karabakh ranges are divided into several side branches descending towards the Karabakh and Mil plains. As a result of the division of the range and their side branches by rivers, deep and steep slopes were formed. In the middle mountains, there are upland depressions in the areas where river valleys expand.

- Aghdam region is located in the north-eastern foothills of the Karabakh range, in the western part of the Kur-Araz lowland. The relief of the region is mainly plain and partly mountainous. The Karabakh and Mil plains, which cover a large area, are gradually descending from southwest to northeast. The maximum elevation in the eastern branch of the Karabakh Range in the south-west of the region is 1365 m.

- Tartar region is in the western part of the Kur-Araz lowland, the surface is flat and sloping from west to east. The surface is mainly mountainous, and the plain in the east (Karabakh plain). The Murovdag range stretches to the west.

- The surface of the Fizuli region is mostly a sloping plain descending to the Araz River, and a lower mountainous in the west (south-eastern foothills of the Karabakh Range).

- The surface of Shusha region is mountainous (Karabakh range). The eastern part of the region is bordered by Kecheldag pass.

- The surface of Khojaly region is mainly mountainous. The Karabakh Range stretches along the western border of the area. The eastern slopes of the range descending to the Karabakh and Mil plains are divided by deep river valleys and erosive mountain branches are formed.

- The surface of Khojavend region is low mountainous in the west (south-eastern branches of the

Karabakh range) and plain in the east (foothills of the Mil plain).

- The city of Khankendi is located orographically in a mountainous and intersecting terrain.

- The relief of the East Zangazur economic region is mainly mountainous. Its territory is surrounded by East Goycha in the north-west, Murovdagh in the north and Karabakh in the east. The western part of the region is occupied by the Karabakh plateau. In the central part, the Mykhtoken range stretches, and in the south-eastern part, it descends to the valley of the Araz River and passes into the sloping plains. The highest peaks are: Buffalo (3724 m), Dalidagh (3616 m), Gizilbogaz (3562 m), Boyuk Ishigli (3552 m).

- The surface of the Jabrayil region is mainly a sloping plain (Incechol, Gayan steppe), low mountains in the north.

- The surface of Kalbajar region is mountainous (Murovdagh, Shahdag, East Goycha, Vardenis, Mikhtoken and part of Karabakh plateau). The highest peaks are Mount Camish (3724 m) and Dalidag (3616 m). There are about 80 peaks in the area with a height of more than 2000 m.

- The surface of Lachin region is mainly mountainous. The southeastern slopes of the Karabakh Range are located in the east of the region, and the Mykhtoken Range in the north. The Karabakh plateau is located in the south-western part of the territory. The highest point of the region is Gizilbogaz mountain (3594 m).

- The surface of Gubadli region is mainly mountainous. Its territory belongs to the south-western part of the Karabakh Range (Topagaj Mountain, 2010 m, Pirdagh, 1316 m), the eastern part of the Bargushad Range (Gartiz Mountain, 1277 m) and the south-eastern part of the Karabakh Plateau (Gurbantepe Mountain, 1976 m). The Yazi plain, which ends at the south-east of the Karabakh plateau, descends to 450 m in the area and passes into the inclined and wavy Inja plain.

- The territory of Zangilan region has a complex and fragmented surface and is located in the middle and low mountainous areas. In the north-western part of the region there is Bargushad range (Susandag, 1304 m). The area from this range to the Bazarchay-Oxchuchay area (Agoyug plain) is a sloping plain with a height of 400-600 m. The north-eastern part of the region (slopes between the Hakari and Araz rivers of the Karabakh range) forms the hilly Gayan plain. The western part of the region is the eastern end of the Mehri-South Range.

1.4.Slopes/Gradient - By Region

The slope characteristics are distributed in the region as follows: 610,522 hectares of land have less than 15%, 323018 hectares have between 15-30%, and 426,438 hectares have more than 30% of slope. On the territories included in the Karabakh economic region, the slopes less than 15% are 390,721 ha, slopes that are between 15-30% are 125,216 ha, and the slopes over 30% cover 139,572 ha area.

- 100,914 ha area in Aghdam region has slope less than 15%, 9,694 ha area has 15-30%, and 5,204 ha area has more than 30% slope.

- In Fizuli region, the area with a slope of up to 15% is 129,053 ha, the area with 15-30% is 8,530 ha, and the area with more than 30% is 1,344 ha.
- In the area of 2,652 ha of Shusha region, the slope is up to 15%, in the area of 8,172 ha is between 15-30%, and in the area of 20,074 ha is more than 30%.
- The area with a slope of up to 15% in the territory of Tartar region is 79,631 ha, areas with a slope of 15-30% are 19,762 ha, and areas with a slope of more than 30% are 27,574 ha.
- The slope of 785 ha area in Khankendi is less than 15%, the slope of 591 ha is 15-30%, and the slope of 115 ha is more than 30%.
- Areas with slope of less than 15% of Khojaly region are 23,567 ha, slopes with 15-30% are 30,868 ha, and slopes of more than 30% are in 37,181 ha.
- In Khojavend region, 54,120 hectares have a slope of less than 15%, 47,600 hectares have a slope of 15-30%, and 48,080 hectares have a slope more than 30%.
- In the East Zangazur economic region, the slopes less than 15% are 219,800 ha, the slopes between 15-30% are in 197,802 ha, and the slopes above 30% are in 286,866 ha.
- In Jabrayil district, 77,228 hectares have less than 15%, 17,200 hectares have 15-30%, and 7,932 hectares have more than 30% of slopes.
- In the Kalbajar region, areas with a slope of up to 15% are 38,413 ha, areas with a slope of 15-30% are 69,803 ha, and areas with a slope of more than 30% are 161,165 ha.
- In the area of 42,006 ha of Lachin region the slope is up to 15%, in the area of 59,181 ha it is 15-30%, and in the area of 81,990 ha it is more than 30%.
- The area of slopes with a slope of up to 15% in the territory of Gubadli region is 31,861 ha, areas with a slope of 15-30% are 29,887 ha, and areas with a slope of more than 30% are 17,767 ha.
- The slope of 30,292 ha in Zangilan is less than 15%, the slope of 21,732 ha is 15-30%, and the slope of 18,012 ha is more than 30%.

2. General strategies

2.1. Regional development alternatives - Integrated East Zangazur and Karabakh economic regions

- Consideration of the existing administrative structure of the territories as the main driving force.
- Development of the Aghdam-Khankendi-Shusha corridor as the central axis of the Karabakh region.
- Integration of Lachin into the Aghdam-Khankendi-Shusha corridor and development of the

territories along the axis extending in an east-west direction, passing through the geographical center of the liberated territories.

- Development of the city of Jabrayil as an important center, along with the proposed settlements along the axis (considering the potential for development as a logistics center between Nakhchivan, Turkey and Iran).
- Population density, especially in the areas along the Aghdam-Khankendi-Shusha-Lachin axis.
- Strengthening integration with the cities of Ganja in the north and Nakhchivan in the south-west and taking advantage of the opportunities of international importance (airports, highways, railways, trade, etc.) of the liberated cities.
- Considering the specifics of the city of Shusha, special planning of the city before inclusion in the hierarchy of proposed centers.

Functional-spatial clusters integrated with development vectors:

- Development of Aghdam as a regional center, considering its significant potential.
- Development of vectors branching from Aghdam in the North, Central and South directions, which will have strong transport and economic ties.
- Development of the northern development vector in the tourism, agriculture and industrial sectors.
- Development of the central development vector in the fields of culture, tourism and education.
- Development of the Southern Development Vector in the industrial, logistics and agricultural sectors.
- Organization of 5 functional clusters that interact with these development vectors and have specific economic and spatial characteristics - North, Central-East, Central, Central-West and South.
- Development of Aghdam, Fizuli, Khankendi, Lachin and Kalbajar cities as centers of the proposed functional clusters.
- Planning each of the functional clusters as areas with self-sufficiency.
- Integration of clusters and settlements in order to build strong space and socio-economic structures.
- Taking into account that Shusha is the cultural capital of the country, special planning without including the city in the hierarchy of proposed centers.
- Linking the region with neighboring districts (Nakhchivan, Ganja, Yevlakh, Agjabadi, Beylagan, etc.).

2.2. Assessment of development alternatives

Table 4.

