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SOME PROBLEMS ON ENHANCING THE EFFICIENCY OF WATER UTILIZATION IN A CLIMATE CHANGE IN THE REPUBLICS OF ARMENIA AND ARTSAKH

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Abstract

The 6th of the UN Sustainable Development Goals refers to water under a heading «Clean Water - Sanitation». The goal is set by 2030 to ensure safe and equal access to drinking water for everyone in the world, to improve water quality by reducing pollution, to eliminate hazardous chemicals and to halve the discharge of untreated wastewater into water reservoirs, to increase the amount of wastewater recycling and reuse. The implementation of water supply based on the principles of sustainable development will increase the efficiency of water utilization and solve the problem of sustainable water supply in conditions of water scarcity, will carry out comprehensive management of water resources at all levels including through cross-border cooperation. Expanding of international cooperation will support water supply and sanitation projects (water intake, land desalination, water conservation, drinking water treatment, wastewater treatment including water treatment, development and application of reusable technologies, etc.). The present article refers to the identification of a number of problems in increasing the efficiency of utilization of water resources and community involvement in water supply and sanitation management in Armenia and Artsakh in the context of global climate change.

Key words: water, water intake, water saving, sustainable development, aquatic ecosystem, water pollution, wastewater treatment.

Introduction

197 countries adopted the Paris Agreement (Paris Declaration) at the 2015 UN Summit in Paris on December 12, 2015 to fight climate change and its negative effects. The agreement, which came into force a year later, aims to significantly reduce global greenhouse gas emissions and to limit rising temperatures to 2^0C by the end of this century. Global climate change makes the reproduction of freshwater resources more vulnerable. Climate change is an urgent global challenge that transcends national borders. This challenge requires coordinated decision-making at all levels and international cooperation. UN 2015 Article 7 (7) (c) of the Paris Summit Declaration stipulates that the deepening of climate knowledge, as well as the monitoring of climate change and the introduction of an early forecasting system is a necessary precondition for the creation of an appropriate information system that will facilitate the process of decision-making [1].

Article 8, Clause 1 of the Paris Declaration states that the Parties shall apply the solutions imposed by the situation and warnings of possible harmful effects of climate change, including

extreme weather events and slow-moving natural processes. They should be aimed at ensuring sustainable development reducing the risks of loss and damage.

It is necessary to activate the actions, in particular, in the following directions:

a) introduction of rapid response systems;

b) preparedness for possible emergencies;

c) monitoring of slow processes;

d) risk management, development and implementation of measures to prevent the development of phenomena that pose a risk of irreversible consequences and large losses;

e) ensuring access to information on global climate change.

Article 12 of the Paris Declaration envisages intensification of cooperation between the parties in the field of education. In this regard, we propose to include relevant new subjects in technology-oriented secondary and higher educational institutions.

At the 2019 Madrid Conference, the parties to the Paris Declaration managed to integrate approaches to the prevention or reduction of losses and the elimination of damage and the mobilization of available resources [2, Clauses 17, 30, 34]. At the same conference, the parties underlined the need of intensifying measures related to the slow-moving processes and non-economic losses [2, Clause 24]. According to the UN Climate Change Mechanism in Warsaw, these problems can only be solved by achieving a synergistic effect [3, point 11].

In September 2015 the UN 2030 Sustainable Development Agenda set 17 goals consisting of 169 targets. Objectives include basic issues of effective management of the environment including water resources. Countries are expected to consolidate their efforts to eradicate poverty in all its forms, to fight inequality and to address climate change challenges while pursuing the motto “no one should be ignored”.

The Government of the Republic of Armenia has established the Council for Sustainable Development Goals to define the priorities and directions for nationalization of the UN Sustainable Development Goals in the country, to fix them in the national strategic programs and to ensure systemization and monitoring of comprehensive implementation of the Sustainable Development Goals by 2030 [4].

Water and sanitation are focused upon the sustainable development. Safe drinking water and wastewater disposal, as well as personal hygiene are the cornerstones of human health and well-being. In addition to household use, water is required for food, energy production and industry. These are highly interrelated and potentially conflicting uses. Water consumption results in wastewater, which, if not properly treated, can lead to pollution. Water provides universal flexibility during anthropogenic and natural changes. The climate system is linked to nature and the socio-economic system by water and as a result of climatic changes there often occur deviations in water availability - water scarcity in some areas and flooding in others. Consequently, water is one of the main risk management factors for women, epidemics, migration, inequality, political instability and natural disasters. Comprehensive water management is irreplaceable for both synergy strengthening and managing possible trade and economic relations which will ensure that everyone has access to water and sanitation [5].

Despite significant progress in improving access to safe drinking water, billions of people, mostly in rural areas still suffer from the lack of stable water supply.

One of three people in the world today do not have access to safe drinking water, and sixty percent do not receive sustainable sanitation. According to the United Nations about 890 million people continue practicing open defecation.

In 80 per cent of households, women are responsible for collecting water in the absence of a stable water supply.

Water scarcity is an urgent problem for more than 40 per cent of the world's population. There are all preconditions that the situation will go from bad to worse. Currently 1,7 billion people live in river basins where the demand for water significantly exceeds its self-cleaning capacity. More than 80 percent of the world's wastewater is discharged into rivers or seas without treatment.

COVID-19 epidemic has become imperative to ensure a stable supply of sanitation, hygiene and clean drinking water. Regular hand washing is one of the most effective steps a person can take to reduce the spread of pathogens and prevent infections.

Conflict setting

Taking into consideration that effects of global climate change include, among other things, a significant reduction in freshwater amounts in the near future and as a result a sharp increase in water prices in the international market, Armenia and Artsakh can set a long-term aim to become one of main exporters of drinking water.

Research results

The management of water resources cannot be done properly without paying attention to water quality. In particular, a link should be established between planning and management of water resources, processes of water utilization and water pollution bench mark.

The main steps in establishing an effective monitoring system of water pollution are:

- Detection of water pollution and preliminary analysis of related problems, including identification and classification of problems and determination of primary problems.
- Definition of a long-term management and short-term goals, including assessment of existing capacities, determination of necessary measures as a part of the management process and definition of realistic short-term, mid-term and long-term goals.
- Defining and implementing the necessary measures, levers and mechanisms for effective water management including planning legal reforms, making necessary changes to existing legal documents; implementation of legal acts, development of a monitoring system, definition of measures, training of bodies involved in the process, definition and implementation of exchange of information and mechanisms of dissemination.

Mechanisms of pollution control have been developed in almost all countries of the world to ensure the protection of the environment, in particular, water resources. According to such mechanisms, companies are obliged to comply with the mandatory environmental standards set by the legal acts of the country, as well as to develop and implement environmental monitoring programs if necessary. Companies carrying out polluting activities are also obliged to comply with the norms set out by international agreements and protocols.

Together with setting of pollution-limiting regulations it is important to develop mechanisms that encourage pollution reduction for the development of the economy which will allow the sustainable use of natural resources including water. The use of such levers provides a number of decisive advantages.

In particular, they force companies to refrain from making investments into environmentally harmful production. Pollution control mechanisms encourage companies to explore, localize and implement technologies that can prevent or reduce pollution as well as apply methods that use natural resources wisely and efficiently.

The use of pollution charge as a control mechanism is often conditioned by the institutional and administrative capacities of the existing system in the country. In other words, you can either invest in a separate type of payment or combine it with another, already existing payment. Obviously, using the

second option can simplify the process of collecting pollution pays.

At present, in order to reduce the level of pollution of water resources, a number of pollution control mechanisms are used worldwide which are related to the principle of "polluter pays". According to it, the polluter must reimburse the costs of cleaning up his emissions, pay fines and penalties in case of pollution, violation of environmental standards, as well as the damage caused by the pollution and elimination of its consequences. There is also a second principle – "the user pays" according to which the users of services must pay the costs of using the natural resources used to receive the product and for their further recovery. In providing pollution control the most applicable mechanisms to be introduced are [6]:

- **Water pollution payment** is calculated based on the amount of pollutants emitted by companies into the environment. Moreover, the amount of payment depends on the number of units of each pollutant emitted into the environment. Moreover, the amount of payment may differ depending on the hazards of the pollutants, the place of discharge and the properties of the pollutants. The variety of pollution sources and their large number make the calculation of the payment for water pollution and its use almost impossible for many materials, which is conditioned by the limited resources required for the organization of monitoring and control. The best pollution payment scheme includes a simple, straightforward calculation approach and is applied for a limited number of pollutants.
- **Fines for violating the standards** are levied on companies if the level of pollution caused by them exceeds the values set by the relevant regulations or permits. Moreover, in order to ensure the efficiency of this mechanism, it is necessary to meet the following conditions:
  - ✓ fines should be set at a fairly high value level which will force polluters to actually meet requirements of standards, rather than just pay the appropriate fine,
  - ✓ the amount of the fine should depend on the extent of exceeding the permitted level of pollution and the frequency of such violations,
  - ✓ the monitoring system of the supervising authority should be sufficiently reliable and efficient to detect violations of the standards in a timely manner.
- **Enforcement of targeted commitments** enables companies to create and introduce a system of environmental protection. Experience has shown that companies which pollute environment tend to reduce their harmful emissions by monitoring their polluting activities if they are clearly aware of the significant amounts of the fine to be paid in case they cause damage to the environment. In case of application of obligations, the field is regulated by the judicial system, and the obligation enters into force after recording the fact of damage caused to the environment. At the same time, it should be noted that the target commitments are difficult to realize in practice, as the polluting company may not have sufficient financial resources to pay the court-ordered liabilities at the time of the damage assessment, or may choose the suspension of its activities. Moreover, in order to ensure the efficiency of this mechanism, the following conditions must be met:
  - ✓ the charge for the damage caused to the environment should be set so high as to oblige the polluting company to comply with the requirements of the established standards in the future,
  - ✓ the fee should depend on the size of damage done to nature,
  - ✓ the information system of the supervising body must be sufficiently reliable and efficient to detect, measure and assess the damage caused on the environment,
  - ✓ citizens and self-governing bodies need to be informed about their rights in the sphere of nature preservation.

- **Guarantees of fulfillment of contractual obligations** are given to the supervisory or regulatory body prior to such an activity carried out by a company that may result in potential pollution. Guarantee payments are refunded to the company upon completion of the project if the regulatory body confirms compliance with the accepted environmental standards. If the company does not comply with environmental standards, the guarantee amount is retained and used to implement measures to eliminate pollution caused by the company.

Sources of water pollution are various. One of the most dangerous sources of water pollution is mining industry which has a negative impact on the whole environment, changes the qualitative composition of air (dust), water and soil. The Subsoil Law aims to ensure that mining waste is properly managed to avoid damaging the environment. It contains provisions on mining waste, which require the miner to ensure the processing, assessment, neutralization and reduction of mining waste while maintaining the norms and rules of waste collection, transportation, storage, processing and burial.

Heavy metal Contamination of soil is a serious health concern in recent years. Heavy metals from mining waste contaminate drinking water, soil, fodder and food. They negatively affect the characteristics of the soil, leading to the limitation of its productive and vital functions. The inclusion of heavy metals in the main group of environmental pollutants is conditioned by their stability and biological accumulation capacity. Their accumulation leads to the emergence of toxic effects on ecological systems that are already clearly visible.

Wastes such as acid mine drainage have a significant harmful effect on water composition. Metal waste promotes the penetration of metallic materials into large waterways, dams, spreads through food chains, appears in hazardous quantities in food and affects the biodiversity of ecosystems.

Of major mining wastes are tailings, waste materials left after the target mineral is extracted from ore. They consist of crushed rock, water, trace quantities of metals and additives used in processing. To store mining wastes conventional tailings dams are built.

The waste technical profile is performed during the Environmental Impact Assessment (EIA) prior to final approval of the project. Structures such as landfills and tailings dams should be planned, designed and operated in such a way that geotechnical risks and environmental impacts are properly assessed and managed throughout mining operations and after mine closure. The subsoil company should develop a monitoring program, subsoil waste management and recycling plan.

In this regard, it is necessary to study the impact of the Kashen mining complex on the surrounding aquatic environment. This problem can be solved by using the method of calculating the filtration in the homogeneous soil dam body of the tailings dam proposed by L.V.Tokmajyan [7]. There are cases of inflow of groundwater contaminated as a result of the penetration of fertilizers, pesticides, domestic and industrial wastewater into the reservoir.

The width of the infiltration area can be determined by considering the general case of the filtration process, when there is a h_o deep water flow on the opposite side of the reservoir slope (Fig. 1).

The depth in reservoir varies with respect to Eq.(1).

$$h(\tau) = B_1 - B_2 \cos 2\pi\tau\,, \tag{1}$$

where $B_1 = \frac{h_{\max} + h_{\min}}{2}$, $B_2 = \frac{h_{\max} - h_{\min}}{2}$, $\tau = \frac{t}{T}$, $h_{\max}$ is the maximum water depth in the reservoir, $h_{\min}$ is the depth corresponding to the dead volume of the reservoir, t is the time variable, and T is

the observed total time.

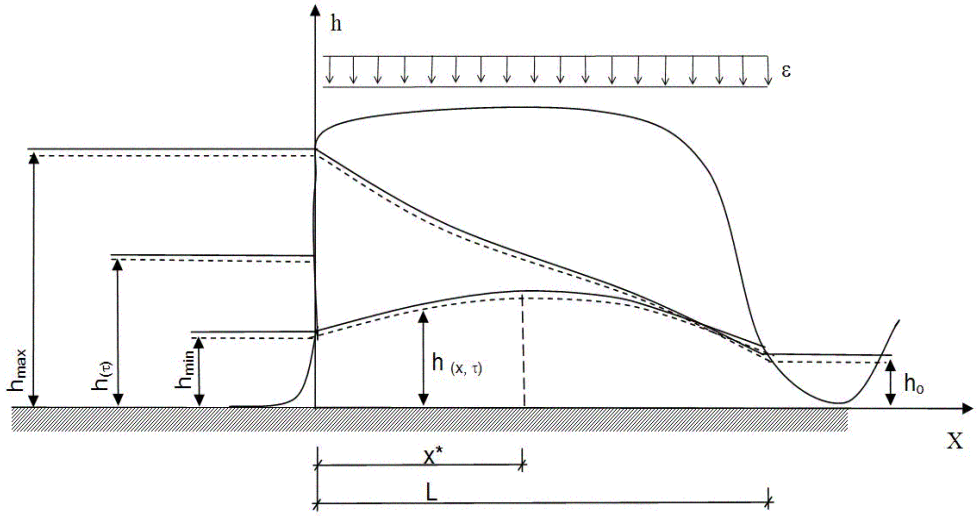

Fig. 1 Filtration through the reservoir homogeneous body

$$\bar{h}(\bar{x},\tau)=(1-\bar{x})\bar{h}(\tau)+\bar{h}_0(x)+v_1(\bar{x},\tau)+v_2(\bar{x},\tau) \quad (0\le\bar{x}\le 1,\ 0\le\tau\le 1), \tag{2}$$

where

$$\bar{x}=\frac{x}{L},\bar{h}(\bar{x},\tau)=h(\bar{x}L,\tau)/L,\bar{h}(\tau)=h(\tau)/L,\bar{g}(\bar{x})=g(\bar{x}L)/L,\bar{h}_0=h_0/h,\overline{h_+}=h_{\max}/L,\overline{h_-}=h_{\min}/L,$$

$$B_1=B_1/L=(\overline{h_+}+\overline{h_-})/2,\overline{B_2}=B_2/L=(\overline{h_+}-\overline{h_-})/2,\bar{p}^2=aT/L^2,\bar{f}=\varepsilon T/\mu L,$$

$0\le\bar{x}\le 1, 0\le\tau\le 1$:

$v_1(\bar{x},\tau)$ ..... $v_2(\bar{x},\tau)$ functions are determined by the following formulas.

$$v_1(\bar{x},\tau)=\frac{8\bar{\varepsilon}}{\pi^3}\sum_{n=1}^{\infty}\frac{\sin[\pi(2n-1)\bar{x}]}{(2n-1)^3}e^{-\pi^2(2n-1)^2\bar{p}^2\tau} \quad (0\le\bar{x}\le 1,\ 0\le\tau\le 1): \tag{3}$$

$$v_2(\bar{x},\tau)=\frac{4\bar{f}}{\pi^3\bar{p}^2}\sum_{n=1}^{\infty}\frac{1-e^{-\pi^2(2n-1)\bar{p}^2\tau}}{(2n-1)^3}\sin[\pi(2n-1)\bar{x}]-\frac{8\bar{B}_2}{\pi}\sum_{n=1}^{\infty}\frac{\sin(\pi n\bar{x})}{n(4+\pi^2\bar{p}^2n^4)}\{e^{-\pi^2n^2\bar{p}^2\tau}+$$

$$+\frac{1}{2}[\pi\bar{p}^2n^2\sin(2\pi\tau)-2\cos(2\pi\tau)]\}$$

$$(0\le\bar{x}\le 1,\ 0\le\tau\le 1): \tag{4}$$

In this regard, it is necessary to study the impact of the Kashen mining complex on the water quality of the Tartar, including the Sarsang Reservoir built on it. Water quality can be determined by taking into account the above mentioned method changing the boundary conditions depending on the operating mode of the complex.

German geologists have studied the temperatures and pressure conditions of the formation of secondary quartzite in the Kashen deposit. Their findings show that the secondary quartzite are formed at a pressure of 110–200 bar and at a temperature of – 150–200^{0}C, i.e. in the sub-volcanic fascia. These thermodynamic parameters do not correspond to the secondary quartzite formed in the near-contact zone of granite intrusive masses of the hypabyssal fascia. Well known in Armenia masses of well-known Paleogene (pyrite quartzite of Hatsavan, Uranium-bearing quartzite of Lernadzor) and Neogene quartzites (Sulfur opalite's quartzites) are isolated from Upper Eocene-Oligocene intrusions. They are spatially associated with basaltic-andesitic volcanic formations of the Middle Eocene and Upper Miocene.

The secondary quartzite of Kashen mineral field are composed of the following minerals: quartz, sericite, kaolin, rutile, pyrite, chalcopyrite, also in the oxidized zone - iron hydroxides (geotite, limonite), oxides (hematite), minerals of propylene volcanic rocks (chlorite, celadonite) and relicts of primary rocks (plagioclase, amphibole, idiomorphic porphyry quartz) (Fig. 2) [8].

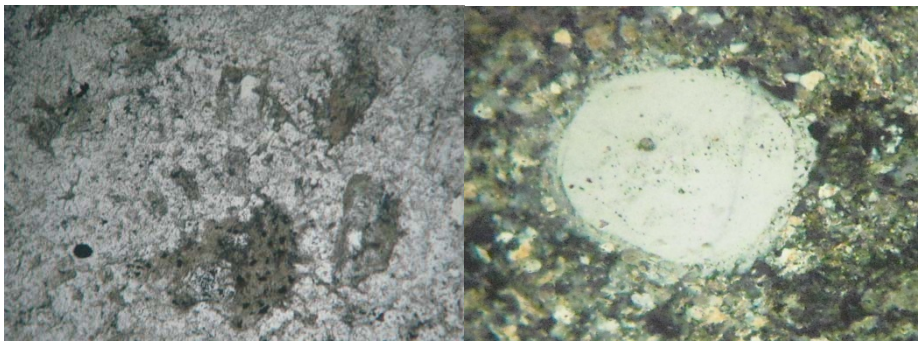

Fig. 2 Sericite quartzite-like metasomatitis

On the right, in the quartz sericite base, aggregates of chlorite from propylite with small pyrite particles are preserved. Without analyzer, d = 4.88 mm, slice 3.

On the left: Quartz relic idiomarphic phenocrystal in metasomatic rocks. With analyzer, d = 4.88 mm, slice 1.

When discussing water management issues, it should be borne in mind that significant climate change already exists in Artsakh [9]. In Stepanakert (capital of Artskh Republic), in particular, the average annual temperature rise over the last 50 years has been 1.3^0C (Fig. 3).

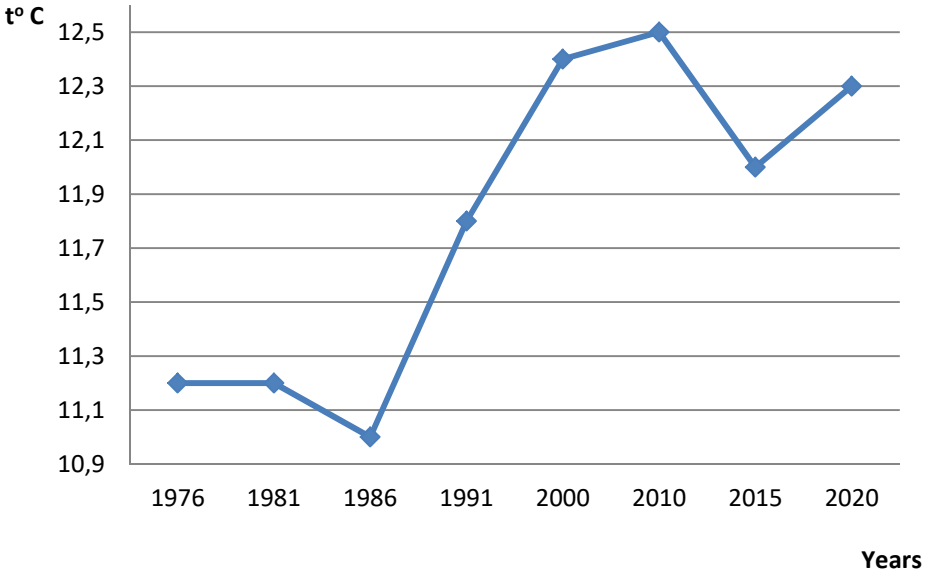

Fig. 3 Dynamics of temperature change in average annual indicators in Stepanakert

During the same period, the average monthly temperature rise in Stepanakert reached 3.2^0C (Fig. 4).

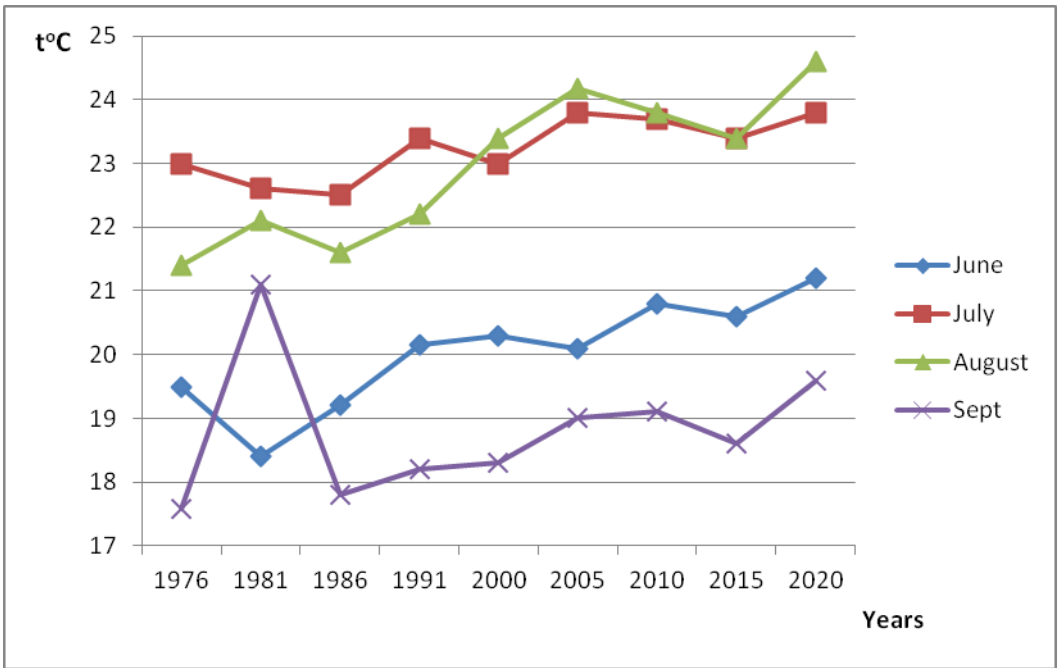

Fig. 4 Dynamics of annual change of average monthly temperature in Stepanakert

In order to increase the safety and efficiency of the use of state-owned water systems of the Republic of Artsakh, to implement a policy in the field of water systems and to ensure the implementation of the national water program, it is necessary to establish an authorized body for water systems management which should be reserved [10].

- Management of state-owned water systems;
- Organization of irrigation and drinking water supply and drainage.
- Ensuring the implementation of redistribution of works of water resources.
- Organizing the development and expertise of investment programs in the field of water systems development;
- Development of programs aimed at increasing the efficiency of water systems management and implementation,
- Providing preliminary examination of design documents for the construction of objects affecting water systems and reconstruction works of submitting proposals.
- Safety regulation of the use of hydraulic structures and control.
- Supervision of work organization in non-competitive water supply systems.
- Ensuring the implementation of water systems inspection activities.
- Carrying out analyses in the field of water systems and monitoring.

Functions of management of water resources should be delegated to another authorized body. Tariff policy in the water sector should be implemented by an independent regulatory commission.

Utilizing the opportunities of Lake Sevan can be a crucial step in becoming a donor of drinking water in the region. For this purpose, it is necessary to raise the level of the lake to the level of the first half of the XX century which is substantiated by H.V. Tokmayan and T.S. Martirosyan [11].

Conclusion

When carrying out management of water resources and water systems in Armenia and Artsakh, it is necessary to be guided by the principles of sustainable development, taking into account that in a

climate change, the scale of fresh water scarcity will increase sharply in the near future, as for the price of fresh water it may jump dozens of times in the international market.

Desalination of ocean and sea water, basically – turning ocean or sea water into drinking fresh water is not only economically inefficient but also unpromising in terms of quality; it cannot be used for drinking in the long run. Therefore, measures to protect freshwater from pollution and depletion are now gaining special importance. Countries that can become exporters of freshwater will have real opportunities for development. In this regard, despite the fact that the water resources of Armenia and Artsakh have largely come under the control of the neighboring country, there are still serious opportunities to become one of the main players in the export of drinking water in the region. Necessary but not sufficient conditions to solve this problem are:

1. Development and implementation of measures designed to enhancing the efficiency of utilization of water resources including the identification and implementation of new methods for water conservation.
2. Implementation of an active and effective policy in the field of water under international law.
3. Protection water resources from pollution and depletion.
4. Implementation of water collection programs, including the construction of small reservoirs.
5. Utilization of Lake Sevan exclusively as a source of drinking water by raising the lake level to 1915.57 m.
6. Improvement of water legislation.
7. Ensuring safe operation of water systems.

The main risks to achieve this goal are:

1. Blocking the flow of water in the neighboring countries to Armenia and Artsakh for political purposes, including the implementation of economically inefficient and very expensive programs. The implementation of such programs in Turkey is currently estimated at more than $ 22 billion. In particular, after the construction of the Kars Reservoir is completed, the cross-border Akhuryan River will be deprived of the inflow from Turkey and we must also return to the neighboring state 50 per cent of Armenia's inflow according to the norms of international law. A possible problem for Artsakh could be the possible actions of our neighbors to direct the waters of the Tartar River to Azerbaijan.
2. Water pollution, including poisoning.
3. Maintaining high rates of water loss.
4. Irregular use of groundwater, especially for fisheries.
5. Implementing the wrong pricing policy for drinking water and irrigation.
6. Inefficient management of water systems and operation.
7. Carrying out subversive actions against water systems.

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ՀԱՅԱՍՏԱՆԻ ԵՎ ԱՐՑԱԽԻ ՀԱՆՐԱՊԵՏՈՒԹՅՈՒՆՆԵՐՈՒՄ ՋՐԱՅԻՆ ՌԵՍՈՒՐՍՆԵՐԻ ՕԳՏԱԳՈՐԾՄԱՆ ԱՐԴՅՈՒՆԱՎԵՏՈՒԹՅԱՆ ԲԱՐՁՐԱՑՄԱՆ ՄԻ ՔԱՆԻ ԽՆԴԻՐ ԿԼԻՄԱՅԻ ԳԼՈԲԱԼ ՓՈՓՈԽՈՒԹՅԱՆ ՊԱՅՄԱՆՆԵՐՈՒՄ

Է.Վ. Ավանեսյան
Շուշիի տեխնոլոգիական համալսարան

ՄԱԿ-ի կայուն զարգացման նպատակներից վեցերորդը վերաբերում է ջրին և ունի «Մաքուր ջուր և սանիտարական պայմաններ» անվանումը: Նպատակ է դրվում մինչև 2030թ. աշխարհում բոլորի համար ապահովել խմելու ջրի անվտանգ և հավասար հասանելիություն, բարելավել ջրի որակը՝ կրճատելով աղտոտումը, վերացնելով վտանգավոր քիմիկատներ և կիսով չափ կրճատել չմաքրվող կեղտաջրերի ջրային օբյեկտներ արտանետելը, մեծացնել կեղտաջրերի վերամշակման և բազմակի օգտագործման ծավալները: Ջրառ իրականացնել՝ ելնելով կայուն զարգացման սկզբունքներից, բարձրացնել ջրօգտագործման արդյունավետությունը, սակավաջրության պայմաններում լուծել կայուն ջրամատակարարման խնդիրը: Բոլոր մակարդակներում իրականացնել ջրային ռեսուրսների համապարփակ կառավարում, այդ թվում՝ անդրսահմանային գործակցության միջոցով: Պաշտպանել և վերականգնել ջրաէկոհամակարգերը: Ընդլայնել միջազգային գործակցությունը ուղղված օժանդակությունը ջրամատակարարման և ջրահեռացմանն առնչվող ծրագրերում (ջրառ, հողերի աղազերծում, ջրի խնայողություն, խմելու ջրի և կեղտաջրերի մաքրում, այդ թվում՝ ջրի մաքրման և բազմակի օգտագործման տեխնոլոգիաների մշակում և կիրառում, այլ): Ավելացնել համայնքների մասնակցությունը ջրամատակարարման և ջրահեռացման կառավարման բարելավման գործընթացներին: Հայաստանի և Արցախի Հանրապետություններում, կլիմայի գլոբալ փոփոխությունների պայմաններում, ջրային ռեսուրսների օգտագործման արդյունավետության բարձրացման մի շարք խնդիրների բացահայտմանն է վերաբերում ներկայավող հոդվածը:

Բանալի բառեր. ջուր, ջրառ, ջրի խնայողություն, կայուն զարգացում, ջրաէկոհամակարգ, ջրերի աղտոտում, կեղտաջրերի մաքրում:

НЕКОТОРЫЕ ПРОБЛЕМЫ ПОВЫШЕНИЯ ЭФФЕКТИВНОСТИ ИСПОЛЬЗОВАНИЯ ВОДНЫХ РЕСУРСОВ В РЕСПУБЛИКАХ АРМЕНИЯ И АРЦАХ В УСЛОВИЯХ ГЛОБАЛЬНОГО ИЗМЕНЕНИЯ КЛИМАТА

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Шестая из целей устойчивого развития ООН относится к воде и имеет название "Чистая вода и санитария".

Поставлена цель, к 2030 году для всех людей во всем мире обеспечить: безопасный и равный доступ к питьевой воде; улучшить качество воды; уменьшить ее загрязнение, уничтожить опасные химические вещества и сократить наполовину сброс неочищенных сточных вод в водные объекты; увеличить объемы переработки и многократного использования сточных вод; осуществлять водозабор, исходя из принципов устойчивого развития; повысить эффективность водопользования; решить проблему стабильного водоснабжения в условиях дефицита воды; осуществлять комплексное управление водными ресурсами на всех уровнях, в том числе посредством трансграничного сотрудничества; защищать и восстанавливать водные экосистемы; расширять международное сотрудничество, направленное на содействие в проектах водоснабжения и водоотведения (водзабор воды, рассоление почвы, очистка питьевой воды и сточных вод, в том числе разработка и применение технологий очистки воды и многократного использования и т.д.); расширить участие общин в процессах улучшения управления водоснабжением и водоотведением.

В статье делается попытка выявить ряд проблем повышения эффективности использования водных ресурсов в республиках Армения и Арцах в условиях глобального изменения климата.

***Ключевые слова*:** вода, водозабор, водосбережение, устойчивое развитие, водная экосистема, загрязнение воды, очистка сточных вод.

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THE IMPACT OF FERTILIZATION PERIODS ON SOME ANATOMIC AND MORPHOLOGICAL CHARACTERISTICS AND YIELD OF WINTER WHEAT

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Abstract

The impact of fertilization periods on anatomic – morphological characteristics of drought resistance directly depends on the specific conditions of plant nutrition and water supply during the ontogeny period in conditions of the post-forest brown, gravel and carbonated medium-strength soil of the foothills of the Artsakh Republic where the average annual air temperature is 11ºC, the long-term average atmospheric precipitation is 490-550mm and the humus content in the soil is 3,5-4%.

Experimental research has revealed the positive effect of phosphorus-potassium fertilizers applied to the soil before sowing on the development of xerophytic traits in crop plants that provide frost and drought resistance and vice versa, the application of phosphorus-potassium fertilizers along with nitrogen fertilizer has negative impact, it reduces plant resistance to unfavorable external conditions and causes low yields of winter wheat. At the same time, it was found that phosphorus-potassium fertilizers applied before winter wheat, and nitrogen fertilizer when applied to the soil in the spring, provide a balanced ratio of mineral nutrition, development of xerophytic properties and high yield under high atmospheric factors.

***Key words**:* fertilization period, anatomic properties of a leaf, stem and root, xerophytic properties, draft resistance, yield.

Introduction

It is known that drought resistance, in addition to being a special and varietal property of plants, also depends on the conditions of the external environment in which the individual development of the organism takes place. In general, there are a number of ways to fight drought. Among these measures are agro-technical measures which ultimately contribute to the accumulation of moisture in the soil and its efficient use by plants. There is a correlation between drought resistance, winter resistance and morphological features in plants. The peculiarity of these features is better expressed in the leaves. One of the characteristic features of xeromorphs of leaves is the high ratio of volume to the surface. Such leaves are small and thick. This feature is related to such internal features as the large thickness of the mesophyll, the strong, well-developed columnar tissue relative to the spongy tissue, the small volume of the intercellular spaces, the tightness of the nerve system, the high density of the stomas and sometimes the microcellularity.

The dryness of the soil and air, strong light, the lack of nitrogen available to the plant and low temperature contribute to the development of xerophytic features, i.e, an increase in the thickness of the lamina, downiness, an increase in the number of stomas in per unit of surface and producing "columnar" tissue. Under the influence of these same factors, the leaf surface, the size of the cells and the intercellular spaces etc. decrease [1, 2, 3, 4, 5, 8, 9, 10].