Evaluation matrix

Criterion	Spatial-functional clusters	Development vectors	Economic districts
Clarity of purpose			
Balanced distribution of the population by area			
Ease of implementation of the plan			
Opportunity for sectoral specialization and high productivity			
Environmentally sensitive situations			
Service availability			
Circumstances facilitating the repatriation of IDPs			
Opportunities for integration into regional and national development			

High degree priority
 Intermediate degree priority
 Lower degree priority

According to the results of the assessment matrix, the combination of Alternative 1. (Spatial-functional clusters) and Alternative 2 (Development vectors) seems to be the most suitable alternatives in terms of successful regional development of the liberated territories.

2.3. Regional development strategy.

1. Horizontal Spatial Union: Karabakh's regional transport planning promotes a hierarchy of settlements: 3 development corridors and 5 functional spatial clusters. None of them are isolated from each other, on the contrary, they are integrated parts of the whole regional system: development corridors; functional spatial clusters; definition of hierarchy.

2. Vertical integration of events: Karabakh's regional transport planning provides spatial proposals with both social and economic dimensions. The distribution of functions in this way is based on an approach that supports spatial distributions targeting self-sustaining planning units (region, subregion, cluster, settlement, etc.) for all dimensions.

3. Comprehensive Development:

3a. Spatial development: Regional transport planning in Karabakh considers the structure of clusters and determines spatial expansion by assessing population, transport infrastructure, surface features, water bodies, forests, cemeteries and nearby settlements.

3b. Social development: Regional transport planning in Karabakh offers several social facilities and several other points to ensure community development in connection with spatial and economic development.

3c. Economic development: Regional transport planning in Karabakh stimulates economic development, considering the historical, geographical, social and characteristics of each spatial unit (settlement, cluster, development corridor, region, etc.).

3d. Ecological balance: Karabakh's regional transport planning ensures the protection of environmental resources. It proposes to increase the share of

alternative energy in the area, provides protection of forest areas, consideration of agricultural lands in determining the expansion of settlements, optimization of water use and, finally, the proposed Strategic Environmental Assessment.

4. Balance between social desirability and economic viability: Karabakh's regional transport planning aims to strike a balance between functionality and rationality, integrating spatial and socio-economic arguments.

3. Conceptual approaches.

3.1. Transport Exchange and Logistics Centers.

The following main conceptual approaches are proposed in the formation of the transport structure of the Karabakh region:

- Establishment of multifunctional and integrated transport system.

- Linking airports with railways to facilitate population-service-goods-cash system flow.

- Formation of transport exchange centers in Gorchu with Aghdam, Fizuli, Jabrayil, Zangilan, Shusha and Kalbajar cities.

- Ensuring interaction between the city of Aghdam and transport-logistics centers in the border settlements of Fizuli and Zangilan districts.

- Creation of wide opportunities for domestic and international products supply of the clusters located in the direction of Aghdam-Khojavend-Fuzuli-Jabrayil-Zangilan, defined as an industrial corridor.

- Establishment of transport-logistics center in Zangilan district.

3.2. Global trends, economic development models

The assessment of the transport and logistics sectors should be carried out jointly, taking into account the changes in the world economy in the trade, transport and logistics sectors, the impact of modern technologies in this area, the growing volume of trade between countries, as well as sectoral interaction. Existing

global challenges in the trade and transport sector are related to changing customer expectations, technological innovations, new players entering the industry, new forms of competition and cooperation.

The level of development of states, recent pandemics, the state of political and economic relations between countries, as well as inter-regional trade flows also have a significant impact on these sectors. In recent years, robotics, artificial intelligence, unmanned aerial vehicle services, increasing automation, increasing the importance of information and its processing, expanding e-commerce and forecasting that the global trade in goods and services will triple by 2030, as well as the share of the transport sector in 5% of global GDP determines the prospects for future development of the sector.

Taking into account the above-mentioned global trends and forecasts, the development of the transport and logistics sector in the liberated territories, the implementation of the Zangazur Transport Corridor, which will be part of the East-West Corridor connecting Asia with Europe via Azerbaijan, significantly strengthens our country's position as a Eurasian transport and logistics center.

Given the high potential of the transit-transport system in the implementation and development of international transport, ways to increase the transit capacity should be explored and existing difficulties in this area should be eliminated.

It is also necessary to increase the capacity of international transport corridors through our country and create new international transport corridors in order to increase transit traffic between countries through Azerbaijan Republic. The new Baku-Tbilisi-Kars railway between the Republic of Azerbaijan and the Republic of Turkey and the international combined cargo transportation from Central Asia (Kazakhstan, Uzbekistan, etc.), East Asia (China, Japan, Korea, etc.) to Europe passing over via the Caspian Sea are mainly transported via Baku-Tbilisi-Kars-Sivas-Ankara-Istanbul-Kapikule (Turkey / Bulgaria border). Considering the territory of the three states, the length of this route is about 2114 km. But the length of the Baku-Tbilisi-Kars route is 826 km [1-6].

3.3.Zangazur Corridor:

The Zangazur Corridor is being established as a transport corridor to connect the main area of Azerbaijan with its integral part of the Nakhchivan Autonomous Republic, along with roads and railways. The Zangazur Corridor is a project that can unite the Turkic world, Europe and Asia. Article 9 of the Nagorno-Karabakh ceasefire declaration signed as a result of the Second Karabakh War states the establishment of the corridor between the western regions of Azerbaijan and Nakhchivan. The reduction of the transportation distance along the Zangazur corridor will also give a strong momentum to the further increase of transit traffic through our countries. The Alat-Nakhchivan-Kars route along this corridor will be shortened by about 100 km compared to the Baku-Tbilisi-Kars route, which will reduce the cost of international transportation operations and make transportation more competitive [5].

The Zangazur corridor will be a bridge connecting the historical land of Azerbaijan with Zangazur and the whole Turkic world. This road will not only connect our territories, which have been separated for more than a century, but also provide a major transit line between Europe and Asia. The route of this transit line through Azerbaijan will be a very serious contribution to the geopolitical position of our country, both regionally and globally. First, the Zangazur corridor will be a transport corridor directly connecting Nakhchivan and the main part of Azerbaijan. At the same time, the opening of this corridor will directly connect Azerbaijan and brotherly Turkey by land and rail.

The Zangazur corridor could also become a major route for Russia to transport goods to the South Caucasus and neighboring countries. Russian trains can pass through the territory of Azerbaijan to the Zangazur corridor, thus directing to Armenia, Turkey, Iran and South Asian countries. This corridor can also improve and maintain the development of trade relations between Turkey and Russia.

From an economic point of view, this corridor will unite the Turkic states with a GDP of more than \$ 1.1 trillion, as well as increase the strategic importance of Azerbaijan. This will strengthen the Turkic states, revive the development of the Union of Turkic States (Turan), make the Turkish Union's participation in international and regional political processes more effective, as well as strengthen the integration process of regional countries. Rehabilitation of the Zangazur corridor will allow transportation of goods from China, India, Central Asia to Turkey and Europe by shortcut, i.e. the Silk Road will be restored again.

The Zangazur corridor increases the opportunities for diversification along the East-West route. Therefore, the countries of Southeast and Central Asia, as well as the European Union are interested in the implementation of the Zangazur corridor. At the same time, the Zangazur Corridor plays an important role in diversifying the North-South and East-West routes. The corridor is not only short, but also important in terms of saving time and resources [5-6].

The vast majority of cargo that can be transported via the Zangazur transport corridor will be the cargo originated from China, Kazakhstan, Uzbekistan and Turkmenistan. At the initial stage, favorable and simplified conditions of transportation should be agreed with the above-mentioned countries, and the smooth passage of these vehicles at the relevant ports should be ensured without unloading. In order to resolve these issues, a quadripartite agreement should be reached between Turkey, Azerbaijan, Turkmenistan and Kazakhstan on the Caspian Sea crossings.

The option of sending international combined cargo via the Black Sea ports of Poti and Batumi to Europe on the existing route once again confirms that international road transport will be more efficient, taking into account the carrying capacity of ferries, the speed of ships and the time spent loading and unloading cargo containers at ports.

At the same time, given the time spent on loading and unloading operations in international combined cargo transportation in the ports of the Caspian Sea, and

the unloading of vehicles by Ro-Ro vessels (vehicles), it is further confirmed that the international transportation on the Zangazur transport corridor will be more efficient.