Additional soil and air moisture, poor lighting and more nitrogen have the opposite effect on leaves.

Thus, the resistance of plants to unfavorable conditions depends on a number of external factors including the nutrients in the soil. The role of fertilizers in ensuring a high crop yield has been known long before but the destructive effect of external unfavorable factors through fertilizers was mentioned only in the second half of the 19^{th} century.

Numerous literary data confirm that the conditions of external environment, especially at a young age, have a significant impact on the anatomical and morphological features of plants. Stem height depends on moisture, soil fertility, fertilization, plant density and other factors. As a rule, the higher the moisture and soil fertility are, the higher the plant height is. Nitrogen or complete mineral fertilizers also contribute to the growth of straw. Phosphorus-potassium fertilizers have a negligible effect on increasing stem height [6, 7].

Phosphorus-potassium fertilizers along with nitrogen nutrition contribute to the increase of transferring sheaves on unit surface of plant stem and only nitrogen or complete (NPK) fertilizers inserted into the soil reduce the number of transferring sheaves and increase their sizes [6, 7].

According to F.M. Prutskov, the development of the root system of winter wheat depends on the nutrients in the soil and the ratio of separate elements. The richer the soil is in nitrogen and phosphorus, the stronger the roots grow. Intensified one-way nitrogen nutrition contributes more to the accumulation of ground mass than to root growth [11].

Conflict setting

Drought, hail, floods, sharp changes of temperature in atmosphere and other anomalous climatic factors contributing to desertification have recently become more common due to global warming.

In the studied area the biggest natural disaster in agriculture is drought the damage of which costs tens of millions of dollars a year. The extent of the damage caused by the drought depends not only on the decreasing amount of atmospheric precipitation and rising temperature, but also on the lack of appropriate agro-technical measures to fight the stress of atmospheric factors. Therefore, any means of fight against drought is relevant and necessary especially in the conditions of arid agriculture.

Based on the above mentioned, we have set the task of finding out the effect of fertilization periods on such anatomic and morphological properties of vegetative parts (leaf, stem, root) of winter wheat of "Bezostaya-1" variety on the basis of field experiments and laboratory researches in the conditions of zero soil cultivation which the resistance of plants to unfavorable environmental factors is conditioned by.

Material and method of research

The research was carried out using laboratory and field method in 2018-2020 at the chair of Agronomy of Shushi University of Technology.

The field experiments were thrice held in the post-forest brown, limestone carbonated soils of medium-strength in Ivanyan village of Askeran region. The estimated area of the experimenting site was 100 m^2. Winter wheat of "Beostostaya 1" served as an object of study.

The following variants were studied:

1. Testing (without fertilization)
2. $P_{90}K_{60}$ before sowing
3. N_{90} before sowing
4. $P_{90}K_{60}N_{90}$ before sowing
5. $P_{90}K_{60}N_{120}$ before sowing
6. $P_{90}K_{60}$ N_{90} before sowing, in spring in the form of nutrition
7. $P_{90}K_{60}$ before sowing, N_{120} in spring in the form of nutrition

Double superphosphate was used as phosphorus-potassium fertilizer, potassium chloride was used as potassium and potassium nitrate was used as nitrogen. The sown furrow was used as predecessor during all time of research.

The seeding was done in mid November by СЗУ-3,6 narrow blade seed driller. The norm comprised 4,5 mln. germinated seed grain per hectare. The main activities of soil cultivation and sowing were done according to the norms of zero cultivation.

The moving forms of nutrients were determined in the plow land (0-15 cm) before the experiment every year. According to these data, the experimental site was well provided with potassium and weakly provided with nitrogen and phosphorus during all years of experiment before fertilization. Consequently, phosphorus and especially nitrogen fertilizers play decisive role in increasing the yield of winter wheat in these areas. For studying field germination, winter resistance, general and efficient bushing plants were registered during vegetation. Phenological observations and biometric measurements were done during vegetation. Typical plants were chosen for anatomic observations from each species in different stages of vegetation. The leaves of the same level were compared for anatomic research. The cuttings were taken from the middle of the leaf near the central nerve. At least 20 preparations from 10 lower and 10 upper epidermis were prepared from 10 plants of each experiment in all periods of testing during the piping and suberating stages. The number of stomas and their length were determined in 10 places in the field of view of the microscope of each preparation. The number of stomas was recalculated in the field of view of a microscope, the area of which was calculated according to the radius of the circle measured in ocular micrometers depending on the magnification of the microscope. The length of the stomas was measured using an ocular micrometer and expressed in microns. Anatomical examinations of the stem were performed on the second node of the main branch during the stages of earing and full maturation. During the anatomical examination of the stem, the number of vessels of transferring sheaves and in one sheaf were calculated. With the help of an ocular micrometer, the diameters of the vessels and the stem (without the tubular part) were measured in microns.

For anatomical examination of the root and expansive cuttings of the root formed from the node of bunching were taken, the diameters of the central cylinder and the root cortex were measured and the number of vessels in the xylem was calculated.

The preparations were stained with fuchsine.

The grain yield was determined by the method of collecting and weighing the yield of each variety and repetition. Yield data were subjected to mathematical processing by the method of dispersion analysis [12].

Research results

The research results of the impact of fertilization periods on the number and sizes of stomas of leaves of winter crop are given in Table 1.

Table 1

The impact of fertilization periods on the number and sizes of stomas of leaves of winter crop (average for three years)

Varieties	Stage of tubering						Stage of suberation					
	Number of stomas on 1 mm^2			Length of stomas mc			Number of stomas on 1 mm^2			Length of stomas mc		
	In upper epidermis	In lower epidermis	Total	In upper epidermis	In lower epidermis	Average ա	In upper epidermis	In lower epidermis	Total	In upper epidermis	In lower epidermis	Average
1	60,2	48,1	108,3	55,98	53,34	54,66	72,8	52,7	125,5	42,34	39,26	40,80
2	63,7	52,3	116,0	55,01	55,00	55,00	71,5	55,4	126,9	42,78	41,81	42,29
3	46,3	38,4	84,7	60,75	57,21	58,98	56,8	46,6	103,4	47,86	43,22	45,54
4	53,2	45,2	98,4	57,54	57,19	57,36	68,7	43,2	111,9	44,10	41,46	42,78
5	48,7	41,3	90,0	61,26	57,25	59,25	60,2	41,5	101,7	48,48	46,74	47,61
6	55,2	43,7	98,9	56,97	54,02	55,49	70,3	58,5	128,8	4627	41,85	44,06
7	49,4	41,8	91,2	58,25	58,05	58,15	66,3	50,0	116,5	47,12	42,92	45,02

The data show that the amount of fertilizers and the period of fertilization had a significant effect on the number and size of stomas of the leaves of winter crop. Those plants which got only nitrogen (variety 3) or full NPK fertilizers before sowing (varieties 4 and 5), compared to unfertilized plants, decreased the number of stomas in per leaf surface and significantly increased in size. In case of only phosphorus-potassium fertilizer before sowing (variety 2), compared to the control version, the number of stomas per leaf area increases and their size decreases to some extent. Compared to the control, the number of stomas per leaf area does not decrease, vice versa, it increases in the cases when phosphorus-potassium fertilizers are used before sowing and the plants receive nitrogen in spring as nutrients.

Thus, 2 and 6 varieties had most stomas (upper and lower epidermis together). They were the least on the leaves of those plants that received the full amount of nitrogen before sowing (3, 4, 5 varieties).

Therefore, if nitrogenous or complete fertilizers applied before sowing contribute to the development of mesophytic traits, then the absence of fertilizers or especially phosphorus-potassium fertilizers before sowing contribute to the development of xerophytic traits. Xerophytic properties can be developed in plants when phosphorus-potassium fertilizers are applied to the soil before sowing and the equivalent amount of nitrogen is applied to the soil in the spring as nutrition.

The same table shows the results of a similar study conducted during the suberation of winter wheat. The data show that in plant leaves which have received different fertilizers during the suberation, the difference in the number and size of stomas is smoothed. This can be explained by the fact that plants of all varieties, especially those that receive nitrogen before sowing, acquire a natural drought resistance in summer under high atmospheric pressure. Despite the reduction in the difference between the number and size of stomas, their number per leaf remains high in those varieties that did not receive nitrogen before sowing.

Due to the fact that mineral fertilizers have a significant effect on the anatomical and morphological features of the plant stem, we have set the task of identifying the effect of the regime of mineral nutrition on several indicators of the anatomical-morphological structure of the stem of winter wheat.

Our research has shown that the stem of cereals has loose, free-scattering sheaf carriers. The carrier sheaves are arranged in two circles like chess.

Table 2

The impact of fertilization periods on some anatomic peculiarities of stem of winter crop (average for three years)

Fertilization	Tubering								Complete maturation					
	Stem surface without hole, mm	number of carrier sheaves on 1 mm^2	Vessel number in 1 mm^2	Number of sheaves on one stem	Number of vessels of one plant	Average diameter of one vessel mc	Sum of diameters of vessels in 1 mc^2	Stem surface without hole, mm	number of carrier sheaves on 1 mm^2	Vessel number in 1 mm^2	Number of sheaves on one stem	Number of vessels of one plant	Average diameter of one vessel mc	Sum of diameters of vessels in 1 mc^2
1	8.4	10.3	21.7	86.5	182.2	30.35	659	8.1	12.4	44.2	100.4	358.0	24.34	1076
2	8.9	11.0	35.1	97.9	312.3	26.12	917	8.5	14.5	60.5	123.2	514.2	19.12	1157
3	10.2	7.9	18.9	80.5	192.7	36.41	688	9.6	9.2	25.1	88.3	240.9	34.21	859
4	11.2	8.5	19.9	95.2	222.8	36.52	727	10.9	9.8	36.8	106.8	401.1	31.24	1150
5	11.5	6.8	18.3	78.2	210.4	38.28	701	11.0	8.7	27.3	95.7	300.3	33.15	905
6	12.9	10.2	27.3	131.5	352.1	32.21	879	11.5	13.4	56.4	154.1	648.6	24.22	1366
7	13.1	10.1	22.4	132.3	293.4	32.25	722	11.5	11.7	45.3	134.5	520.9	27.33	1288

The data in Table 2 show that fertilizers had a significant effect on the number of carrier sheaves and vessels of the stem unit surface during both periods of research. The diameter of the vessels and the thickness of the stem changed under the influence of mineral nutrition.

Observations have shown that nitrogen fertilizers applied to the soil before sowing, both separately and in combination with phosphorus-potassium, help to reduce the number of vessels per unit surface and carrier sheaves and to increase the diameter of the vessels. Only in the variant which received phosphorus-potassium fertilization, an increase in the number of vessels and sheaves and a decrease in their sizes were observed. Plants with phosphorus-potassium fertilizing and an equivalent amount of nitrogen nutrition (version 6, 7) keep xerophytic properties.

According to the data in the table, increasing the amount of nitrogen nutrition contributes to the development of mesophyte properties in the stalk of winter wheat even in the presence of phosphorus-potassium fertilizer.

Hence, the number of vessels and carrier sheaves per unit surface of the stem is small in plants that have received the full amount of nitrogen before sowing (Versions 3, 4, 5). Most carrier sheaves and vessels were control in plants of 2 and 6 variants.

The results of our detailed research show that, as a rule, not only the number and diameter of vessels changes under the influence of mineral fertilizers but also the total surface area of all vessels per unit surface of the stem. In this case, the highest value of this indicator was observed in plants that received only phosphorus-potassium fertilization. This indicates that xerophytic features of the stem of winter wheat develop under the influence of phosphorus-potassium fertilizers. At the same time, plants with only nitrogen or complete NPK fertilization showed a decrease in the total surface area of all vessels before sowing. The total surface area of all vessels at 1 mm^2 was significantly higher than in the control varieties where phosphorus-potassium fertilizers were applied to the soil before sowing and nitrogen was applied in the spring as a nutrient.

The data in Table 3 show that the thickness of the crust of the root of winter wheat and central tube and the number of vessels and their diameter increases under the influence of phosphorus-potassium fertilizers.

Table 3

The impact of fertilization periods on some anatomic peculiarities of stem of winter crop in the stage of complete maturation (average for three years)

Variety	Crust thickness, mc	Diameter of central tube, mc	Number of vessels, 1 mm^2	Average diameter of 1 vessel, mc	Sum of diameters of vessels, 1mc
1	307,18	475,78	31,4	33,29	1045
2	366,86	498,82	34,7	36,14	1245
3	217,68	298,46	19,5	44,82	874
4	332,64	439,65	25,8	42,49	1096
5	319,76	430,52	23,7	43,84	1039
6	369,14	487,65	33,9	36,75	1246
7	376,16	450,56	27,1	43,16	1170

In autumn the thickness of the root crust and the central tube and the number of vessels decreases only in plants with nitrogen fertilizer compared to the control variant but the diameter of the vessels increases.

Nitrogen fertilizers contribute to the thickening of the root crust and the central tube and the increase in vessel diameters in sufficient phosphorus-potassium fertilizer available to plants with the

nitrogen nutrient. It should be noted that the total diameter of the vessels remains high compared to the control variant under the influence of complete fertilizers although the number of vessels per unit surface decreases. According to the average data of the three-year study, in the plants where the nitrogen was fed in the spring, the thickness of the root crust and the central tube increased significantly as well as the number of vessels and their diameters resulting in the total diameter of the vessels per unit surface of the central tube. An increase in the total diameter of all vessels in 1 mm^2 is considered to be the result of increase of both their number and their diameters. The average diameter of all vessels per unit surface of root can be considered as an indicator of root water and carrying potential capacity of the salts dissolved in it.

During all the years of the study, the sum of the diameter of the vessels per unit surface of the root was the highest in the plants that received phosphorus-potassium fertilizers before sowing and nitrogen in the spring as a nutrient. This indicates that phosphorus-potassium fertilizers applied to the soil before sowing contribute to the development of a strong xerophytic root system in plants and further nitrogen nutrition in the spring does not significantly affect the anatomical and morphological features of the root. The variant received only the nitrogen shows the smallest sum of vessel diameters per unit surface in autumn.

Purposeful use of mineral fertilizers plays an important role in the complex of agro-technical measures to achieve a high and sustainable crop of winter wheat. In this case it is necessary to take into account the biological characteristics of the plant which will help to develop measures to increase the efficiency of the application of unit fertilizer.

Nitrogen fertilizers are given priority in increasing the yield of winter crops. There is much material in the scientific literature on the effects of nitrogen fertilizers on accumulated yields depending on the periods of their application to the soil. However, there is no common opinion on this issue. Some authors argue that nitrogen fertilizers are best applied before sowing to increase crop yields of winter crop, others argue that nitrogen fertilizers should be applied before fertilization and many argue that in order to use nitrogen more completely, it should be applied into the soil with fragmented way.

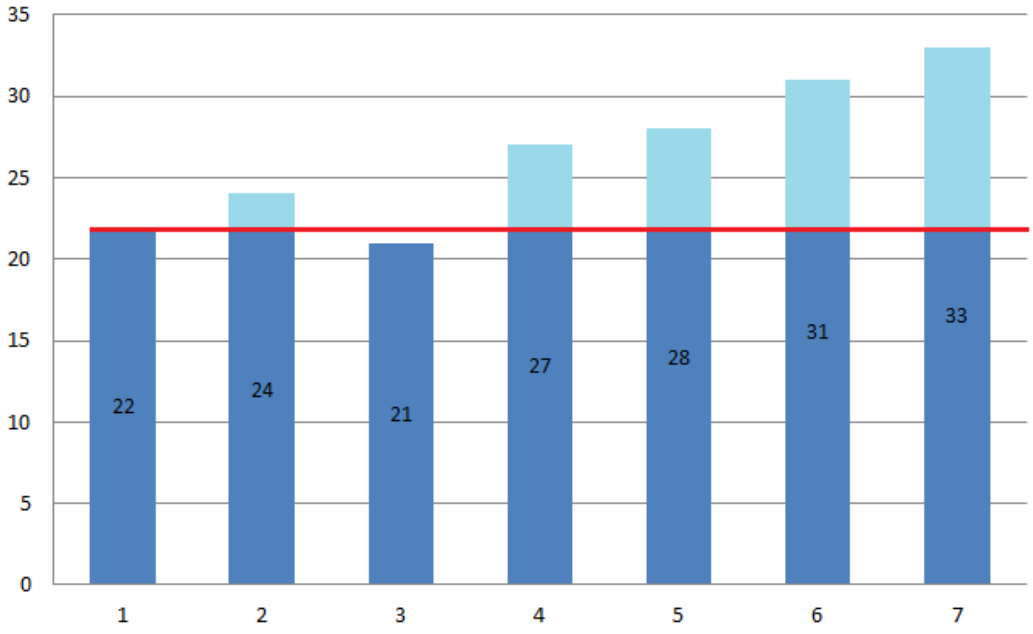

Fig. Yield of winter wheat depending on fertilization periods (average in 2018-2020)

We were also interested in studying the effect of application periods of ammonia saltpeter on the yield of winter wheat.

According to the three-year average data, the best grain yield variants were 6 and 7 where phosphorus-potassium fertilizers were applied to the soil before sowing and the equivalent amounts of nitrogen were applied as a nutrient in the spring (Fig).

Conclusion

The yield of crops mainly depends on the general pressure of the environment in the conditions of arid agriculture in the foothill zone of Artsakh Republic.

Numerous studies have shown that if plants grow in the early stages of ontogenesis under low environmental pressure, they develop mesophytic properties. Such plants are more vulnerable to unfavorable external conditions. With the application of agro-technical measures in the period of low environmental pressure the development of xerophytic features in plants contributes to the increase of their resistance to unfavorable external conditions and the yield.

Our research has shown that fertilizers are not only a source of mineral nutrition, but also regulators of water regime, winter and drought resistance of the plants.

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ՊԱՐԱՐՏԱՑՄԱՆ ԺԱՄԿԵՏՆԵՐԻ ԱԶԴԵՑՈՒԹՅՈՒՆԸ ԱՇՆԱՆԱՑԱՆ ՑՈՐԵՆԻ ԱՆԱՏՈՄԱ-ՄՈՐՖՈԼՈԳԻԱԿԱՆ ՈՐՈՇ ԱՌԱՆՁՆԱՀԱՏԿՈՒԹՅՈՒՆՆԵՐԻ ԵՎ ԲԵՐՔԱՏՎՈՒԹՅԱՆ ՎՐԱ

Ս.Բ. Գալստյան, Վ.Ա. Ալեքսանյան, Թ.Գ. Գրիգորյան, Մ.Շ. Միրզոյան
Շուշիի տեխնոլոգիական համալսարան

Արցախի Հանրապետության նախալեռնային գոտու հետանտառային շագանակագույն, խճաքարային, կարբոնատացված միջին հզորության հողային պայմաններում, որտեղ օդի տարեկան միջին ջերմաստիճանը 11^{o}C է, մթնոլորտային տեղումների բազմամյա միջինը՝ 490-550մմ, հողում հումուսի պարունակությունը՝ 3,5-4%, ուսումնասիրվել է պարարտացման ժամկետների ազդեցությունը աշնանացան ցորենի երաշտադիմացկունությունը պայմանավորող այնպիսի անատոմիա-մորֆոլոգիական առանձնահատկությունների վրա, որոնց ձևավորումը ուղղակիորեն կախված է օնտոգենեզի շրջանում բույսերի սննդառության և ջրապահովվածության կոնկրետ պայմաններից:

Փորձարարահետազոտական ճանապարհով բացահայտվել է ցանքից առաջ հող մտցված ֆոսֆորա-կալիումական պարարտանյութերի դրական ազդեցությունը ցորենի բույսերի մոտ ցրտադիմացկունություն ու երաշտադիմացկունություն ապահովող քսերոֆիտ հատկանիշների զարգացման վրա և հակառակը՝ ցանքից առաջ ազոտական պարարտանյութերի ինչպես առանձին, այնպես էլ ֆոսֆորակալիումականի հետ համատեղ կիրառման ազդեցությունը մեզոֆիտ հատկանիշների ձևավորման վրա, ինչը իր հերթին նվազեցնում է բույսերի դիմացկունությունը արտաքին անբարենպաստ պայմանների նկատմամբ և պայմանավորում է աշնանացան ցորենի ցածր բերքատվություն: Միաժամանակ պարզվել է, որ Ֆոսֆորա-կալիումական պարարտանյութերը ցանքից առաջ, իսկ ազոտականը սնուցման ձևով գարնանը հող մտցնելիս՝ ստեղծվում է հանքային սննդառության հավասարակշռված հարաբերակցություն, ապահովվում է քսերոֆիտ հատկանիշների զարգացում և մթնոլորտային գործոնների բարձր լարվածության դեպքում ստացվում է բարձր բերք:

Բանալի բառեր. Պարարտացման ժամկետ, տերևի, ցողունի, արմատի անատոմիական առանձնահատկոջություններ, քսերոֆիտ հատկանիշներ, երաշտադիմացկունություն, բերքատվություն:

ВЛИЯНИЕ СРОКОВ ВНЕСЕНИЯ УДОБРЕНИЙ НА НЕКОТОРЫЕ АНАТОМО-МОРФОЛОГИЧЕСКИЕ ОСОБЕННОСТИ И УРОЖАЙНОСТЬ ОЗИМОЙ ПШЕНИЦЫ

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В условиях предгорной зоны Республики Арцах на коричневых щебнистых, карбонатных почвах средней мощности, где среднегодовая температура воздуха составляет 11ºС, среднее многолетнее количество осадков - 490-550 мм, содержание гумуса в почве - 3,5-4%, изучено влияние сроков внесения удобрений на такие анатомо-морфологические особенности озимой пшеницы, обусловливающие ее засухоустойчивость, формирование которых напрямую зависит от конкретных условий питания и водоснабжения растений в период онтогенеза.

Экспертно-исследовательским путем выявлено положительное влияние фосфорно-калийных удобрений, внесенных в почву перед посевом, на развитие ксерофитных признаков, обеспечивающих морозостойкость и засухоустойчивость зерновых растений, и наоборот - влияние применения азотных удобрений перед посевом, как по отдельности, так и в сочетании с фосфорно-калийными, на формирование мезофитных признаков, что, в свою очередь, снижает устойчивость растений к неблагоприятным внешним условиям и приводит к снижению урожайности озимой пшеницы. В то же время выяснилось, что при внесении в почву фосфорно-калийных удобрений перед посевом, а азотных, в виде подкормки - весной, образуется сбалансированное соотношение минерального питания, обеспечивается развитие ксерофитных свойств и при интенсивном воздействии атмосферных факторов урожайность повышается.

Ключевые слова: сроки внесения удобрений, анатомические особенности листьев, стебля, корня, ксерофитные признаки, засухоустойчивость, урожайность.

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ALTERNATIVE ENERGY: TYPES OF WIND POWER PLANTS AND THEIR IMPACT ON THE ENVIRONMENT

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Abstract

This article provides answers to basic questions regarding wind energy**.** The main parameters of wind are considered, a brief description of the use of wind energy in the world is given and the types of wind power plants are described and the impact of wind energy on various components and parameters of the environment is shown.

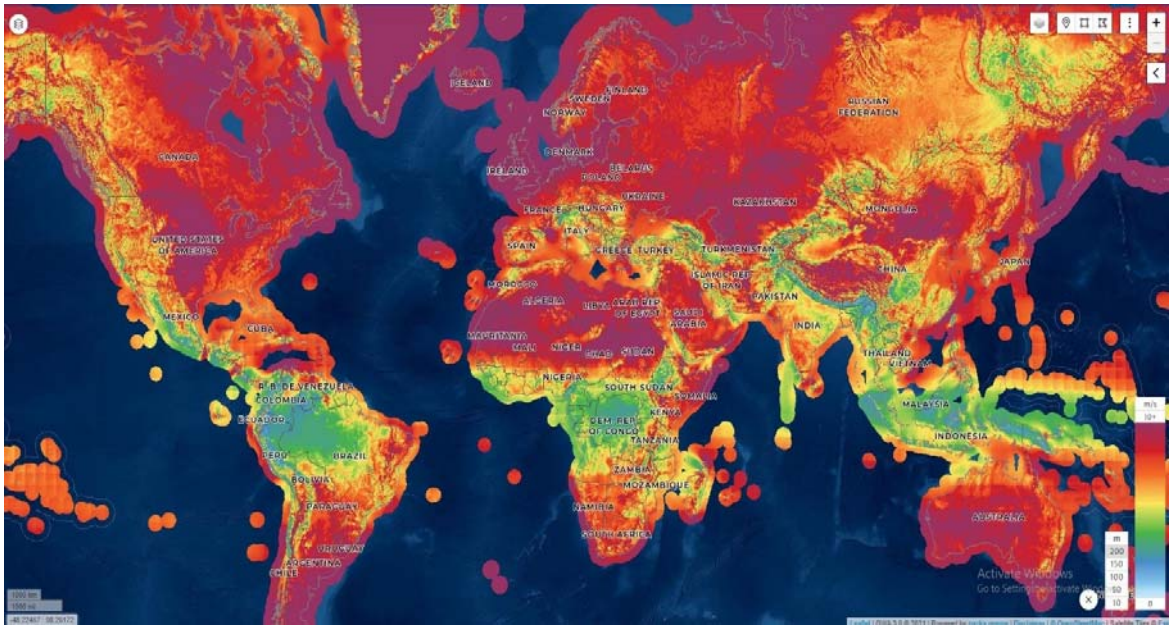
Key words: environment, types of wind power plants, wind farms, wind turbines, energetic potential of wind.

Introduction

Wind – “the movement of air relative to the earth's surface...”. Usually they mean horizontal movement averaged over a time interval of about 1-3 minutes. Thanks to this averaging, micro scale pulsations with a period of several seconds are excluded. The occurrence of wind is associated with uneven heating of the Earth due to cloudiness, heat accumulation by water bodies, relief and a number of other reasons. Wind is closely related to pressure and is directed from high pressure to low pressure. On a global scale, air circulation has the character of convective transport from one pressure belt to another. The most important characteristics of wind are direction and speed. A smoothed value is an average value over a period of time. The instantaneous value gives the indicator directly at the time of measurement, it can significantly fluctuate around the smoothed value. For wind energy, smoothed wind speed is important. The direction of the wind is the direction from which it blows [1]. To indicate the direction, 8 main rhombs of the horizon are usually used: north, northeast, east, etc. and 8 intermediate rhombs between them. Wind speed is usually measured in meters per second. Zoning of the globe by wind speed is shown in Pic. 1 [2].

Wind energy is inherently the energy of the Sun converted into the kinetic energy of moving air masses. Wind energy was widely used in ancient Egypt and the Middle East to drive mills and water-lifting devices. Currently, the use of wind for grinding grain is practically stopped and in some places the preserved windmills are only monuments of the era. Wind farms are built in places with a high average wind speed - from 4.5 m/s and above. Conventional meteorological information for the choice of the construction site of wind farms is not suitable, because it contains information about surface wind speeds. To select a construction site, a preliminary study of the wind potential of the area is carried out. At an altitude of 30 to 100 meters, anemometers are installed and within one to two years they collect information about the speed and direction of the wind.

Since the wind speed increases with altitude, it is preferable to build wind farms on hills. Items that can affect the wind are taken into account: trees, large structures, etc. In general, the wind energy potential is quite large. Wind farms convert wind energy into electrical energy. They consist of several wind turbines assembled in one place.



Pic. 1 Average annual wind velocity map from global wind atlas

Conflict setting

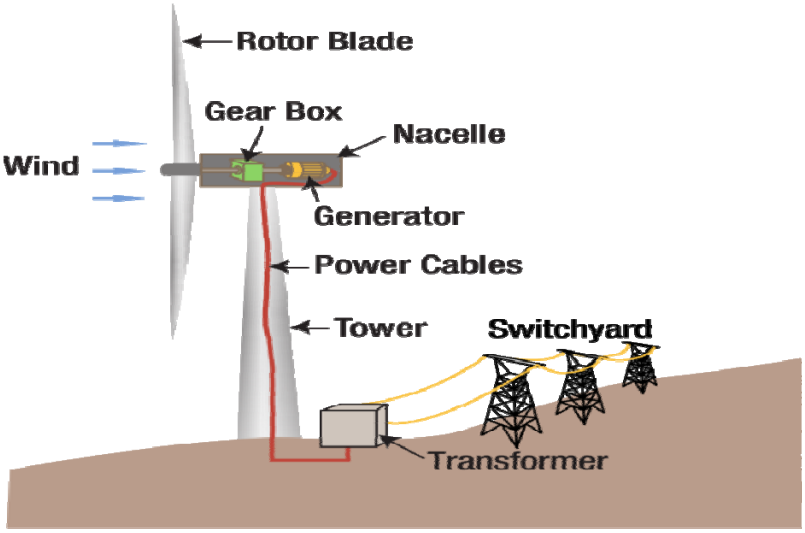
There are four types of wind power plants – Land-based (wind turbines are installed on the hills), coastal (at a short distance from the seashore), offshore (they are built in the sea 10-12 kilometers from the coast) and floating. Land-based is the most common type of wind farms at present. To install a wind turbine, places are being sred on the hills and heights. The Gansu Wind Farm in China is the largest land-based wind farm in the world with a target capacity of 20,000 MW by 2020. Largest coastal power plant is Horse Hollow station located at state of Texas, USA. It consists of 421 wind farms turbine and has a capacity of 735 megawatts. A coastal wind farm in the Philippines is shown in Pic. 2. The largest offshore station is Hornesa power plant in England (Pic.3), with an installed capacity of 40 MW, built in January 2021. The United Kingdom has the world's largest potential for offshore stations. The first prototype of a floating wind turbine was built in December 2007. The 80 kW wind turbine is installed on a floating platform 10.6 nautical miles off the coast of Southern Italy on a 108 meters deep sea. Thus, wind power plants have their advantages and disadvantages. Therefore, for the purpose of further research and applied work, it is necessary to study the characteristics of wind plants and their impact on the environment to carry out their analysis. Despite all of the above, the main disadvantage of a wind farm is its impact on the environment.

Pic. 2 A coastal wind farm in the Philippines

Pic. 3 Hornesa offshore power plant in England

Research results

Wind currents rotate the blades of the wind generator: they pass through the turbine, drive it, and it begins to rotate. Energy is generated on the shaft which will generate the turbine to the wind flow. The stronger the wind, the more energy is generated. Further, the energy is transferred along the shaft to the rotor to the multiplier (if any), which generates it (Pic.4).



Pic. 4 The structure of the wind power plant

Wind power has advantages and disadvantages. The advantages of wind power systems are as follows:

- wind energy is inexhaustible; electricity production with the help of wind power plants is not accompanied by hazardous emissions into the atmosphere;
- possibility of placement in hard-to-reach places;
- require a small area and fit into any landscape; obtaining free electricity in the long term, no costs for fuel and its delivery;
- autonomy - independence from the state and operation of external electrical networks.

However, wind power plants have their disadvantages, including:

- noise;
- high price;
- long payback period;
- inconstancy and unregulated wind flow.

Adverse effects of wind energy expressed in the following:

alienation of land;

- alienation of land;
- influence on the animal world;
- noise impact;
- visual impact;
- electrical, radio and television interference [3].

Wind generators cannot be close to each other, since due to the interference of their power will be reduced. Therefore, their placement requires significant land acquisition. Wind farms require approximately 0.1 km^2 of free space per megawatt of rated power. Accordingly, a power plant with a capacity of 100 megawatts will need about 10 km^2.

The impact on the animal world is expressed in the danger to aquatic organisms, birds and insects. The impact on the fauna is most dangerous during the construction of the wind farm:

disturbances in the habitat lead to migration and death of fish. During operation, the impact of noise and vibration is small, and the termination of navigation and fishing between turbine supports may even have positive effects. The impact on marine mammals (dolphins, seals, whales) is also small.

During the construction period, bottom sediments and the structure of turbulent flows change, which adversely affects, first of all, bottom organisms. The magnitude of the impact depends on the nature of the substrate, it is minimal in the case of rocky bottom soils. During the period of operation when transmitting electricity through a submarine cable when the permissible voltage values are exceeded electric and magnetic fields in fish and bottom animals can have a persistent reaction scaring away, and then the cable line will become an obstacle to the migration of fish.

As for the impact on birds, according to the data of European bird watchers, it is minimal. Birds feel wind turbines at a distance of more than 1 km and fly around them. The death of birds is 0,3-0,4 birds per 1 Gigawattis/ hour of electricity generated which corresponds to about 70 thousand birds per year for the United States.

Noise generated by wind turbines impact can be divided into mechanical and aerodynamic. Components that produce the greatest noise level are the generator, swing drive that unfolds the upper part of the wind turbine towards the wind, gearbox and blades. The noise from some of these components occurs constantly, from others - from time to time, but all the noises only happen when the turbine is running. At the same time, the noise of working wind turbines in comparison with other industrial sources is relatively small.

There is also visual impact, but it is ambiguous. Many people think that wind farms improve the aesthetic perception of the landscape, but there are also people who dislike them. There is a known case when the implementation of a wind farm project in the United States was postponed for several years precisely for reasons of landscape aesthetics.

Wind farms are the source of radio and television interference. In particular, due to reflections of USW (ultra short waves) and microwaves from moving blades of wind power plants, the normal operation of the navigation aircraft equipment and it is difficult to receive television broadcasts [4].

Conclusion

Natural contamination and the emissions of CO2 and other gasses from the utilization of fossil fuels constitute a risk to wellbeing, the environment and economical financial development. The foremost risk comes from quickening climate alter as the coordinated result of the greenhouse effect. Wind turbines cause for all intents and purposes no emissions during their operation and exceptionally small noise during their establishment, support and evacuation. The wind as a “fuel” is free and endless and the innovation is developing and competitive. Consequently, the wind vitality can shape the premise of a long-term feasible vitality supply framework and is basic in the event that the fundamental decreases in CO2 and other emissions from power era are to be met and economic advancement and feasible development are to be accomplished. In spite of the fact that there are numerous positive angles of wind vitality, the negative impacts of the wind power plants on the environment have to be considered moreover. The most concerns are clamor and visual interruption, as well as the feathered creature and bat mortality at wind turbines. In any case, the scale of the biological affect may or may not be noteworthy, depending on particular circumstances and each conceivable negative affect must be considered and managed with when arranging wind power plants.