New railway project Kars-Igdir-Nakhchivan:

The length of the line in the territory of Turkey (Kars-Igdir-Intermediate-Diluju) is 224 km. At present, 9 tunnels with a total length of 9631 m and 9 bridges with a total length of 4184 m have been built according to the project amount.

At the same time, a 7 km long railway line should be built on the Azerbaijani side from Sadarak station to the Turkish border. Moreover, for the effective operation of the new railway line, the following work must be done in Nakhchivan: - 62 km of Nakhchivan-Sadarak road, Nakhchivan-Validag-Sadarak area (80 km) Information Transmitters and communication facilities, the communication network and 6 substations in the Nakhchivan-Sadarak area (79 km) must be all be overhauled and renovated.

If the railway connection is going to be extended to Julfa station, the above-mentioned works should be carried out in the 46 km Julfa-Nakhchivan area and the bridge over the Nakhchivanchay in the Nakhchivan-Garabork route should be overhauled (replaced) [1-6]. However, in order to prevent additional political manipulations, we consider it expedient to carry out the processes after the implementation of the Zangazur corridor.

4. Strategies of the Regional Transport Plan – Results and Suggestions

The following main strategic approaches are proposed in the formation of the transport structure of the Karabakh region:

Target 1. Strategies to achieve goals within the framework of interregional adaptation:

- Existing infrastructure plans should be implemented considering the initial results of the intermodal transport model.
- Infrastructure projects should be given priority to support interregional travel.
- Priority should be given to infrastructure projects aimed at connecting populated and industrially advanced regions.
- Potential of building programs in the logistics sector should be established for the development of customer-oriented transport services.

Target 2. Strategies to achieve the goals of becoming a regional center in the field of transport and logistics:

- Invest in infrastructure, customs services, transport and logistics training, which are the three main components of the Logistics Performance Index.
- Azerbaijan should be effectively promoted as an effective transport and logistics center.

- East-West railway corridors should be developed to facilitate exchanges and reduce traffic congestion in the Baku-Nakhchivan direction.

- Azerbaijan's competitiveness in transport and logistics should be monitored and regular performance appraisals should be provided.

Target 3. Strategies to achieve security goals:

- Investments on the projects of safe roads and roads with multiple lanes should be made / maintained
- Safe driving skills must be developed.
- Road safety training and awareness should be increased.
- The efficiency of vehicle inspections should be increased.
- The transition to safe vehicles must be supported.
- The transition to safer establishments should be encouraged.

Target 4. Strategies to achieve national security goals:

- Corridors / routes used by security units to meet protection needs against natural disasters and potential risks should be identified.
- Alternative routes to the existing road network should be constructed along designated corridors and routes to access and provide connectivity to settlements.

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ORGANIZATION OF REGIONAL TRANSPORT INFRASTRUCTURE IN THE OCCUPIED TERRITORIES OF THE REPUBLIC OF AZERBAIJAN - KARABAKH REGIONAL TRANSPORT PLANNING

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Abstract

The Patriotic War, which began on September 27, 2020, in response to another military provocation committed by the Armed Forces of the Republic of Armenia against our country, ended 44 days later with a historic victory of the Azerbaijani nation and the territories which were under occupation for 30 years were liberated. As a result of ensuring the territorial integrity of our country, necessary measures are being taken to restore the liberated territories, build new economic and social infrastructure, support economic activity and ensure well-deserved living conditions.

Considering the need for a comprehensive and systematic approach to the restoration of transport infrastructure and organization of services in the liberated territories, the article lists proposals for the organization of regional transport infrastructure in the liberated territories of the Republic of Azerbaijan and the "Action Program" for Karabakh regional transport planning.

The article identifies issues to be addressed and the measures to be taken in the process of building transport infrastructure and services in Karabakh, including requirements and approaches, expedient planning of available resources and activities related to the organization of qualitative transport services in accordance with standards, norms and rules established by existing regulations in the field of transport.

The main purpose of the article is identification of necessary measures in order to establish mobile and stable transport networks in accordance with modern requirements for the comprehensive integration of the liberated territories into a single transport quarter (system), to ensure quality and uninterrupted transport system, organization of transport and logistics services and ensuring continuity and sustainability of these services.

Keywords: Regional transport planning, "One pipeline, one road", Caspian bridge, Turkish corridor, East Zangazur, transport-logistics services, logistics performance index, highways, transport scheme, logistics center.

1. Introduction

Immediately after the great victory, it was determined that the transport networks of the region were insufficient and that the living quarters, as well as the transport infrastructure, were completely useless. For this reason, measures are being taken to improve and reconstruct residential areas, develop the main transport infrastructure, roads, railways, and airport networks. These investments are essential to ensure the return to the liberated areas, restoration and improvement work, as well as the sustainable growth of safe accommodation, productive activities and prosperity.

This study will identify the needs of regional transport networks, considering investments in the construction, planned transport infrastructure and settlements in the region, and assess the need for new transport corridor proposals.

2. Scope

The study aims to: provide safe, comfortable, and fast access to the region, increase the region's attractiveness, provide the highest level of access to settlements, military and logistics, and identify new investments suitable for additional needs.

The initial goals and objectives of this study are as follows:

Objective 1 – Interregional adaptation: to create a unified transport system that will meet the travel (mobility) needs of users and provide efficient, sustainable, effective freight and passenger transportation systems between all regions of the country.

- **Goal 1.1:** Link all liberated areas with road, rail and air transport infrastructure connecting major regional centers.

- **Goal 1.2:** Create complementary road, rail and air transport opportunities and capabilities that will enable citizens to travel within the country in a sustainable and cost-effective manner by 2040.

- **Goal 1.3:** Create complementary road, rail and air transport capacity and capabilities that will ensure sustainable and cost-effective freight transport within the country by 2040.

Objective 2 – Becoming a regional center in the field of transport and logistics services: to make Azerbaijan a regional center in the field of transport and logistics services in accordance with its geographical advantages, by making the investment in logistics services attractive and creating a transport and logistics sector that will create added value as well as new job opportunities.

- **Goal 2.1:** to support transport and logistics services to be comparable to the top 15 countries in the Logistics Performance Index.

- **Goal 2.2:** to establish links between the countries of the Far East and the countries of the Middle East and Europe, as well as between the Turkic states.

- **Goal 2.3:** to create a transport and logistics sector that provides a service that competes with neighboring countries in terms of price and quality.

Objective 3 – Safety: to create a transport system that will ensure a high level of safety for users and significantly reduce the number of deaths and serious injuries on the roads.

- **Goal 3.1:** to further reduce the number of fatal road accidents in 2030 compared to 2020 and to achieve the goals set by the government by 2031.

Objective 4 - National Security: to build a transport network in the region that meets defense needs.

- **Goal 4.1:** Establish a transport network on routes that can be used by security units with identification of security corridors that can meet defense needs.

The scope of regional transport planning in Karabakh, which is the subject of this study, covers the liberated regions of Agdam, Jabrayil, Fizuli, Kalbajar, Lachin, Gubadli, Shusha, Tartar, Khankendi, Khojaly, Khojavend, and Zangilan.

3. Available information and statistics

According to the Decree of the President of the Republic of Azerbaijan: No. 1386 dated July 7, 2021 "On the new division of economic regions in the Republic of Azerbaijan", the research area is divided into 2 economic zones:

- *Karabakh economic region (Khankendi city, Agjabadi, Aghdam, Barda, Fuzuli, Khojaly, Khojavend, Shusha and Tartar regions),*

- *East Zangazur economic region (Jabrayil, Kalbajar, Gubadli, Lachin and Zangilan regions).*

There are 585 km of highways in the region, only 1,563 km of national roads, 1,522 km of local roads and a total of 8,560 km of other roads. The following table shows the pre-occupation national highways in Karabakh and East Zangazur economic regions.

Table 5.