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ԱՅԼԸՆՏՐԱՆՔԱՅԻՆ ԷՆԵՐԳԵՏԻԿԱ: ՀՈՂՄԱՅԻՆ ԷԼԵԿՏՐԱԿԱՅԱՆՆԵՐԻ ՏԵՍԱԿՆԵՐԸ ԵՎ ՆՐԱՆՑ ԱԶԴԵՑՈՒԹՅՈՒՆԸ ՇՐՋԱԿԱ ՄԻՋԱՎԱՅՐԻ ՎՐԱ

Ռ.Հ. Ավոյան
Հայաստանի ազգային պոլիտեխնիկական համալսարան

Տրվում է քամու էներգիայի վերաբերյալ որոշ հիմնական հարցերի պատասխաններ: Դիտարկված են քամու հիմնական պարամետրերը, տրված է աշխարհում քամու էներգիայի օգտագործման համառոտ նկարագրությունը, նկարագրված են հողմային էլեկտրակայանների տեսակները, քամու էներգիայի ազդեցությունը շրջակա միջավայրի տարբեր բաղադրիչների և պարամետրերի վրա:

Բանալի բառեր. շրջակա միջավայր, հողմային էլեկտրակայանների տեսակները, հողմակայան, հողմային էներգիայի ներուժ:

АЛЬТЕРНАТИВНАЯ ЭНЕРГЕТИКА: ВИДЫ ВЕТРОВЫХ ЭЛЕКТРОСТАНЦИЙ И ИХ ВЛИЯНИЕ НА ОКРУЖАЮЩУЮ СРЕДУ

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Даются ответы на некоторые основные вопросы, касающиеся ветроэнергетики. Рассмотрены основные параметры ветра, дано краткое описание использования энергии ветра в мире, описаны виды ветровых электростанций, показано влияние энергии ветра на различные компоненты и параметры окружающей среды.

Ключевые слова: окружающая среда, типы ветровых электростанций, ветряная электростанция, потенциал ветровой энергии.

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PECULIARITIES AND SELECTION OF TECHNOLOGY OF MINIMUM SOIL TILLAGE ACCORDING TO ZONING

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Abstract

The article analyzes the peculiarities of land cultivation technologies to identify the factors affecting the energy efficiency of land cultivation, costs, as well as searching for solutions to reduce negative factors and to substantiate the advantages of the technology of minimum soil cultivation.

By using energy-saving machines with minimum tillage and increasing soil fertility and productivity, costs are reduced by about 2-6 times.

Key words: minimum processing, fertility, erosion, energy saving, energy costs.

Introduction

Land cultivation technologies have been practiced since the 18th century. This type of intensive scientific research has been noted among European farmers. Europe has made significant progress through the use of organic fertilizers, pasture and plowing poor soils.

With the advent of tractor power, deep cultivation with careful processing of the next surface layer was widespread which ensured high fertility in conditions of sufficient moisture, excessive use of manure and weeds.

The “blind” introduction of this tillage technology in Eastern Europe, Siberia and other places where there was an acute shortage of moisture, especially in the steppe regions, agriculture went bankrupt, weeding was unjustified and organic fertilizers became less effective. Farmers in the USA and Canada found themselves in the same tragic situation when aeration increased due to constant

deep subsidence of the soil which led to accelerated decomposition of humus, loss of soil structure water and wind erosion.

Due to the improper implementation of land cultivation technology in 1934, a dust storm swept over 40 million large areas of the United States and carried 300 million tons of fertile land into the ocean [11].

This tragedy of agriculture has mobilized the scientists of the advanced states to decide how to find a solution to the problem. In 1943 Faulkner's book, «The Plowman's Madness» gained widespread acceptance among farmers. Faulkner strongly criticizes tillage and suggests using the topsoil 7-7.5cm deep to mix fertilizer with the topsoil.

The mechanical transfer of soil cultivation techniques to agriculture under different conditions was sharply criticized by the Russian scientist V.V. Dokucha and D.I. Mendeleeva [8]

T.S. Maltz proposed to plow the land every 3-5 years, the rest of the time it was proposed to cultivate soil with suitable tools in 1953 [1].

After Faulkner's critical analysis, serious work began on soil cultivation technology and it was proposed to revise the foundations of scientific agriculture. A characteristic feature of this scientific process was a single recipe for cultivating the land. Moving from ordinary schemes to creative ones based on scientific advances and best practices, taking into account local conditions.

According to G. Kant about the minimum tillage, we read: “As much as needed, but as little as possible”. First the method of minimum cultivation was tested in 1945 in the United States. Currently, 50% of the southern United States is cultivated using minimum and zero technology. In 2013, it is planned to cultivate the entire sown area using this technology [4]. It has been established that the soil intended for sowing cereals should have a density of 1.1-1.3 g / cm 3, for potato-sunflower - 1-1.2 g / cm 3, for sugar beets 1.1-1.5 g / cm 3 [9]. This means that if the density of the soil is lower than the specified one, it should be rolled and at high density - shallow cultivation must be applied.

In this regard, I. B. Revut stated «The deviation of soil density from the optimal 0.1-0.3 g / cm^3 leads to a loss of yield by 20-40%” [6].

It is known that agricultural land is distinguished by a great variety which is expressed by the type of soil, physical and mechanical properties, climatic conditions, position, area of use etc. Thus, the problem lies in the minimum tillage technology for the most efficient use of different types of land in different areas applying various working aggregates or machine-tractor units.

Material and method

Until the 1990s, in agricultural production in the United States and today in the Republic of Armenia [7], minimal soil cultivation is combined with preservatives, that is, crop residues remain in the process of soil cultivation, which not only increases the yield, but also prevents its erosion. In this case, it is necessary to combine this technology with protection against plant diseases, pests and weeds. The presence of crop residues on the soil surface improves moisture penetration, reduces evaporation, but requires a large amount of nitrogen fertilizers, since crop residue nitrogen does not enter the soil, it decomposes uselessly.

Minimum tillage technology is considered the most important result of the scientific and technological revolution in agriculture.

Results and analysis

Numerous theoretical and experimental studies were carried out in order to identify factors affecting the energy efficiency of land cultivation, as well as their reduction, taking into account the following main aspects:

Agronomic point of view - studies have shown that after deep seeding (20-25 cm) in the next two years, the soil can be cultivated face down (15-18 cm) without compromising fertility. Decreasing the depth by 1 cm reduces fuel consumption by 0.4-0.6 kg / ha and cash costs by 0.43-0.52 US dollars / ha. Preparation of the land during cultivation with aggregates in combination with sowing wheat yielded more yield than with double cultivation, and the costs decreased almost twice, the fuel economy was 3.5-4 kg / ha [2].

Energy aspect - in the case of soil cultivation with passively acting organs, the expended energy is determined by resistance [5, 7].

$$E_m = K_1 = k_1 +_1 \cdot v^2, \quad (1)$$

E_m - specific energy intensity of the earth N/m^2

K_1 - specific traction resistance of the car, N/m

$_1$ - dynamic resistance coefficient, Ns^2/m^3

V - the working speed of the car m/s

The specific fuel consumption required for tillage is determined by the following formula: [13]

$$Q_0 = 2.778 \cdot 10^{-6} g_e \eta_{V\max} (k_1 + \varepsilon_1 V^2) e^{c(V_0 - V)^2}, \quad (2)$$

Q_0 - specific fuel consumption , kg / ha

g_e - specific fuel consumption of the tractor engine, g / kWh

$\eta_{V\max}$ - maximum value of the tractor power factor

$e = 2.718$, the basis of the natural logarithm

V_0 – the speed corresponding to the maximum traction power, m / s,

c-coefficient that takes into account the physical and mechanical properties of the soil and the operating conditions of the tractor.

For wheeled tractors $c \approx 0.15 \pm 0.05$ - for compacted soils; $c \approx 0.3 \pm 0.05$ - for cultivated soils.

The above formula (2) shows that the specific fuel consumption for tillage is determined by the energy intensity of the technological process, the energy characteristics of the tractor as well as their changes [2, 12, 13] (Tab.).

Table

Energy characteristics of tillage machines in the range of speed- 1.5 - 3 m / s (5-11 km / h)

Process type/ used machine	Static resistance, k_1', N/m	Dynamic resistance coefficient, ε, Ns^2/m^3
Planting at a depth of 20-21 cm		
- with corpus of attaching plow	7000-18000	400-700
- with corpus of hanging plow	6000-15000	400-700
- spiral corpus of hanging plow	5000-12000	250-450
surface sowing	1500-2300	100-400
Cultivation at a depth of 8-12 cm		
- with T-shaped cultivators	1300-3500	80-400
- with crusher	2000-3600	60-400
- combined high-speed machines	4000-5500	200-550
double cultivation 8-12cm		
- with T-shaped cultivators	800-1000	50-100
Deep loosening of soil (15-20 cm) with combined machines	2000-5300	150-500

The data in the table shows that downstream processes are considered to be more energy intensive than other processes. In addition, pre-sowing cultivation of arable land is associated with additional energy costs. Therefore, in order to reduce energy costs, it is advisable to replace the bottom with other tillage methods.

The technical point of view is the introduction of more efficient machines and the use of combined machine units.

One of the main indicators that determine fuel consumption is the specific traction resistance of the vehicle, which is characterized by static resistance (k_1') and coefficient of dynamic resistance (ε_1). Their size depends on the physical and mechanical properties of the soil, the design of the machine, working bodies, as well as on their suitability for work in specific conditions [12, 13]. The lower these indicators, the less fuel is required, the higher is the productivity and the cheaper is the work.

Greater fuel savings can be achieved by combining technological processes. It is advisable to use combined machines to combine the following processes:

- main soil cultivation with simultaneous additional cultivation,
- pre-sowing treatment by integration of herbicides and fertilizers,
- sowing grain and other crops by applying herbicides and fertilizers.

In the case the fuel economy is 15-30%.

From an economic point of view, with intensive cultivation of the land, the cost of labor, fuel and other resources is 1.5 times higher than when traditional technology is used. By simplifying the processing technology, it will be possible to reduce costs by 30% with the use of the minimum processing technology - 2 times, with zero - 6 times [12].

Environmental point of view - minimal tillage is considered environmentally friendly. This reduces the number of machines used, reduces unwanted soil compaction and reduces the amount of toxic gases released into the atmosphere.

Research confirms that for better soil cultivation in mining agriculture in the Republic of Armenia, it is necessary to develop a minimum soil cultivation technology and apply various machines or machine-tractor units. And in general, if we take into account that the choice of the technology for its cultivation is conditioned by the physical and mechanical properties of the soil, then the choice of the type of tractor, tractor shape or traction becomes a decisive factor.

Conclusion

1. One of the most effective ways to reduce the cost of land and energy processing is the use of minimum processing technology, which is considered agriculturally acceptable, economical and environmentally friendly. When using the technology of minimum tillage, costs are reduced by about 2-6 times.
2. The use of energy-saving machines (chisel cultivators, machines with active working units, machines with vibrating units, combined tillage machines) increases the efficiency of the soil cultivation process, soil fertility and productivity.
3. For the best tillage in the mining agriculture of the Republic of Armenia, it is necessary to develop a minimum tillage technology using machines of various shapes or machine-tractor units.

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ՀՈՂԻ ՆՎԱԶԱԳՈՒՅՆ ՄՇԱԿՄԱՆ ՏԵԽՆՈԼՈԳԻԱՅԻ ԱՌԱՆՁՆԱՀԱՏԿՈՒԹՅՈՒՆՆԵՐԸ ԵՎ ԸՆՏՐՈՒԹՅՈՒՆԸ ԳՈՏԻԱԿԱՆՈՒԹՅԱՆԸ ՀԱՄԱՊԱՏԱՍԽԱՆ

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Հոդվածում՝ հողի մշակման էներգատարության, ծախսերի վրա ազդող գործոնների բացահայտման, ինչպես նաև դրանց կրճատման լուծումների որոնման նպատակով կատարված է հողի մշակման տեխնոլոգիաների առանձնահատկությունների վերլուծություն և նվազագույն մշակման տեխնոլոգիայի առավելությունների հիմնավորում:

Էներգախնայող մեքենաների կիրառմամբ հողի նվազագույն մշակման դեպքում բարձրացնում է հողի բերրիությունը և մշակաբույսերի բերքատվությունը, ծախսումները կրճատվում է մոտ 2 - 6 անգամ:

Բանալի բառեր. նվազագույն մշակում, բերրիություն, էրոզիա, էներգախնայող, էներգածախսեր:

ОСОБЕННОСТИ ТЕХНОЛОГИИ МИНИМАЛЬНОЙ ОБРАБОТКИ ПОЧВЫ И ВЫБОР В СООТВЕТСТВИИ С ЗОНАЛЬНОСТЬЮ

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В статье проанализированы особенности технологий обработки почвы с целью выявления факторов, влияющих на энергоемкость и стоимость обработки почвы, а также поиска решений по их снижению, и обоснованы преимущества технологии минимальной обработки почвы.

При минимальной обработке почвы с применением энергосберегающих машин повышается плодородие почвы и урожайность культур, затраты сокращаются примерно в 2-6 раз.

Ключевые слова: минимальная обработка, плодородие, эрозия, энергосбережение, энергозатраты.

- Հետազոտությունն իրականացվել է ՀՀ գիտության կոմիտեի ֆինանսական աջակցությամբ՝ 21T - 4B008 ծածկագրով գիտական թեմայի շրջանակներում:

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DEVELOPING BI-DIRECTIONAL RECOMMENDATION SYSTEM BASED ON CONTENT FOR JOBS AND MATCHING CANDIDATES USING FAST TEXT MODEL

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Abstract

In this paper, a content-based bi-directional candidate-job recommender system is suggested for matching the best candidates for a given job and vice versa. Our solution is based on deep learning techniques. It uses applicant information (title, skills, location, etc.) and job descriptions/information to find the best suggestion for a given job or candidate. For evaluation of the suggested recommendation system the Job2Candidate dataset has been constructed. It is shown that using the FastText model and seniority level allows our approach to get more accurate results than other existing alternative approaches give.

Key words: recommendation system, candidate recommendation, job recommendation, NLP, FastText, language models, unsupervised learning.

Introduction

Recommender systems are being utilized in a wide range of applications. However, depending on the domain in which it is used, the type of advice offered may vary. We need to discover a way to rank all candidates from a certain pool for a specific position to create a candidate recommendation system based on the job description. The candidate recommender will assist recruiters in locating and contacting the finest prospects. As it is bi-directional, the solution can also be used to suggest jobs for specified candidates. However, the candidate recommendation system is our primary focus.

Most candidate and job recommendation systems [1, 2, 4, 6] utilize collaborative filtering (CF) [7, 8, 9], and just a few methods [3, 5] contain some content-based techniques which are only used to overcome the so-called cold-start problem of CF approaches and they are all strongly CF-based approaches in general.

Our system is unique as it focuses solely on content-based suggestions outperforming previous alternatives.

Conflict setting

The aim of the work is to develop a recommender system for jobs to make efficient the process of finding the best options from a certain pool of candidates.

Datasets

The main dataset which we have used for training our model is the jobs dataset. Also, we have constructed the Job2Candidate dataset, which mainly helps in the evaluation stage.

Jobs dataset. We have crawled the most popular job posting websites to create a jobs dataset, which contains job titles and descriptions from various industries. Crawled and the filtered dataset contains over 15 million job titles and descriptions. All titles and descriptions are written in English. All the job titles and descriptions are concatenated to form a big text corpus which was used to train our model.

Job2Candidate dataset. We gathered a job-candidate dataset, which contains the title and description for the job, and the title, skills and bio for the candidate (which also includes previous experience). Using job and candidates sets, we have manually created the Job2Candidate dataset, where for each pair of jobs and candidates, we have label 1 if the candidate is a good enough match for suggesting and 0 otherwise. Then we combined it with our internal "offers and hires" dataset which contains job and applicant pairs where the candidate was hired or received an offer for that job. As a result, the dataset is evenly balanced with almost 3000 job-candidate pairs with labels of 0 or 1. We utilized this dataset to evaluate a solution's capacity to filter out bad candidates and recommend only those who are a good enough match.

Models and Methods

We have used the FastText [10] model and jobs dataset to get our model. FastText is a commonly used model for word embedding. It is an extension of word2vec [11], created by Facebook. It uses a fast and effective method to learn word representations and perform text classification. The model was used to get embeddings for both candidate information and job information, then cosine similarity of two embeddings gives a score between 1 in case the job and the candidate are a perfect match and -1 otherwise. The same cosine similarity score was used to rank suggested candidates or jobs.

We have used the standard FastText model to help us get embeddings for our job and candidate information. Choosing the FastText over the standard word2vec algorithm is based on the FastText extra feature to provide embeddings even for tokens that are out of train vocabulary using some techniques with ngrams. The FastText model works pretty fast both in the training and the evaluation phase.

With the FastText model, we are using job and candidate information separately to get their embeddings. We are using only professional information for embedding, which means no personal information is used in the recommendation system, which helps avoid biases. We use the same model for jobs and candidates, which means all embeddings are from the same distribution space and have the exact dimensions. For each job and candidate pair, we are calculating the cosine similarity using their embeddings.

$$similarity = \frac{\sum_{i=1}^{N} A_i B_i}{\sqrt{\sum_{i=1}^{N} A_i^2} \cdot \sqrt{\sum_{i=1}^{N} B_i^2}}, \text{ where } A_i, B_i \in R^N \quad (1)$$

The following formula is used to calculate the score, which is bounded between -1 and 1. N is the dimension of embeddings. As a result, each job candidate pair has a score. We have used a threshold of 0.54 to filter candidates. All candidates with scores below 0.54 are marked as not relevant candidates. The rest of the candidates are ordered via their respective scores. The grid-search algorithm found the given 0.54 threshold.