Available road indices		
Road number and index	Road name / encription	Length of the road (km)
M-6	Hajigabul-Bahramtepe-Minjivan-State border with the Republic of Armenia	286
R-19	Ganja-Kalbajar-Lachin	200
R-27	Tartar-Hindarx	41
R-28	Yevlakh-Khojaly-Lachin	151
	Access road to Khankendi	1
	Access road to Shusha	2
	Entrance to the city of Kalbajar	4
R-30	Khankendi-Khojavend	42
R-31	Shusha-Fuzuli	53
R-33	Aghdam-Hindarkh-Agjabadi	48
R-34	Aghdam-Aghdara	26
R-35	Aghdam-Fuzuli-Horadiz	90
	Entrance road to Khojavend city	4
R-36	Lachin-Hakari	83
R-37	Lachin-Zabukh State border with the Republic of Armenia	23
R-38	Gubadli-Khanate	16
R-39	Hakari-Zangilan	23
R-40	Fuzuli-Jabrayil-Mahmudlu	46
	Other	465
	Total	1563

There is a need to upgrade almost all road networks in the areas. No investment has been made in the research network for 30 years, and most roads have been destroyed.

The existing Horadiz-Jabrayil-Zangilan-Agband road, Gubadli-Lachin, Shukurbayli-Jabrayil-Hadrut

road, Ahmadbeyli-Fuzuli-Shusha, Fuzuli-Hadrut, Barda-Agdam roads are in a very bad condition in terms of transport, operational indicators and geometric parameters and in many places there are ruins of roads which looks like a dirt road.

Most of the Togana-Kalbajar and Kalbajar-Lachin highways currently serve as dirt roads and are very slow. These roads, which are classified as roads of national importance in the network of highways, have in fact become uncategorized, non-asphalt roads.

The occupied parts of the Agjabadi-Aghdam road (Hajimammadli-Aghdam) are also one of the roads in need of restoration.

The largest number of vehicles, about 25,000, are registered in the Aghdam region. The next region with the largest number of vehicles is Fizuli with 15,000 vehicles. There are less than 5,000 vehicles in Khojavend, Khojaly, Shusha, Zangilan and Gubadli districts.

The total number of vehicles registered in the study area is 86,290, which is 6% of the total (1,418,404) vehicles registered in the Republic of Azerbaijan. It is possible to say that the indicators in the field of research are low compared to the number of cars per capita in the country.

The length of the existing railway line in and around the study area is 1,189 km and has a total of 32 stations. The most important stations are Agdam, Khojaly, Khankendi, Agjabadi, Zangilan, Yevlakh and Ganja. While the territories were under occupation, the railways between Horadiz-Agband and Barda-Agdam were completely destroyed and rendered as unfit for usage.

According to the statistics of 2020, the rate of railway use in the transport sector of the country was implemented in the following ratios.

- Cargo transportation 7.8%,
- Intercity passenger traffic is about 1.0%,
- Suburban passenger traffic 0.76%.

Compared to road, rail transport was less frequent (especially passenger transport).

4. Background information, statistics, project proposals and planning

Four main goals should play a role in the formation of the transport structure of the Karabakh region:

- **Objective 1.** To ensure the integration of the region into the international transport system with other regions of the country and through transport corridors.
- **Objective 2.** Ensuring access to the transport infrastructure of the settlements forming the region, including service and production areas.

- **Objective 3.** Ensuring accessibility and increasing transport efficiency through integration between modes of transport.

- **Objective 4.** Stimulation of environmentally friendly modes of transport for the region, organization of modern public transport services, creation of a network of bicycle infrastructure, and introduction of new modes of transport.

The Dashkasan-Kalbajar corridor in the north-west, Barda-Agdam in the north-east, Agjabedi-Agdam in the east, Beylagan-Ahmadbeyli in the southeast and Nakhchivan-Agband corridors in the south-west should be planned as the main entrances to the region and close ties with other regions should be organized. The region should be connected with the neighboring countries of the region, as well as through the Arazbayli-Agband corridor and the Fizuli, Zangilan, Gorchu international airports.

The 155-kilometer section of the Arazboyu-Nakhchivan-Turkey-Europe transport corridor (Zangazur corridor) starting from the Baku International Sea Trade Port in Alat settlement, located between Ahmadbeyli and Agband, plays an important role in the development of planning strategies in the Karabakh region. Thus, this part is proposed as a development corridor, providing industrial/logistics type activities, starting from the city of the regional center, Agdam.

In the future, planning solutions may be considered for the extension of the Ahmadbeyli-Horadiz-Minjivan-Agband highway to Alat settlement, the creation of an independent route for the international corridor, and the construction of a new road bridge over the Araz River between Azerbaijan and Iran (already offered).

In addition, to increase the capacity of international transport corridors passing through our country and create new international transport corridors, the Historical Silk Road (Turkish Corridor) - "TRACECA" on the Europe-Caucasus-Asia transport corridor", which reduce distances, facilitate transit transport links between countries, joint road and railway bridge plan (Caspian Bridge) directly connecting Azerbaijan (Alat) and Turkmenistan (Turkmenbashi) across the Caspian Sea in order to create a strong integration between Europe and Asia, is very important in terms of achieving goals.

The route map for the proposed extension of the Ahmadbeyli-Horadiz-Minjivan-Agband highway to Alat settlement and for the proposed new Caspian Bridge, is shown below.

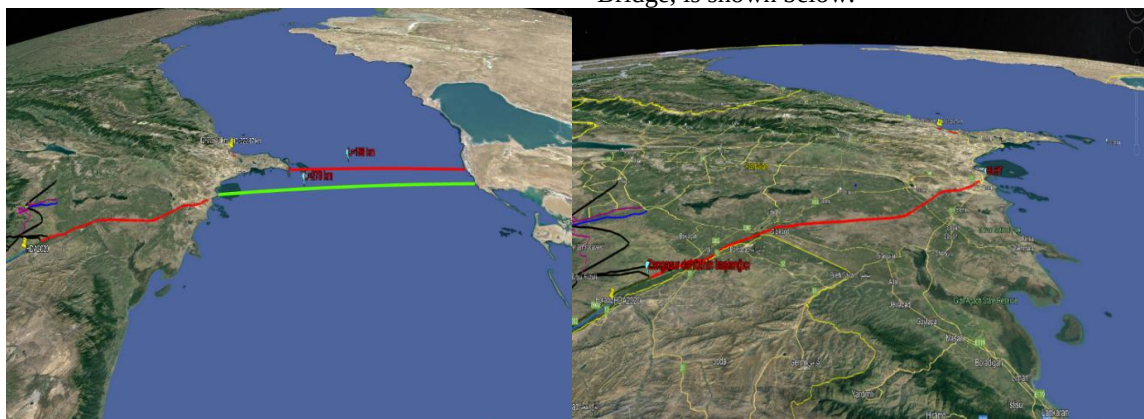


Figure 4. Khazar bridge

The Araz Valley, economic zone in Soltanli, the Logistics Center in Minjivan, and the Solid Waste Management Center between Soltanli and Gumlaq are the main investment projects designed and proposed along this corridor. Fuzuli International Airport, which is being built on this development corridor, and Zangilan International Airport, which is being designed, are also transport infrastructures that have a strong impact on the development of the corridor.

The Ahmadbeyli-Fuzuli-Shusha corridor, designed and currently under construction, consists of 2 highways and 1 railway line. The design of Shusha-Khankendi-Khojaly-Agdam section of the railway between Ahmadbeyli-Fuzuli-Shusha and Barda-Agdam railways, has been proposed which provides a ring structure, make transport more fluent and increase accessibility. One of the proposals is to extend the railway from Arazboy to Agjabadi to the city of Agdam. Thus, Agdam will be a strong regional center where railways and highways from Barda, Shusha and Agjabadi intersect.

The projected Shukurbayli-Jabrayil-Hadrut-Fuzuli highways connect the important settlements with each other and with other main modes of transport (Fuzuli International Airport, Ahmadbeyli-Fuzuli-Shusha railway and highways, Ahmadbeyli-Horadiz-Agband railway and highways) are considered major investments for the purpose of building and strengthening.

At the same time, it was proposed to strengthen the existing local roads between Hadrut-Horadiz, Jabrayil-Soltanli, Jabrayil-Turshsu and Jabrayil-Balasoltanli-Gubadli and convert these into national roads.

The main roads proposed for construction in the region for infrastructure measures are:

1. "Ahmadbeyli - Fuzuli - Shusha" ("Victory Road", performed),

2. "Ahmadbeyli - Fuzuli - Shusha" highway,
3. "Talysh - Tapgaragoyunlu - Gashalti sanatorium" highway,
4. "Barda - Aghdam" highway,
5. "Horadiz - Jabrayil - Zangilan - Agband" highway,
6. "Togana - Kalbajar - Istisu" highway,
7. "Khudaferin - Gubadli - Lachin", a new highway without entering the city of Lachin,
8. "Shukurbayli - Jabrayil - Hadrut" highway,
9. "Fuzuli - Hadrut" highway,
10. "Kalbajar - Lachin" highway,
11. "Aghdam-Fuzuli" highway,
12. "Gubadli - Eyvazli" highway,
13. "Gubadli-Mahmudlu-Yazduzu-state border with the Republic of Armenia" highway,
14. "Hadrut - Tug - Azykh" highway,
15. "Istisu-Minkend-Lachin" highway,
16. Construction of road infrastructure in Pirjahan-Goshasu, Kalbajar and Lachin districts,
17. "Jabrayil - Balasoltanli (Gubadli)" highway,
18. "Jabrayil - Turshsu", "Balasoltanli (Gubadli) - Gubadli" highway,
19. "Fuzuli-Khankendi" highway,
20. "Shukurbayli - Soltanli (new route)" highway,
21. "Soltanli - Jabrayil" highway,
22. "Horadiz - Hadrut" highway,
23. "Lachin (Safiyan) - Hadrut" highway,
24. "Aghdam-Vangli-Takhtabashi-Bashlibel-Istisu" highway,
25. "Kalbajar-Gadabay" (and Dashkasan) highway,
26. "Zangilan-Alibeyli" highway,
27. Gorchu-Minkend highway,
28. Agdam outer ring road.

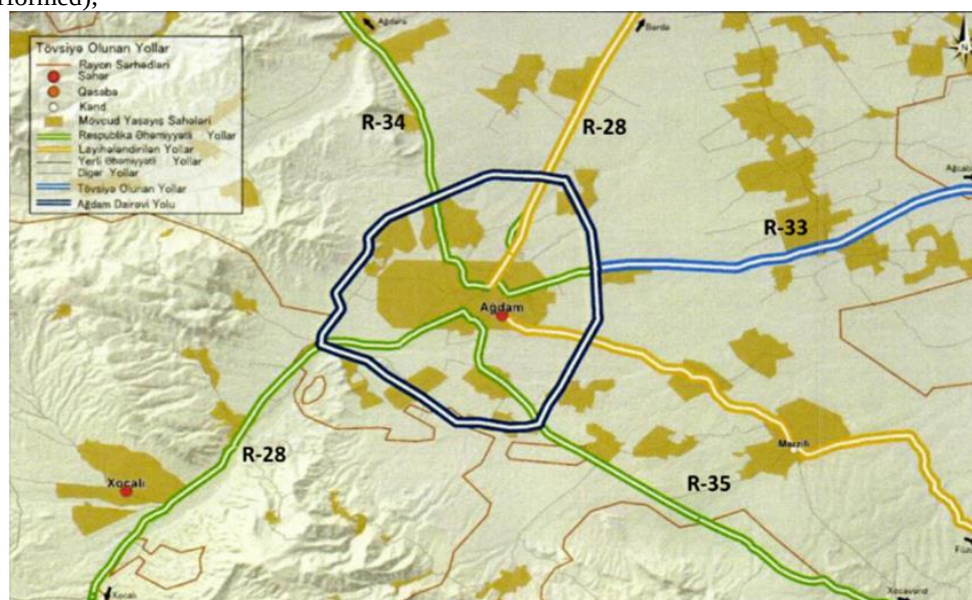


Figure 5. Agdam city circular highway project

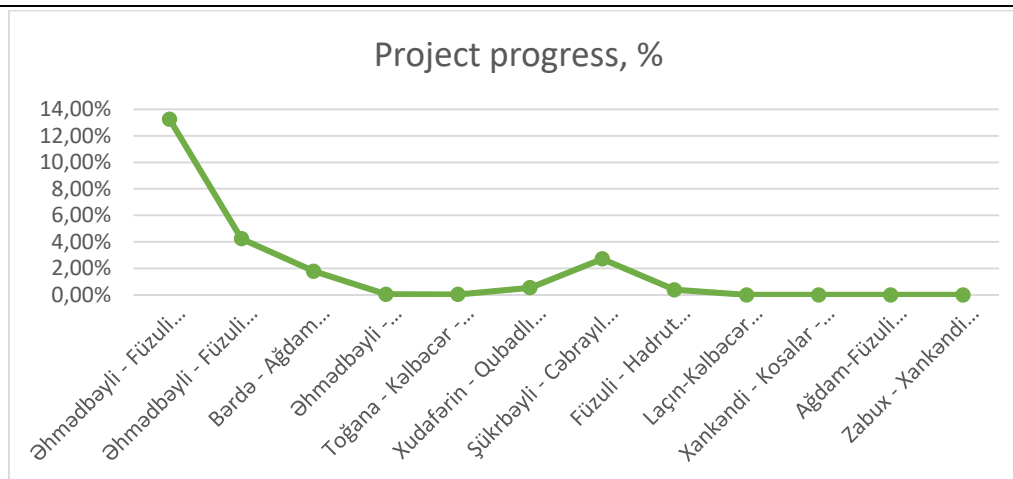


Figure 6. Project progress by 09.09.2021

At the same time, the construction and maintenance of the Beylagan-Khojavend-Fuzuli highway (connecting the newly designed Fuzuli-Agdam highway and the Beylagan-Allahyarli-Alkhanli-Kerimbeyli highway) should be implemented within the framework of projects.

In addition, the repair and reconstruction of highways, as well as the construction of artificial facilities should be considered, which will provide transport links between the villages and settlements to be built in the liberated areas, as well as between the regional centers. It is proposed to connect the centers of 315 identified settlement groups in the region to the nearest republican roads through local roads.

1. "Ahmadbeyli - Fuzuli - Shusha" highway.

- Technical indicators: 81.6 km, "I" technical grade, four lanes.

- Work done: Construction of land in the 0-18, 26-45, 51-53, 58-65, 71-73, 75-81 km sections, bridges are being built at 1, 27, 34, 37, 50, 62, 79 km, tunnels at 80 km and underpasses at 60 km.

2. "Toganali - Kalbajar - Istisu" highway.

- Technical indicators: road - 80.7 km, technical grade "I-II", 2-3 lanes, tunnel - 11.6 km.

- Carried works: excavation of a field in the 12-13 km section of the road, construction of water pipes in the 12.8 and 13.3 km sections and relocation of existing canals. A total of 750 m of upper semi-drilling was carried out at the entrance and exit of the Murovdag tunnel. Due to the winter conditions, maintenance of the roads, snow plowing and distribution of salt-sand mixture will be provided throughout the project.

3. "Kalbajar - Lachin" highway.

- Technical indicators: road - 72.3 km, "I-II" technical level, 2-3 lanes, tunnel - 9.8 km;

- Work done: the construction of the roadbed is 40% completed, mobilization work continues.

4. Construction of road infrastructure in Kalbajar and Lachin districts.

- Technical indicators: 30 km, technical grade "IV", two lanes.

- Work done: construction of roadbed and road wear is underway, construction of pipes is 95% completed, road signs are installed 85%.

5. "Horadiz - Jabrayil - Zangilan - Agband" highway.

- Technical indicators: 123.8 km, "I" technical grade, 4-6 lanes.

- Work done: Construction of a soil field is underway at 0-23 and 42-76 km. Earthworks were carried out by 25%, construction of pipes and crossings by 29%, construction of bridges by 25%.

6. "Khudaferin - Gubadli - Lachin" highway.

- Technical indicators: 70.4 km, "I" technical grade, four lanes.

- Work done: 0-37 km in the direction of Gubadli - Lachin, a field is built at 0-1 and 5-14 km in the direction of Khanlig, bridges are being built at 1, 11, 23, 33 and 39 km. Earthworks were carried out by 37%, road wear by 4%, construction of pipes and crossings by 37%, construction of bridges by 29%.

7. "Gubadli - Eyvazli" highway.

- Technical indicators: 26 km, "IV" technical grade, two lanes.

- Work done: Construction work is underway on the road to Eyvazli village in Gubadli region, destroying rocky soils. Work has been completed to expand the landfill to 8 km of the general road and bring it to the normative width.