The technique mentioned above works well, but there is a problem with seniority levels. For example, suppose we need a Senior javascript engineer with skills [javascript, jquery]. In that case, the same terms can be matched in junior developers' profiles, but we do not have to suggest them. It became natural to include a new seniority level feature to address this problem, which allows us to

match candidates by content and seniority level. We used a keyword search in the job title and extracted experience requirements from the job description to get seniority level for the job. The same keyword search method is used for the candidate titles. We combine that with calculating years of experience from candidates' experience to get seniority level for candidates. As stated in Tab. 1, there are six levels of seniority.

Table 1

Seniority levels

Level 0	Interns, juniors, …
Level 1	Mid-level, assistants, …
Level 2	Senior-level, …
Level 3	Managers, team leads, …
Level 4	Directors, senior managers, …
Level 5	C-level executives, owners, founders, …

After detecting the seniority level for candidates, we are filtering out candidates with mismatching seniority levels.

Research results

As previously stated, we evaluated using the Job2Candidate dataset, but this is only the first stage of our system's evaluation. Accuracy, recall, and precision were the metrics we used in the first stage.

We have defined a metric called Top10-referrals for the second stage of evaluation, which is customer feedback/usage. Our platform's referral/hire events are used to calculate the Top10-referrals metric. The Top10-referrals metric indicates how many percent of the customer's referrals/hires came from our top 10 recommendations.

Let us denote each referred/hired candidate with x_i. Define k_i, which is equal to 1 if x_i is in the top 10 suggestions of recommendation, otherwise 0.

The top10-referrals metric is calculated as shown below:

$$y = \frac{\sum_{i=1}^{N} k_i}{N} \quad (2)$$

where N is the number of referred/hired candidates.

Here are the results of several months of testing with the existing algorithms and the currently described technique.

Evaluation stage one results are shown in Tab 2:

Table 2

Evaluation stage one, results

Solution name	Accuracy	Precision	Recall
CF (without cold start solution)	68.91%	61.66%	74.12%
CF + content-based solution	71.32%	67.37%	77.01%
Content-based solutions with Solr	76.01%	75.33%	78.50%
FastText model (without seniority level)	77.01%	79.97%	74.26%
FastText model (with seniority level)	86.66%	81.36%	92.69%

On the first step of evaluation, our solution outperforms previous CF-based alternatives. We deployed our solutions for 100+ customers for several months (10000+ referred/hired candidates) in the Team able platform for the second stage of review, and the results are displayed in Tab 3.

Table 3

Evaluation stage two, results

Solution name	Top10-referrals metric
CF (without cold start solution)	9.20%
CF + content-based solution	10.01%
Content-based solutions with Solr	18.88%
FastText (without seniority level)	28.51%
FastText model (with seniority level)	35.94%

Our approach surpasses other existing alternatives by a large margin during the review process. Furthermore, our approach eliminates the cold start issue, which is a significant issue for new consumers. Also, our solution is bi-directional, which means it can be used as a job suggestions system for the specified candidates.

Conclusion

We introduced an innovative strategy in this research that allowed us to surpass prior CF-based and content-based approaches. It also does not have a cold start issue and performs better with or without previous data. In terms of execution time, our solution is relatively quick, even with over 1 million candidates. The calculation of embeddings and respective scores is a one-time job, after which we only need to use those scores to filter and rank candidates.

The described solution is bi-directional which means it can be used as a job suggestions system for the specified candidates. As of now, we have used the job suggestion part in our product, but there is no automated way of tracking the effectiveness on our platform.

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ԲՈՎԱՆԴԱԿՈՒԹՅԱՆ ՎՐԱ ՀԻՄՆՎԱԾ ԵՐԿԿՈՂՄԱՆԻ՝ ԱՇԽԱՏԱՆՔՆԵՐ ԵՎ ԹԵԿՆԱԾՈՒՆԵՐ ԸՆՏՐԵԼՈՒ ԱՌԱՋԱՐԿՈՒԹՅՈՒՆՆԵՐԻ ՀԱՄԱԿԱՐԳԻ ՄՇԱԿՈՒՄԸ՝ ՕԳՏԱԳՈՐԾԵԼՈՎ FAST TEXT ՄՈԴԵԼԸ

Ն.Հ. Հովսեփյան
Հայ-Ռուսական համալսարան

Այս հոդվածում առաջարկվում է բովանդակության վրա հիմնված երկկողմանի թեկնածու-աշխատանք առաջարկող համակարգ՝ տվյալ աշխատանքի համար լավագույն թեկնածուներին գտնելու համար և հակառակը: Մեր լուծումը հիմնված է խորը ուսուցման տեխնիկայի վրա: Այն օգտագործում է դիմողի տեղեկատվությունը (անվանումը, հմտությունները, գտնվելու վայրը և այլն) և աշխատանքի նկարագրությունները/տեղեկությունները տվյալ աշխատանքի կամ թեկնածուի լավագույն առաջարկը գտնելու համար: Առաջարկվող համակարգի գնահատման համար ստեղծվել է Job2Candidate տվյալների հավաքածուն: Ցույց է տրված, որ FastText մոդելի և ավագության մակարդակի օգտագործումը թույլ է տալիս մեր մոտեցմանը ստանալ ավելի ճշգրիտ տվյալներ, քան գոյություն ունեցող այլ մոտեցումների տված արդյունքները:

Բանալի բառեր. առաջարկությունների համակարգ, թեկնածու առաջարկ, աշխատանքի առաջարկ, NLP, FastText, լեզվի մոդելներ, առանց ուսուցչի ուսուցում:

РАЗРАБОТКА СИСТЕМЫ ДВУНАПРАВЛЕННЫХ РЕКОМЕНДАЦИЙ НА ОСНОВЕ СОДЕРЖАНИЯ ДЛЯ ПОДБОРА РАБОТЫ И КАНДИДАТОВ С ИСПОЛЬЗОВАНИЕМ МОДЕЛИ FAST TEXT

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В данной статье предлагается основанная на содержании двунаправленная рекомендательная система кандидатов на работу для подбора лучших кандидатов на данную должность и наоборот. Наше решение основано на методах глубокого обучения. В нем используется информация о кандидате (должность, навыки, местонахождение и т.д.) и описание/ информация о вакансиях, чтобы найти лучшее предложение для данной работы или

кандидата. Для оценки предложенной системы рекомендаций был построен набор данных Job2Candidate. Показано, что использование модели FastText и уровня старшинства позволяет нашему подходу получить более точные данные, чем другие существующие подходы.

Ключевые слова: система рекомендаций, рекомендация кандидата, рекомендация работы, NLP, FastText, языковые модели, обучение без учителя.

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A NEW APPROACH FOR SPEAKER ADAPTATION WITH TTS MODELS BASED ON TRANSFORMER AND FEW-SHOT LEARNING METHOD

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Abstract

Deep learning methods are showing state-of-the-art results in many fields of machine learning and speech synthesis with multiple speaker voices is not an exception. Adapting the existing multispeaker text-to-speech (TTS) model to new speakers remains a challenging task. Current methods of synthesizing speech with the voice of unseen speakers (referring to the speaker recordings not included in the model's training data) are based on either transfer-learning methods or fine-tuning of existing multispeaker TTS model which requires a lot of data (30 minutes at least). In the current work a new approach has been developed to synthesize unseen speaker speech with only about 3 minutes of data based on the same TTS model and a few-shot learning method for speaker embeddings.

Key words: multispeaker text-to-speech model, few-shot learning, voice cloning, transformer.

Introduction

After decades of research, text-to-speech synthesis or the process of creating natural voice from text remains a difficult task. There are numerous TTS systems available today that can produce natural-sounding voices that are incredibly near to human ones. Unfortunately, many of these systems acquire the ability to synthesize text using just one voice. The purpose of this study is to develop a TTS system capable of efficiently generating natural speech for a diverse range of speakers who are not necessarily encountered during the training phase. The process by which these models are created is called Voice Cloning. It has various use-cases including recording podcasts without voice recordings or personalizing digital assistants such as Apple's Siri.

Conflict setting

There has been a growing interest in end-to-end solutions throughout time. Tacotron 2 [1] learned directly from text-audio pairs using WaveNet [2] as a vocoder to transform generated spectrograms by sequencing with attention model architecture [3] that encrypts text and decrypts spectrograms; however, it was limited to a single speaker. Later, Gibiansky et al. [4] presented a multi-speaker Tacotron variant to learn a latent speaker embedding for each training speaker from training data. Deep Voice 3 [5] developed a fully convolutional encoder-decoder architecture that supports thousands of speakers from [6] LibriSpeech data. Previously we have obtained a TTS model, which is able to generate spectrograms of multiple speakers as well. However, these systems are not able to generate speech with the voice of an unseen speaker.

Voiceloop [7] suggested an innovative architecture capable of producing speech from unheard voices during training. However, this method needs more tens (30 minutes or even more in some

cases) minutes of speech and transcripts. Later, transfer-learning-based methods were invented [8] to use only a few seconds of audio to generate speech with that voice. However, these methods do not have the desired Mean Opinion Score (MOS). They do not sound like professional recordings because they used a predefined network for speaker embedding prediction for which the TTS model is not adapted.

To overcome these problems, we introduce a new method to get embedding for unseen speakers having no more than 3 minutes of speech using the same TTS model which will later condition that embedding to generate speech. To achieve this, we have changed the concatenative speaker embedding condition method with a complex layer to make our model more sensitive for speakers. We freeze the whole model except the embedding layer to finetune with 3 minutes of data and get the desired speaker embedding. This approach has few advantages over others. First, it uses the same weights to generate speech for all speakers, even for unseen ones and we have just to store embeddings. Next, it does not require significant data to achieve desired results, and finally, the training time to adapt to new speakers does not make the model forget old ones.

Methods and Models

Text to speech is a one-to-many mapping problem as a single letter or phoneme can be pronounced differently in different contexts. This section reviews the methods based on transfer-learning [8]. It covers our model's core components, FastSpeech2, FastPitch and TransformerTTS and methods intuition for solving unseen speaker problems.

A Multi-speaker Text-to-speech Synthesis Approach Based on transfer learning system consists of three components: a *speaker-encoder* that generates a fixed-dimensional embedding vector from a few seconds of reference speech delivered by a target speaker; a *synthesizer* that generates a mel-spectrogram from an input text and an embedding vector; and a *neural vocoder* that infers time-domain waveforms from the synthesizer's mel-spectrograms. At inference time, the speaker encoder receives a brief reference utterance from the target speaker as input and creates an embedding vector based on its internal learnt speaker characteristics space. The synthesizer accepts a phoneme (or grapheme) sequence as input and creates a mel-spectrogram with the speaker encoder embedding vector as a condition. Finally, the vocoder takes the synthesizer's output and creates the speech waveform. Following results can be accomplished by training a neural network model on a text-independent speaker verification task to optimize the GE2E loss [10], such that embeddings of the same speaker's utterances have a high cosine similarity. In contrast, those of different speakers' utterances are widely separated in the embedding space. The main disadvantage of this method is that it uses a pre-trained network to extract embeddings from a single utterance, leading to a leak of data about emotions in embeddings because of GE2E loss. Also, at inference, there is no possibility to fix some embeddings if there are any problems. The overall architecture of the method is described in Fig. 1.

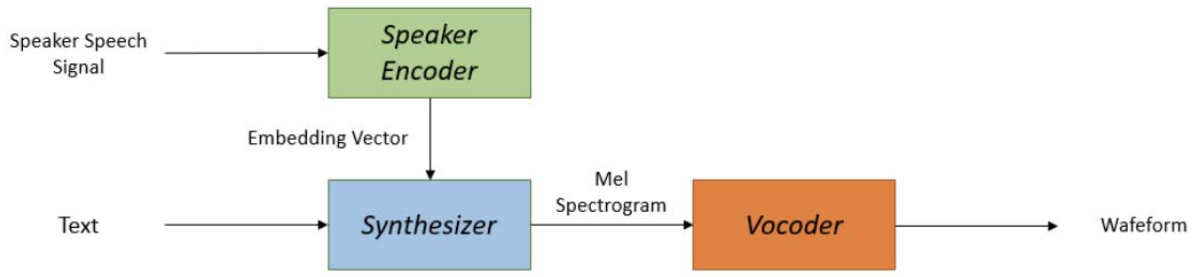

Fig. 1 High-level overview of the system

Our previous model has generated speeches with a high MOS score (4.173) for a large range of speakers using no more than 3 minutes of audio for each speaker. We achieved those results thanks to Transformer based architecture based on the Multi-Head Attention mechanism [11] and pitch and duration prediction during inference. The overall architecture of our previous model is described in Fig. 2. The following section shows how we use this model as a base, change the concatenative speaker embedding conditioning mechanism with a more complex layer, and adapt it to new speakers without forgetting old ones.

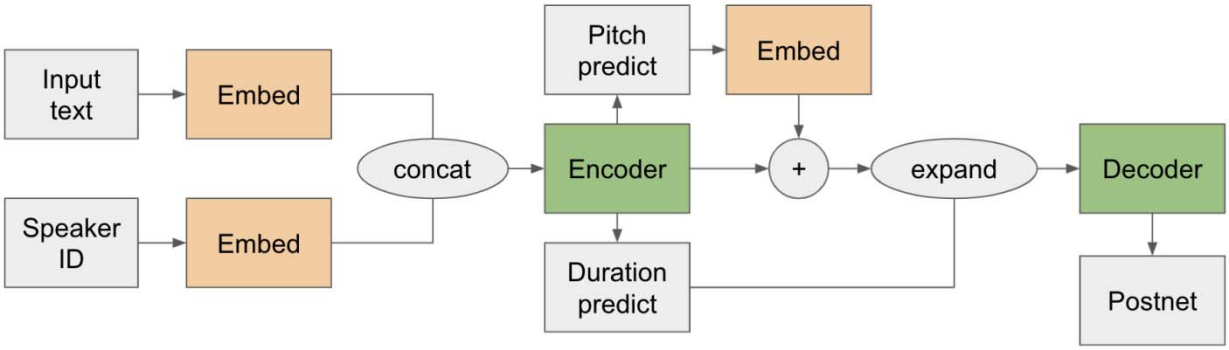

Fig. 2 The overall architecture of our previous TTS model

As a base, we use the model described in Fig. 2, a stack of Multi-Head Attention Transformer blocks. Both Encoder and Decoder consist of Self-Attention-Dense Blocks (SADB) followed by Self-Attention-Conv Blocks (SACB). This model can generate speech with more than 800 different voices with a MOS score higher than 4.1.

We have changed the concatenative method of applying speaker embedding with a more complex layer. Let us suppose that we have phoneme embeddings $E_s = E_{symbol}(x) \in R^{n \times d1}$ and speaker embedding $E_{sp} = E_{speaker}(s) \in R^{n \times d2}$, where n is the length of the input sequence (the length of phonemes of graphemes), x is an input sequence, E_{symbol} is the symbol encoder, and $E_{speaker}$ is a speaker encoder, $d1$ is the dimension of phoneme embedding and $d2$ is the dimension of speaker embedding. We changed the concatenative method $E = concatenate(E_{symbol}, E_{speaker}, axis = -1) \in R^{n \times d1+d2}$ with a more complex layer by adding a liner layer with bias. The final equation of merging symbol and speaker embeddings is below.

$$E_{concat} = concatenate(E_{symbol}, E_{speaker}, asix = -1) \in R^{n \times d1+d2}$$
$$E = W * E_{concat} + b \quad (1)$$

where W and b are trainable parameters. The intuition is that each speaker embedding dimension relates to each dimension of symbol embedding, which gives merged contextual embedding of symbols and speakers.

We found that by picking a random vector from speaker embedding space or merging few speaker embeddings with sum, mean or max pooling, the model generates speech with voices of unseen speakers. So we came to the idea that for every new unseen voice, we can find an embedding. Suppose we have a pre-trained model described in Figure 1 and data of a new unseen speaker. Our goal is to find an embedding with which the model will generate speech with an unseen speaker voice. To achieve this, we first have to find an initialization of that embedding e and, next, finetune that

embedding. First, we use two approaches for initialization - random initialization and picking one from the training set with a similar voice. Experiments show that convergence is faster in the second case, but the first case does not require any human interaction. In both cases, the results are very similar. Next, we change the $E_{speaker}$ layer in the model with our initialized embedding e. We freeze the whole model except e and train few hundred steps on the new data. Next, we pick the resulted embedding. In this way, the model can find such embedding with which it can generate speech of unseen voice.

To train the model using a new data, we employ the following loss previously introduced by us. It is a weighted sum of L1 loss for pitch, duration, and target mel-spectrogram and categorical cross-entropy for the speaker (as a weight of this loss, we use 0). L1 loss and categorical cross-entropy loss functions have these formulas:

$$L1(y,\hat{y}) = \sum_{i=1}^{n}|y_i - \hat{y}_i|. \quad (2)$$

Where y is the actual value, $\hat{y}$ is the predicted value, n is the vector size of vectors y and $\hat{y}$. With weights w_s, w_y, w_p, the total loss of the model will be:

$$L = w_s * CCE(s,\hat{s}) + w_y * L1(y,\hat{y}) + w_p * L1(p,\hat{p}) \rightarrow min \quad (3)$$

Research results

To evaluate the results, we use the Mean Opinion Score (MOS). We finetune the model for our internal speakers and it performs slightly better than other solutions as shown in Tab. 1.

Table 1

Mean Opinion Score (MOS) for speech naturalness with 95% confidence intervals

Method	MOS Score
Tacotron2 + GST - Zero-shot	2.67 ± 0.10
Expressive Neural Voice Cloning - Zero-Shot	3.56 ± 0.09
Expressive Neural Voice Cloning - Adaptation Whole	3.75 ± 0.09
Expressive Neural Voice Cloning - Adaptation Decoder	3.61 ± 0.09
Proposed model	3.83 ± 0.12

Overall, our solution works better and requires a small amount of data for unknown speakers which is a huge advantage compared to the existing solutions.

Conclusion

The challenge of speech synthesis for multiple voices is a rapidly developing area using deep learning methods. In this paper we have explored a new model of multispeaker text-to-speech generation which uses the fraction of the data required compared to existing methods (3 mins VS 30 mins) for speaker recordings which have not been previously used in the training data.

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ԽՈՍՆԱԿԻ ՁԱՅՆԻ ՀԱՐՄԱՐԵՑՄԱՆ ՆՈՐ ՄՈՏԵՑՈՒՄ ՏՐԱՆՍՖՈՐՄԵՐՆԵՐԻ ՎՐԱ ՀԻՄՆՎԱԾ TTS ՄՈԴԵԼԻ ԵՎ ՄԻ ՔԱՆԻ ՓՈՐՁՈՎ ՈՒՍՈՒՑՄԱՆ ՄԵԹՈԴԻ ԿԻՐԱՌՄԱՄԲ

Գ.Պ. Մաթևոսյան
Հայ-Ռուսական համալսարան

Խորը ուսուցման մեթոդները ցույց են տալիս բարձր մակարդակի արդյունքներ մեքենայական ուսուցման բազմաթիվ ոլորտներում, և բազմակի «խոսնակներով» խոսքի սինթեզը բացառություն չէ: Գոյություն ունեցող բազմախոսնակ տեքստից խոսք (TTS, text to speech) մոդելը նոր խոսնակներին հարմարեցնելը մնում է դժվարին խնդիր: Անտեսանելի խոսնակների (անտեսանելին վերաբերում է խոսնակի ձայնագրություններին, որոնք ներառված չեն մոդելի ուսուցման տվյալներում) ձայնով խոսքի սինթեզման ներկայիս մեթոդները հիմնված են կամ փոխանցման ուսուցման (transfer-learning) մեթոդների կամ գոյություն ունեցող բազմախոսնակ TTS մոդելի ճշգրիտ կարգավորման վրա (fine-tuning), որը պահանջում է բազմաթիվ տվյալներ (առնվազն 30 րոպե): Տվյալ աշխատանքում նոր մոտեցում է մշակվել անտեսանելի խոսնակի խոսքի սինթեզման համար՝ ընդամենը մոտ 3 րոպե տևողությամբ տվյալներով, հիմնված նույն TTS մոդելի և մի քանի փորձով ուսուցման (few-shot learning) մեթոդի վրա:

Բանալի բառեր. բազմախոսնակ տեքստից խոսք մոդել, մի քանի փորձով ուսուցում, ձայնի կլոնավորում, տրանսֆորմեր:

НОВЫЙ ПОДХОД ДЛЯ АДАПТАЦИИ ГОЛОСА СПИКЕРА С ИСПОЛЬЗОВАНИЕМ TTS-МОДЕЛЕЙ НА ОСНОВЕ ТРАНСФОРМЕРА И МЕТОДА ОБУЧЕНИЯ С НЕСКОЛЬКИМИ ПОПЫТКАМИ

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Методы глубокого обучения показывают высокие результаты во многих областях машинного обучения, и синтез речи с голосами нескольких спикеров не является исключением. Адаптация существующей мультиспикерной модели преобразования текста в речь (TTS, text to speech) к новым спикерам остается сложной задачей. Современные методы синтеза речи с голосом невидимого спикера (невидимый относится к записям спикера, не включенным в данные обучения модели) основаны либо на методах трансфер-обучения, либо на тонкой настройке (fine-tuning) существующей мультиспикерной модели TTS, которая требует большого количества данных (минимум 30 минут). В настоящей работе был разработан новый подход к синтезу речи невидимого спикера, с данными всего за 3 минуты, на основе той же модели TTS и метода обучения с несколькими попытками.

Ключевые слова: мультиспикерная модель текста в речь, обучение с несколькими попытками, клонирование голоса, трансформер.

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APPLICATION OF A GENERATIVE-ADVERSARIAL NETWORK FOR MANAGING A PRECISE STOCHASTICALLY CHANGEABLE SIGNAL SOURCES

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Abstract

The paper presents the results of calculations and tests of stochastically changeable sources of precise time in a network infrastructure. The simulation of the attack of availability for stochastically changeable sources of precise time signals managed by a generative-adversarial network has been carried out. To synchronize the decentralized network infrastructure, a minimum number of stochastically changing precise time signals sources has been determined.

Key words: regression, precise time signals, generative-adversarial network, attack of availability.

Introduction

Various devices («СТВ-01, ИСС-1.3», SEL-2488, PTP-1U) are used to provide data transmission networks with precise time (PT) signals the protocols of which are described in the scientific papers [1, 2, 3, 4]. With the growth of network-centric conflicts and network attacks based on M2M (Machine-to-Machine, M2M), the number of types of attacks both on sources of PT and on the network infrastructure (NI) itself, where the source of the exact time is the generator of the attack is also growing [5, 6].

When using highly dynamic network devices that constantly change their geospatial position (a swarm of unmanned aerial vehicles, many mobile terminals), the task of synchronizing all devices arises. The use of a stationary PT source is not always advisable, since in the event of an attack, the stationary PT source will be one of the primary targets. To ensure the stable functioning of the network infrastructure, the PTS source must move within the network infrastructure in accordance with the stochastic law. This problem is being actively investigated [7, 8, 9, 10, 11, 12], but the proposed solutions have certain limitations.

In particular, it is proposed to increase the number of PT sources during their pseudo-random movement, the secret of which lies in the movement algorithm. But this method has several disadvantages:

- all synchronized devices must know the switching order (key),
- with long-term observation, you can open the key to the switching algorithm and, as a result, attack the next PT source,
- impossibility of introducing new devices into the network infrastructure that do not have a switching algorithm,
- in any case, the system is centralized, since the number of PT sources is finite and small in relation to the entire set of synchronized devices.

To overcome these limitations, the model uses machine learning (ML) and deep learning (DL) techniques.

These terms mean: machine learning - is a class of artificial intelligence methods in which a solution to a problem is not found directly, but by using solutions to many similar problems, and deep learning is a set of machine learning methods based on the study of representations [13, 14].

Based on the above mentioned, the development of an algorithm for stochastic movement of sources of precise time signals in the network infrastructure becomes relevant. The scientific novelty of the research lies in the study of a model of stochastically moving sources of PT signals within the existing constraints.

Conflict setting and set of methodology

Development of an algorithm for stochastic switching of sources of PT signals in highly dynamic network infrastructures.

Three tasks are solved within the framework of the study:

1. determination of the boundary conditions of the algorithm,
2. development of an algorithm for switching PT sources to the state of a synchronized device and vice versa,
3. development of software that allows connecting synchronized devices to STV sources on the basis of a generative adversarial network [15].

Stage 1. Boundary conditions of the developed algorithm.

1. all devices must be both a PT source (server, S) and a synchronized device (client, C),
2. sampling from several PT sources must satisfy the conditions of the Marzullo algorithm (an algorithm for selecting a PT source from several sources of different accuracy) [16],
3. the probability of a geo-positional discrepancy between the servers and clients of the CTB should not exceed the value of the Kullback-Leibler interval (at the physical level, this limitation means that there should be communication between devices) [17].

Stage 2. Development of an algorithm for stochastic switching from the server state to condition of the client.

As a tool for the implementation of the second stage, a generative adversarial network has been chosen, which allows stochastic switching of the device from the state of the source of precise time signals to the state of the synchronized device. As a method for switching the state of devices, a «supervised learning» generative learning model («supervised learning» model is an algorithm, the prediction of which is based on existing templates) [18, 19] was chosen.

The choice of that method is conditional on the fact that the set of data of the functioning NI is known.

To determine the learning rate of a GAN, equation (1) is used to obtain [16].

$$a_t = a_{start} - (a_{start} - a_{end}) \times \frac{t}{K} \quad (1)$$

where a_t - learning rate, t - learning step, a_{start} – initial learning rate, a_{end} - end learning rate, K - number of iterations.

The learning rate of a generative adversarial network is a parameter at which the network learns to approximate the input-output relationship that is contained in the training data. The

manifestation of learning is a change in weight and a change in the rate of change in weight which determines the rate of learning [21, 22].

To determine the probability of failure of the decentralized PT system, equation (2) is used to obtain [17]

$$P(A) = \frac{(S-s+1)\times(S-s+2)\times\ldots\times(S-s+N)}{(S+1)\times(S+2)\times\ldots\times(S+N)} \quad (2)$$

where

P(A) - the probability of NI destabilization, *N* - the total number of PT servers and clients, *S* - the number of all PT servers, *s*-- the number of PT servers selected by the synchronized devices at a given time.

The use of equation (2) is due to the fact that a stochastically switched system of sources of precise time signals is decentralized due to the absence of a central stratum. A scheme is also implemented in distributed registry systems where each node (in our case, a synchronized device) randomly selects N_{nodes} to replenish and verify its database (in this case, update the time).

On the basis of equations (1.2), the equation (3) was obtained which determines the critical value of the number of sources of PT, above which the system becomes desynchronized. This inequality was obtained based on the solutions described in [13,24,25,26] in particular, the concept of logits is considered in [13, 24, 25] and the method for determining the coefficient of learning rate and decisions based on interactive the proofs are considered in [26].

$$P(A)_{a_t} \leq K_{crtttcat} \quad (3)$$

where, $P(A)_{a_t}$ is probability of desynchronization of the NI from retraining of the GAN, $K_{crtttcat}$ is the critical value of a decentralized synchronization system.

The critical number of PT sources is understood to be such a number at which an increase by one source leads to «overfitting» of the generative adversarial network.

Experimental procedures

1. Description of *GAN* working

The developed GAN based on previously entered data sets begins the procedure of stochastic switching server PT to client PT and client PT to server PT. Any PT client on the basis of the boundary conditions «searches» for PT servers and when conditions 2, 4 of stage 1 are satisfied, connects to it updating its time base. The training used a GAN with equal weights. The software implementation of the generative adversarial network was carried out using the «scikit-learn» library [27, 28, 29, 30]. Fig. 1 shows a model of a neural network of stochastic switching between PT servers and PT clients based on GAN with forward signal propagation.

2. Description of practical modeling

In the virtual environment of Microsoft Hyper-V Server 2016 [31], a virtual software-defined network is deployed based on 100 virtual routers (Cloud hosted router, CHR, based on Mikrotik license) [32] with installed NTP (Network time protocol, NTP) server packages and NTP client.

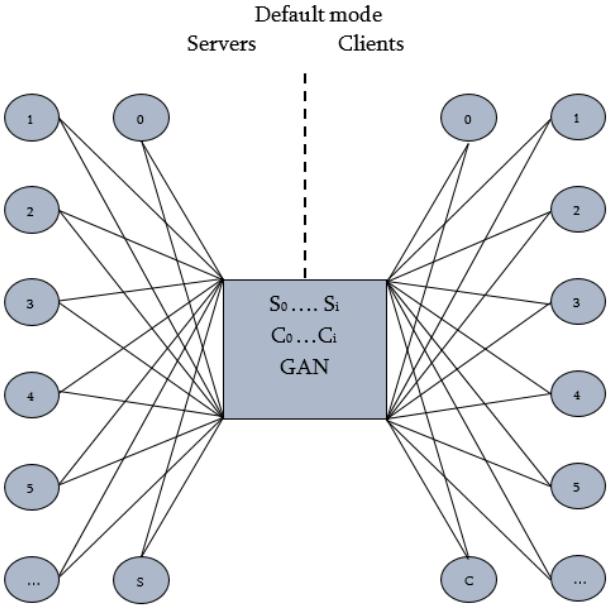

Fig. 1 A model of neural network of stochastic switching between CTB servers and PT clients based on GAN with direct signal propagation

S_0-S_i- - time server datasets, C_0-C_i - time clients datasets,GAN - generative adversarial network.

The purpose of virtual routers is to model a virtual network infrastructure. Various configurations are configured in the virtual NI. The procedure for turning on/off routers, switching to the NTP server or NTP client mode, changing the routing parameters is carried out using the developed software. The training of the generative network was carried out in 8 stages, 22 iterations each (at each stage, data sets of different levels of the OSI model were entered, the behavior of the virtual network was measured, a parameter was determined that led to a change in the source of the exact time signals). The hardware parameters of the server in which the measurements were carried out are presented in Tab. 1. The block diagram of the virtual environment is shown in Fig. 2.

Table 1

Type	Total RAM	CPU	Operation System	RAM for one CHR (Server/Client)
Dell Power Edge T-330	128 Gb	Intel Xeon E3-1200 v6	Microsoft Hyper-V Server 2016	1Gb

where, RAM- random access memory, CPU-central processor unit.

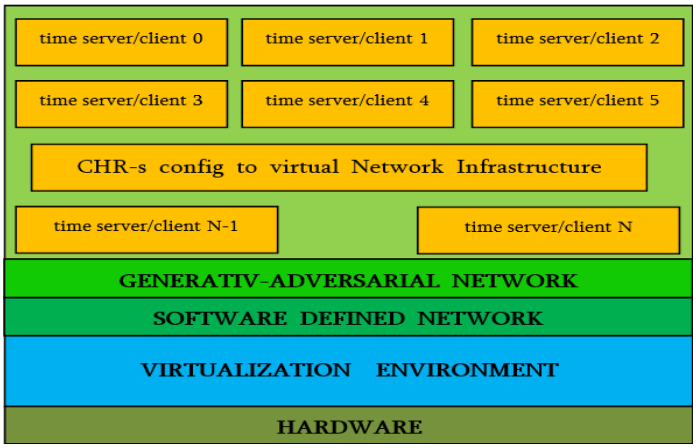

Fig. 2 The block diagram of the virtual environment

Research results

For training the generative adversarial network and calculations, a test dataset is used which is obtained from the existing data transmission network as well as three peering exchange points.

The results of studying a network infrastructure consisting of 100 devices controlled by a generative adversarial network are presented in Tab. 2, with $0{,}43 < K_{crittcal} \leq 0{,}45$.

The calculations were performed in the following software environments:

1. IBM SPSS Statistics [33],
2. Matlab (Statistics and Mashine learning toolbox) [34].

Table 2

t	MAE Actual	MAE Predicted	RMSE Actual	RMSE Predicted	a_t Actual	a_t Predicted
0	3,485	3,496	1,185	1,218	8	3* 7** 10***
1	4,128	4,278	1,431	1,476	14	5* 9** 11***
2	5,527	5,573	1,536	1,542	17	6* 9** 13***
3	6,134	6,146	1,647	1,680	19	8* 11** 14***
4	7,528	7,614	1,852	1,873	22	9* 16** 20***

where,

t is learning step, a_t is learning rate, MAE mean absolute error, RMS root mean squared error, * - undertrained generative-adversarial network, ** - trained generative-adversarial network, *** - retrained generative-adversarial network (overfitiing GAN).

Figures 3, 4, 5 show graphs of predicted (P) and actual (A) values of linear regression for undertrained, trained and retrained (overfitting) GAN.