8. Shukurbayli-Jabrayil-Hadrut highway.

- Technical indicators: 43 km, "I" technical grade, four lanes.

- Work done: Earthworks 53%, road wear 10%, construction of pipes and crossings 55%, construction of bridges 51%.

9. "Fuzuli - Hadrut" highway.

- Technical indicators: 13 km, "I" technical grade, four lanes.

- Work done: Construction of the roadbed is underway. Earthworks and construction of the roadbed in the first 8 km have been completed by 50%.

10. "Barda - Aghdam" highway.

- Technical indicators: 45 km, "I" technical grade, four lanes.

- Work done: earthworks by 45.9%, road wear by 9.8%, construction of pipes and crossings by 33.5%, construction of bridges by 84.9%.

11. "Talysh - Tapgaragoyunlu - Gashalti - Naftalan" highway.

- Technical indicators: 22 km, "II-IV" technical level, two lanes.

- Work done: In the first 1.8 km part of the road, the bottom layer of asphalt-concrete pavement was built, in 1.8-6 km and 12-22 km sections, pipes are installed, and the foundation is built.

It is proposed to design the 82 + 380 - 102 + 700 km section of the highway in a northerly direction, north of the currently designed route, bypassing the Minjivan settlement, in order to outflank the main road from the settlements and establish the route with a shorter distance. It should be noted that in accordance with the requirements of road design standards, highways should be designed outside settlements. There are several factors determining the effectiveness of the proposal which are stated below:

- the road will be shortened by about 8.9 km in total (due to the shortening of the route, the design of the tunnel on the new route can be provided to some extent).
- The intersection of the road with the existing road of national importance at the entrance of Jahangirbeyli village will be eliminated and more optimal slope of the road will be provided.
- Intersection of the road with the existing water channel at 3 locations will be eliminated.
- Security of Zangilan airport runway will be ensured.
- the road can be re-routed outside Minjivan settlement.
- The residential areas of Minjivan settlement can be used effectively.
- Spatial planning framework can be optimally formed.

It is planned to build new railway lines in 4 directions with a total length of 328.38 km in the liberated territories ("Barda-Agdam", "Horadiz-Agband", "Fuzuli-Shusha" and "Dalimammadli-Kalbajar" railway lines).

Couple of these, the Fuzuli-Shusha and Dalimammadli-Kalbajar railway lines, did not exist before the occupation and are being redesigned.

1. "Barda-Agdam" railway line:

- length 47.1 km.
- number of stations - 4 (Barda, Kocharli, Tazakend, Agdam).

The repair work is being carried out in two stages.

Phase I, in the direction of "Barda-Kocharli-Tazakend" (20.78 km). At present, the total physical completion of the first stage is 39%.

Phase II, on "Tazakend-Agdam" (26.32 km). In order to continue the construction work at this stage, the mine clearance process has not been completed, whereas research work has been completed on the identified route, and in general, 90% of the design work of the railway line and artificial facilities have been completed.

2. "Horadiz-Agband" railway line:

- length 110.4 km;
- number of stations - 8 (Horadiz, Marjanli, Mahmudlu, Soltanli, Gumlag, Minjivan, Bartaz, Agband).

The design and construction of the railway is planned in 3 stages.

1st stage: it is planned to build a 23 km railway line between the Horadiz-Marjanli-Mahmudlu locations with the existing route, and a new railway line from Mahmudlu to the 30th km. At this stage, the physical topographic plan of the area has been completed.

At present, a total of 53% of the earthworks on the first stage have been completed, the construction and installation of artificial facilities has been completed. Construction of 9 water pipes and 10 bridges is underway.

2nd stage: it is planned to build a new route from the 30th km through Soltanli and Gumlag stations to Minjivan station, and in the third stage at 85-110.4 km through Minjivan, Bartaz and Agband stations.

3. "Fuzuli-Shusha" railway line:

- length 82.8 km.
 - number of stations - 2.
- At present, research and design work of the route has been completed.

4. "Dalimammadli-Kalbajar" railway line:

- length 88.08 km.
 - number of stations - 2.
- At present, the research and design work of the route is being completed.

In addition, it is proposed to design the Zangilan-Lachin (Gorchu) and Agdam-Agjabadi railway lines with a total length of about 120 km.

The projected Dashkasan-Kalbajar railway and Togana-Kalbajar-Istisu-Minkend-Lachin highway will play an important role in the development of Kalbajar region. Another important proposal is the railway line from Agali Agilli village in Arazboy, planned for 2040, to Gorchu International Airport, which is being built after Lachin. The railway stations proposed in the existing important settlements along this line (Agali, Khanlig, Gulebird, Lachin, Pirjahan, Gorchu) will play a key role in the development of the surrounding areas, especially in Lachin, Gubadli, Zangilan districts. The proposed railway line will further strengthen ties with the remaining settlements within the coverage area of Zangilan and Gorchu airports. At the same time, the industrial and commercial activities of these settlements will be supported.

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TECHNICAL SCIENCES

ANALYSIS OF THE STATE AND PROSPECTS OF LTE TECHNOLOGY IN THE INTRODUCTION OF THE INTERNET OF THINGS

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Abstract

In the coming years, LTE technology will develop at the fastest pace and will probably be the main option for wireless data transmission of the Internet of Things (IoT) over cellular networks. With the development of 5G networks and the Internet of Things (IoT) of the fifth generation, many new services will appear for people and society as a whole, and the growth of the 5G technology network segment will contribute to business development in all sectors. Nb-IoT is a specification of the cellular standard, which is designed to service devices that generate small amounts of data. The technology is excellent for various meters, sensors, alarm systems, etc. This article is devoted to the analysis of the state and prospects of the application of LTE technology in the introduction of the Internet of Things.

Keywords: 4G, LTE, 5G, Internet of Things (IoT), Narrow-Band IoT, mobile network.

Introduction

4G is the fourth generation of mobile communications. The formal date for the emergence of 4G was 2008, when the International Telecommunication Union set standards for it. According to these standards, the connection speed for moving objects (smartphones, tablets) must be at least 100 Mbps, and for static (access points) - at least 1 Gbps.

Over the next few years, companies worked to bring these speeds closer. That's how LTE (Long Term EVolution) came about - a new communication standard that was originally positioned as an improved 3G.

However, the International Telecommunication Union has decided that the LTE standard can be described as 4G if it offers significant improvements over the previous generation of communications. Companies immediately began to advertise their connection as 4G LTE, using marketing tricks that allowed them to talk about the "new generation" and without reaching its standards.

The standard that can really be considered true 4G is called LTE Advanced (LTE-A). In 2012, it was officially recognized by the same International Telecommunication Union. LTE Advanced meets all the requirements of 4G, in particular, meets the speed.

However, it is important to note that communication in devices connected to LTE-A can only theoretically reach the required 100 Mbps and 1 Gbps, ie such speeds a smartphone with LTE-A can reach only in the laboratory.

According to the results of 2020, 4.5 billion connections in the global LTE networks are 57% of all mobile connections. By the end of this year, 4G networks will cover 80% of the world's population, and in 2026 - 95%. The demand for LTE will peak in 2021, when the number of connections will reach 4.8 billion, and then the demand for LTE services will begin to decline gradually and by the end of 2026 will be only 3.9 billion connections. The reason is obvious - the migration of subscribers to 5G technology.

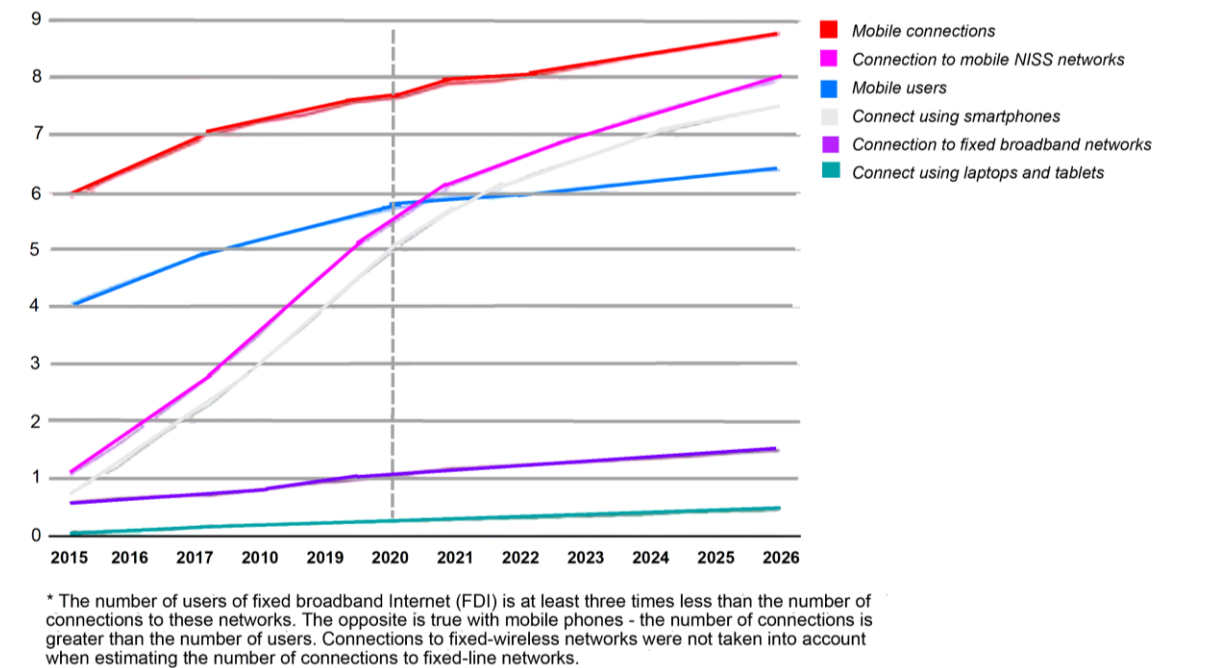


Fig.1. Connections and users (billion)

For the mobile market, 2020 has been the year of fifth generation (5G) technology - the number of commercial networks has exceeded 100, and by the end of the year in their coverage area will live 15% of the world's population. It is already clear that 5G will be the fastest growing technology, which will significantly

exceed the standards of previous generations. By the end of the year, operators will have 220 million 5G connections, and in 2026 - 3.5 billion. New scenarios are being created that use the key advantages of 5G technologies: low latency, high speed and reliable protection of transmitted data.

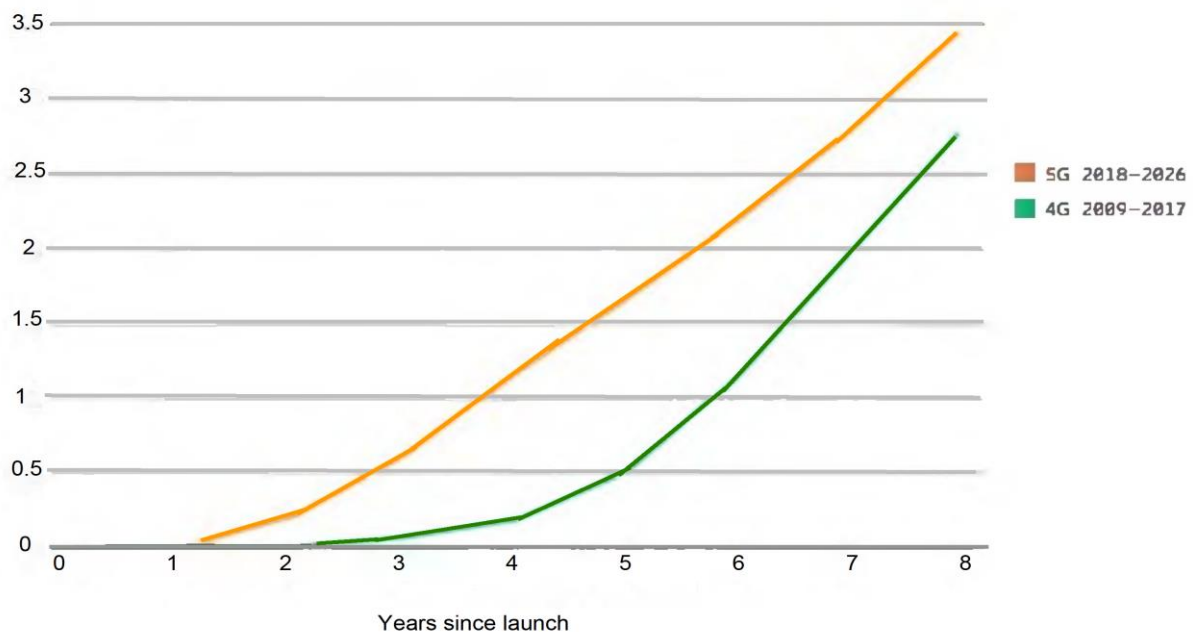


Fig.2. Dynamics of growth of connections in 5G and 4G networks during the first years (billion).
Source: Ericsson Mobility Report November 2020[1,2].

According to reputable research centers, in the coming years, LTE technology will develop at the fastest pace and will probably be the main option for wireless data transmission "Internet of Things" (IoT) over cellular networks.

With the development of 5G networks, usage scenarios based on critical Internet of Things (CriticalIoT) connections will become widespread. With the development of 5G networks and the Internet of Things (IoT)

of the fifth generation, many new services will appear for people and society as a whole, and the growth of the 5G technology network segment will contribute to business development in all sectors. Data transfer for a guaranteed period of time - for example, 50 milliseconds with a 99.9% guarantee - will be required for applications designed to control devices remotely, as well as for entertainment services.

Experts have identified [2] four types of promising scenarios for the use of 5G technologies, which require connection to a network with guaranteed data transmission time.

1. Real-time media technology - connections in which data transmission time plays a key role. They allow you to create industrial applications and cloud gaming services using augmented and virtual reality (AR / VR) technologies.

2. Remote control devices - a person remotely controls machines and equipment moving on land and air. People will no longer have to work in difficult climatic and dangerous conditions - instead they will control autonomous devices.

3. Industrial control - real-time monitoring and control functions will be used to control smart grids, and machine vision technology will be available for robots.

4. Mobile automation - automation of the cycle of control of vehicles and mobile works will provide safe maneuvering of many remotely controlled devices on one site.

Fifth generation networks will allow you to combine all the devices of a smart home into a single high-speed system. Counters, door locks, game and TV set-top boxes, climate control and security systems - all this can be connected via a mobile network to a single control device.

5G is able to combine the devices of an entire smart city. Traffic lights, surveillance cameras, bank terminals, parking meters, car navigators, rented vehicles (including unmanned) - smart devices in real time will exchange information with each other. Owners of gadgets connected to 5G will experience unprecedented freedom of interaction with each other. You will have almost instant access to cloud services, streaming video, multiplayer cloud games, augmented and virtual reality shopping, online remote collaboration and more.

With the development of the Internet of Things (IoT), the number of connections to mobile networks of operators will increase many times. According to Ericsson [4], by 2021 the total number of devices connected to the Internet in the world will be 28 billion, of which 1.5 billion will be consumer electronics and smart cars that interact with each other through mobile networks. In the coming years, the number of machine-to-machine (M2M) connections will grow by 25% per year, and most M2M devices available on the market will support the LTE standard. As the IoT market grows, it is becoming apparent that for many applications, existing mobile technologies are inadequate due to insufficient coverage, high cost of end terminals, and short life of their batteries.

An innovative solution for the Internet of Things - Narrow-Band IoT

Innovative Internet of Things technology is a Narrow-Band IoT (NB-IoT) solution. It is a wireless low-bandwidth version of the Low Power Wide Area (LPWA), which is primarily designed for inter-machine interoperability (M2M) applications. The NB-IoT standard will open up a wide range of new opportunities for companies specializing in telecommunications services. In particular, it will significantly increase the profitability of operators per subscriber (Average revenue per user, ARPU). NB-IoT technology will occupy its low-speed niche in the class of solutions, where the priority is uninterrupted data transmission and low power consumption.

In early 2020, Vodafone Ukraine launched the Nb-IoT network, which is a dedicated frequency channel for IoT equipment in the existing LTE network [5].

Nb-IoT is a specification of the cellular standard, which is designed to service devices that generate small amounts of data. The technology is perfect for various meters, sensors, alarm systems, etc.

In terms of its physical structure and architecture, the Nb-IoT network inherited almost everything from LTE, so building an Internet of Things infrastructure requires nothing more than updating software on existing base stations. Due to the simplicity of the system, operators can provide low rates for customers of the Internet of Things.

The main characteristics of Nb-IoT

- Sufficient bandwidth for most IoT devices.
- You can exchange objects spaced in time.
- Ability to work in more remote areas than 4G on the same frequency.
- Noise resistance.
- Incredibly low power consumption (sensors can "live" from one battery for about 10 years).
- Reduced CPU requirements.

To understand how these properties are achieved, it is necessary to delve a little deeper into the technical component of the network.

Nb-IoT is based on LTE. In simple terms, the 4G band consists of separate channels (subcarriers) of 15 kHz. The carrier in LTE is divided into resource blocks (RB), each of which consists of 12 subcarriers of 15 kHz. A total of 180 kHz is obtained. Each resource block includes 84 resource elements (12 by 7 grid). The 5 MHz band, which can run LTE, includes 25 resource blocks.

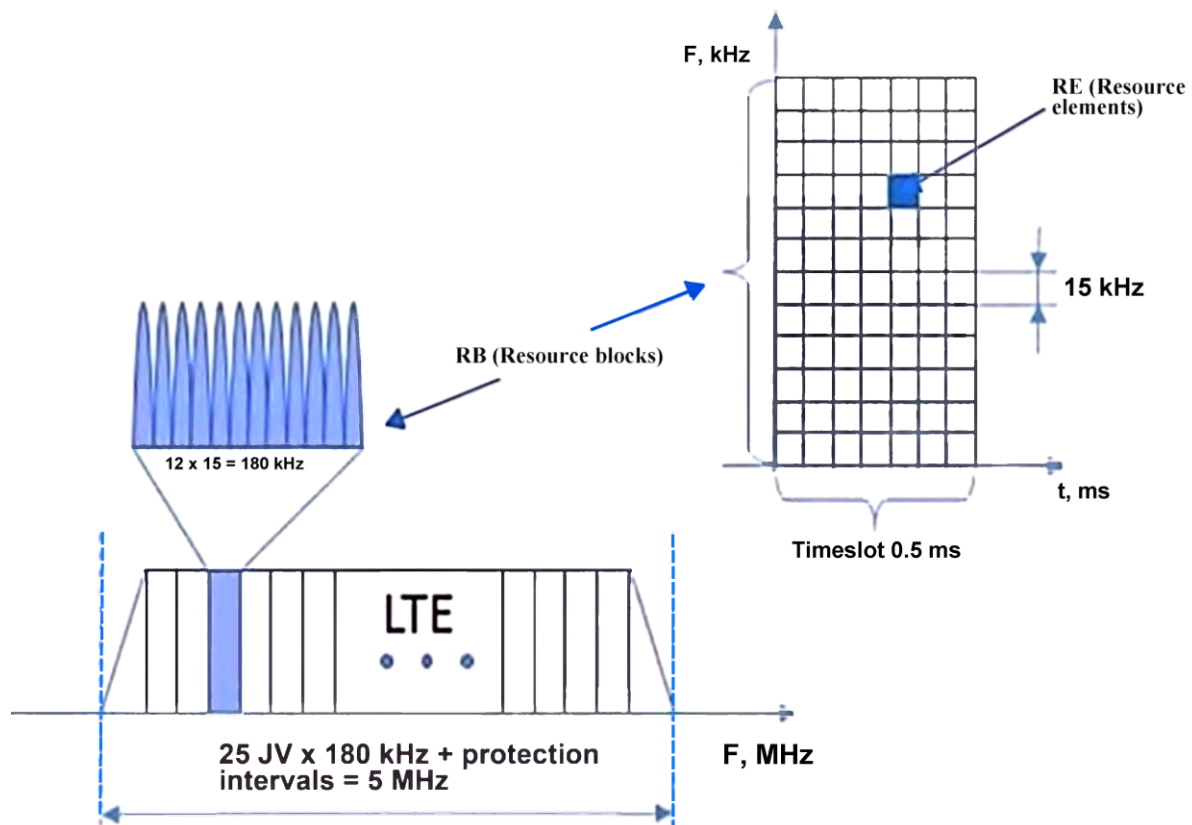


Fig. 3. Component of the Nb-IoT network

Only one 180 kHz resource unit is used to run Nb-IoT. For signal range it is amplified by 6 dB. This explains why the Internet of Things has a wider coverage than LTE, although the frequency used is the same.

Network startup can be done in three ways:

1. on a dedicated 200 kHz channel, which also includes a protection spectrum of 300-600 kHz to avoid interference. This method is not relevant for Ukraine, as the frequency resource is not enough, plus you need more costs;

2. on the guard band: each band on which the operators deploy the communication has a guard interval of 500 kHz on each side. This option is suitable if you want to save frequency resource and reduce the mutual impact on the LTE network;

3. inside the strip (relevant for Ukraine).

Nb-IoT technology is considered to be the transition to the fifth generation of communication

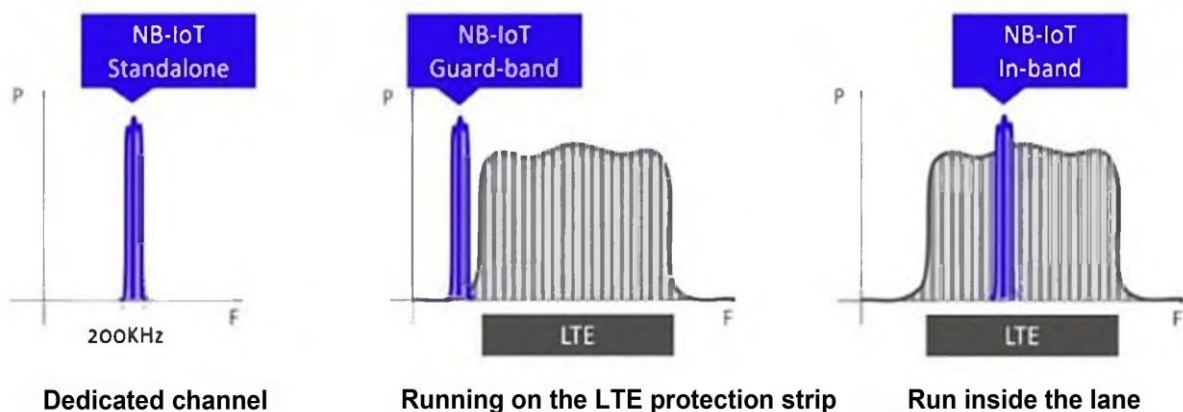


Fig. 4. Ways to lowering Nb-IoT network

Maximum speeds in the Nb-IoT network

For different sensors, the speed does not matter much: the stability of the connection is much more important. It is worth noting that one device can not occupy all available radio resources, so customers do not have problems with the connection.

The data transfer rate in Nb-IoT reaches 58.8 Kbps. There are solutions that can increase this value to a maximum of 100 Kbps.

Data transmission on the 15 kHz subcarrier allows to increase the spectral density of the signal, thereby reducing the signal-to-noise ratio. Noise reduction is especially important for IoT devices because they have weak transmitters.

Features of energy consumption in the Nb-IoT network

Low energy consumption is achieved not only due to low data rates, but also by reducing the number of energy-intensive registration procedures in the network. When turned on, each device communicates with the base station, "agrees" on the mode of operation and then "falls asleep". In case of awakening, the data can be transferred immediately. In sleep mode, the base station is a gateway and accumulates information for the end device. This reduces the time on the radio. It is important to note that for such work the equipment must be at one point. Moving the device forces each time to "discuss" with the base station such parameters as power, sensitivity, etc.

Conclusions

A study by the World Bank and the Swedish School of Economics on the impact of broadband access on the economy shows that with a 10% increase in Broadband penetration, the economy gains an additional 1-2% of GDP. This applies to developed countries. For developing economies, as in Ukraine, the impact is even greater. Society will strive to automate everyday tasks. The pandemic has shown that migration to digital technologies will accelerate. One example of the

impact of the mobile Internet on people's lives is the 2020 quarantine.

Internet of Things (IoT) -based technologies will be the most promising. Industrial IoT solutions allow more efficient use of enterprise resources and minimize production losses. Experience shows that thanks to this technology companies can save 17-20% of operating costs [6]. Businesses don't have to wait for 5G to start implementing new technologies. 4G and other communication standards in Ukraine are already successfully meeting most of the needs of large, small and medium enterprises.

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