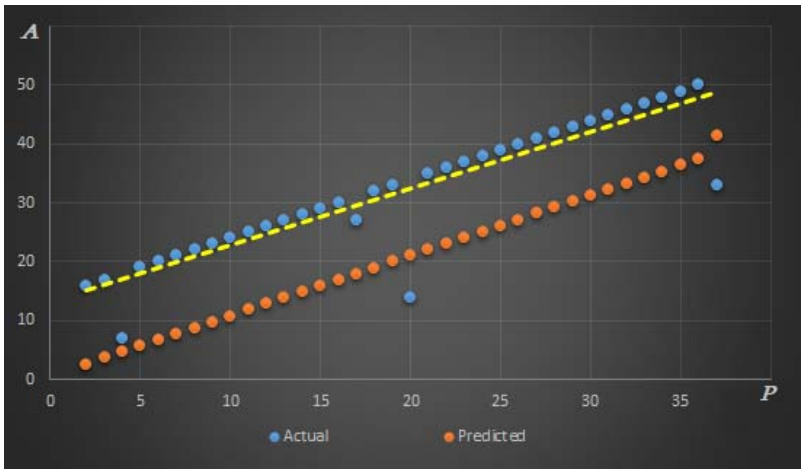

Fig. 3 The values of linear regression for undertrained GAN

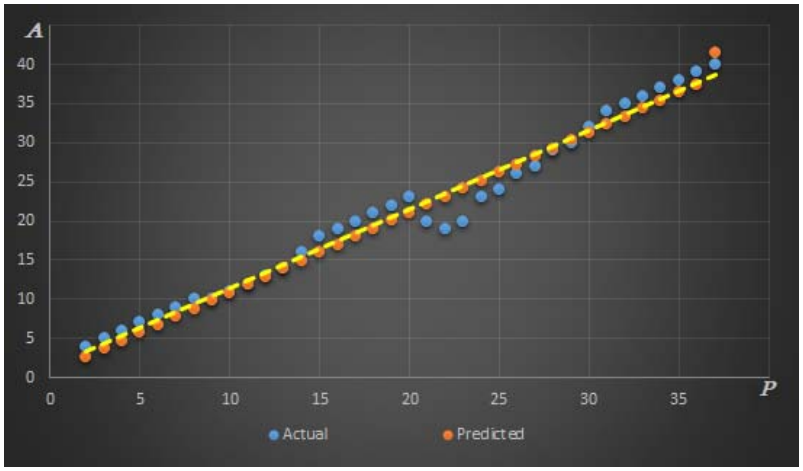

Fig. 4 The values of linear regression for trained GAN

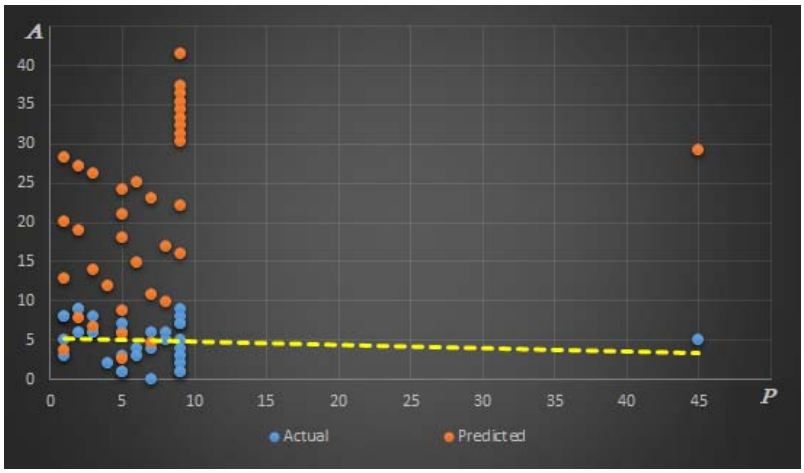

Fig. 5 The value of linear regression for retrained GAN

Conclusion

The research of the use of a GAN for the control of stochastically moving sources of precise time signals has been carried out. A model and software have been developed that allow connecting synchronized devices to sources of precise time signals based on a generative adversarial network. The results obtained confirm that with a trained generative adversarial network, it is possible to create a network infrastructure with a decentralized stochastically moving source of precise time signals.

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ԳԵՆԵՐԱՏԻՎ-ՄՐՑԱԿՑԱՅԻՆ ՑԱՆՑԵՐԻ ԿԻՐԱՌՈՒՄԸ ՍՏՈՒԱՍՏԻԿ ՏԵՂԱՓՈՒՎՈՂ ՃՇԳՐԻՏ ԺԱՄԱՆԱԿԻ ԱԶԴԱՆՇԱՆՆԵՐԻ ԱՂԲՅՈՒՐՆԵՐԻ ՂԵԿԱՎԱՐՄԱՆ ՀԱՄԱՐ

Թ.Վ. Ջամղարյան
Հայաստանի ազգային պոլիտեխնիկական համալսարան

Ներկայացված են ապակենտրոնացված ցանցային ենթակառուցվածքում ստոխաստիկ տեղափոխվող ճշգրիտ ժամանակի աղբյուրների կիրառության հնարավորության հաշվարկները և թեստերի արդյունքները:

Ճշգրիտ ժամանակի աղբյուրների կլիենտների տեղափոխման ղեկավարումը և միացումը ճշգրիտ ժամանակի սերվերներին իրականացվել է գեներատիվ-մրցակցային ցանցի հիման վրա: Իրականացվել է ճշգրիտ ժամանակի ազդանշանների աղբյուրների դեմ հասանելիության գրոհի մոդելավորում՝ իրենց ստոխաստիկ տեղափոխման ժամանակ:

Անցկացված տեսական (գծային հետընթածի հիման վրա) և գործնական (վիրտուալ միջավայրում) թեստերը ապացուցում են համակարգի օգտագործման հնարավորությունը բարձր դինամիկայով, ապակենտրոնացված ցանցային ենթակառուցվածքներում հասանելիության դեմ գրոհի զանգվածային կիրառման դեպքում: Մշակվել է հաշվեկարգ և համապատասխան ծրագրային ապահովում գեներատիվ-մրցակցային ցանցի գործունեության ապահովման համար:

Բանալի բառեր. հետընթած, գեներատիվ-մրցակցային ցանց, հասանելիության դեմ գրոհ, ճշգրիտ ժամանակի ազդանշան:

ПРИМЕНЕНИЕ ГЕНЕРАТИВНО-СОСТЯЗАТЕЛЬНЫХ СЕТЕЙ ДЛЯ УПРАВЛЕНИЯ СТОХАСТИЧЕСКИ ПЕРЕМЕЩАЕМЫМИ ИСТОЧНИКАМИ СИГНАЛО ТОЧНОГО ВРЕМЕНИ

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Представлены результаты расчетов и тестов применения стохастически перемещаемых источников сигналов точного времени в децентрализованной сетевой инфраструктуре. Управление перемещением и подключением клиентов точного времени к серверам точного времени осуществлялось на основе генеративно-состязательной сети.

Проведено моделирование атаки на доступность на источники сигналов точного времени при их стохастическом перемещении. Проведенные теоретические (на основе линейной регрессии) и практические тесты (в виртуальной среде), доказывают возможность применения системы в высокодинамичных децентрализованных сетевых инфраструктурах при массированных атаках на доступность.

Разработан алгоритм и соответствующее програмнное обеспечение для функционирования управляющей генеративно-состязательной сети.

Ключевые слова: регрессия, генеративно-состязательная сеть, атака на доступность, сигнал точного времени.

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THE PERSPECTIVES OF INDUSTRIAL DEVELOPMENT IN POST-WAR ARTSAKH REPUBLIC

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Abstract

The experience of developed free market-oriented economies indicate that the creation of financial-industrial groups is one of the best forms of industrial enterprises and integration of financial-crediting structures. Generaly speaking, financial-industrial groups create necessary prerequisites for having more manageable economy and concentration of resources in the right direction promoting establishment of more effective links between the state and the private sector. Establishment and functioning of financial-industrial groups will open up wide opportunities for industrial enterprises of the Republic of Artsakh to restore economic relations interrupted by the last war, to optimize the flow of goods and finances, to carry out capital-productive investment and to upgrade production technologies and capital assets.

This paper presents the main economic performance in the Republic of Artsakh for both prewar (2015-2019) and 2020-2021 periods for January-August growth tendencies.

***Key words**:* town, urbanization, industry, infrastructure, product.

Introduction

The consistent introduction of principles of multicenter development aimed at neutralizing possible threats of uncontrolled urbanization and creating a more spatially balanced system of settlement is conditioned by both the necessity of overcoming the existing imbalances in regional development and the zones of high seismic danger, and, in particular, taking measures to prevent undesirable density of population growth in the capital.

One of the important directions of industrial development in the post-war Republic of Artsakh is urban development. In this field, the necessity of implementing the principles of the strategy of national security of the Artsakh Republic is conditioned by the fact that the formation of the vital space of each country and the development of vital activities takes place in an environment formed by urban development. Having lived its development for millennia and always being an essential component of human civilization, urban planning has solved many fundamental problems of creating a man-made environment.

The importance and urgency of ensuring the systems of security, reliability and stability of urban development are also conditioned by the rapidly growing urban population around the world, greatly urbanizing the directions of the solution of various problems.

In a country considered a war zone, the implementation of necessary measures in buildings which are in poor technical condition is of strategic importance for the Republic of Artsakh. Therefore, serious technical intervention and state control are required as further operation of the mentioned buildings without reinforcement and restoration will lead to further development of damages and deformations in the structural elements, the emergence of new ones, seismic resistance of buildings and in this regard, the additional requirement of significant financial resources for the implementation of further reconstruction work, the need to demolish buildings conditioned by emergency state, as well as by possible unpredictable consequences.

In terms of seismic resistance of buildings built years ago in Artsakh, the implementation of their process of passport registration is used to ensure the reliability. The main task of issuing the passports of buildings under study is to provide the necessary technical data for the development of appropriate effective measures to determine the minimum permittable level of reconstruction of buildings as a result of inspections of the technical condition of the facility.

Including the spheres of urban planning, architecture, construction, housing and communal services and dealing with problems in many other areas and engineering infrastructures, in fact, they are called to ensure the harmonization of the interests of the state, society and the individual related to balancing the resettlement systems of the country, sustainable use of territorial, natural and historical and cultural resources, and having a safe and affordable living space for the population and enabling access to utilities with the issues of protection from dangerous geological and man-made phenomena, ensuring seismic resistance of buildings and structures and their safe operation.

Such thorough investigation is directly related to the vital interests of the state, society and the individual. Therefore, it is necessary to consider the ways of prevention and neutralization of the threats to the latter within the framework of the agenda ensuring national security.

Thus, industry is that branch of the economy where the bulk of the means of production and articles of consumption are produced. Therefore, both the social production development and the increase of the the population living standard, eventually, are conditioned by the development of the industry.

Conflict setting

Generally speaking, the primary goal of development of sustainable industry is to create a favorable environment for the future generations to live and to gradually improve the quality of life of

the population through urban development. The growth of industrial production is ensured by increasing labor productivity and the latter ensures the efficiency of social production as well as the growth of the population.

As the development of industry characterizes the level of development of the whole economy, the complex program of industrial development is important in the system of other programs of economic and social development of Artsakh. The program of industrial development is also connected with the development programs of other branches of production which is conditioned by the real interconnections of those branches. The development of the industry is possible in the case of introduction of new production capacities and realization of fixed assets. The volume of capital construction in Artsakh depends on the problems of industry development because the material and technical base for the development of that branch - construction machinery, mechanisms and construction materials - are mainly imported from abroad.

Research results

The program of industrial development is closely linked to the use of labor resources and programs designed to improve the living standards of the population.

Despite the implementation of the state policy aimed at the development of industry, it is still impossible to maintain the prewar industrial potential of the Republic of Artsakh and to create the necessary preconditions for its further development.

One of the main directions of the industrial policy of the Republic of Artsakh is the reconstruction and restoration of production infrastructures. The positive changes observed in Artsakh in the post-war period in the field of industry are not enough to contribute to the socio-economic development of the country. The problems of identifying the components that ensure the effectiveness of industrial policy and their application have not been solved yet.

One of the issues of strategic importance should be that Artsakh should become an industrial country. It is necessary to clarify the state policy towards a number of key economic complexes listed below:

- agriculture,
- energy sector,
- mining,
- construction,
- science-consuming industry.

This section provides data that describe the data representing the dynamics of the volume of industrial production in full and individual sectors, including the production of the most important types of industrial products in 2019-2021 given in the statistical yearbooks of the Republic of Artsakh [1-3].

The volume of industry output, in its entirety, according to its individual branches, is determined in terms of value as the sum of the volume of released manufactured goods and services provided by economic entities. Data on the product volume are given by the prices of the respective year. Summary of data on the volume of industrial output includes data on the volume of industrial output released by large, medium and small organizations. The volume of the industrial output of any organization is determined without the value of internal turnover.

An index of the physical volume of an industrial product is a relative index that describes the change in the mass of material good produced over comparable periods. The chain index is applied to construct dynamic series. Product appraisal is carried out directly in organizations on the basis of manufacturers' prices. Value added tax, excises and other sales taxes are not taken into account in the

volume of industrial output when calculating the physical volume index. The volume of sold products is the cost of own production that was actually delivered to consumers during the reporting period, the work and services performed accepted by the customer regardless of whether the payment was credited to the manufacturer or not. The production of an industrial product in its natural form, as a rule, is given according to the gross output of the product, that is the product processed from the raw material of the customer spent for the industrial-production needs within the given organization.

The main indicators of the industry of the Artsakh Republic and their fluctuation in 2015-2019 is presented in Table 1. During this period, the share of industry in the added value of Artsakh has almost doubled. It is noteworthy that the share of industry in GDP increased from 16,4% in 2015 to 30,0% in 2016. It should be noted that this indicator almost exceeds the corresponding index of the Republic of Armenia which means that the level of industrialization of the economy in Artsakh is almost twice as high as in Armenia. Such a high rate was achieved in Artsakh due to the progressive growth of the physical volume of industrial production, especially in 2017-2019, in the period when the index indicator was 154,8%, 129,3% and 140,1%, respectively. It should be noted that the development of industry has also undergone a qualitative change, the latter being manifested by the fact that the processing industry compared to the type of "mining industry - exploitation of open pits" economic activity, especially in 2019, has increased by 2-7 times compared to that in 2018. The type of economic activity as "supply of electricity, gas, steam - conditioned air" has also grown at a high rate (Table 2).

Table 1

The main indicators of the industry of the Republic of Artsakh and their fluctuation in 2015-2019 [2, p. 201]

	2015	2016	2017	2018	2019
Industry: share in value added, %	17.3	17.6	26.3	30.4	31.5
Industry:share in GDP, %	16.4	16.9	24.9	28.5	30.0
Number of industrial organizations, units	347	369	395	416	433
Volume of industrial production, million AMD	53541.9	58999.5	97490.3	125006.1	164999.8
Index of physical volume of industrial output compared to the previous year, %	102.5	109.7	154.8	129.3	140.1
Index of manufacturers' price compared to the previous year, %	106.9	103.0	102.4	98.0	97.1
Fixed assets (end of year, by: initial cost), million AMD	145754.6	158986.1	182977.6	204400.5	234201.4
List number of average industrial-production staff, people	6630	6345	6319	6518	7080
compared to the previous year, %	105.9	95.7	99.6	103.1	108.6
Average monthly nominal salary, AMD	155883	152707	166205	184542	215171

Table 2

Indices of industrial output of the Republic of Artsakh by types of economic activity in 2015-2019 related to the previous year in percentage [2, p. 202]

	2015	2016	2017	2018	2019
The whole industry	102.5	109.7	154.8	129.3	140.1
Mining and open pit mining	87.4	139.2	263.4	134.7	97.2
Manufacturing industry, total	106.8	91.5	103.2	129.4	2.7 times
Supply of electricity, gas, steam and good air	109.3	110.8	116.2	112.9	114.9
Water supply, sewerage, waste management and recycling	148.7	99.5	136.2	90.8	85.0

However, the data on the volume and structure of industrial production listed in Table 3, show that the physical volume of manufacturing industry in 2015-2019 increased more than 3-5 times during 2015, due to which the share of manufacturing industry in the volume of industrial output grew from 40,4% in 2015 to 43,0% in 2019. This, of course, is a positive trend. During the mentioned period, the open pit mines operation in the mining industry reached its "peak" in 2018, amounting to about 69.3 billion Armenian drams or 55.4% of the total industrial output. Due to the high growth rates of the latter manufacturing industry, it decreased to 38,1 % in 2019.

Table 3

Volume and structure of industrial production in the Republic of Artsakh by sections of types of economic activity, 2015-2019 [2, p. 204-205]

	2015	2016	2017	2018	2019
The whole industry	53541.9	58999.5	97490.3	125006.1	164999.8
	100.0	100.0	100.0	100.0	100.0
Mining and open pit mining, total	12937.5	17119.6	52059.9	69293.9	62935.5
	24.2	29.0	53.4	55.4	38.1
Manufacturing industry, total	21613.9	19932.0	20812.9	28385.1	70877.1
	40.4	33.8	21.3	22.7	43.0
Supply of electricity, gas, steam and good air	18279.0	21250.5	23667.0	26464.4	30454.5
	34.1	36.0	24.3	21.2	18.5
Water supply, sewerage, waste management and recycling	711.5	697.4	950.5	862.7	732.7
	1.3	1.2	1.0	0.7	0.4

numerator - million Armenian drams
enominator - by percentage of the total.

Table 4 shows the production of industrial products of the Republic of Artsakh in natural form and their fluctuation in 2015-2019. The highest economic growth rate in the mentioned period was the production of ore concentrate (493.1%), as well as the power production (216.6%). As for the territorial structure of the industrial products of the Republic of Artsakh, in 2015-2019 the share of Stepanakert made about 50% of the industrial production, and the share of Martakert administrative district increased about 4.8 times in the same period (Table 5). Figure 1 shows the structure of industrial production in the Republic of Artsakh by sections of types of economic activity in 2019.

Table 4

Production of PC products in natural form and their movement 2015-2019 [2, p. 206-207]

	2015	2016	2017	2018	2019	2019 compared with 2015-%
A	**1**	**2**	**3**	**4**	**5**	**6**
Electric power, million k/Wh	221.3	296.5	328.0	385.1	479.3	216.6
Ore concentrate, t	21889.7	30241.8	84076.6	115990.0	107935.0	493.1
sawn materials, m3	4066.5	6892.3	9925.3	7472.9	3964.7	97.5
parquet, m2	1467.6	804.0	3017.9	130.0	2569.7	175.1
facing tiles made of natural stone, m2	26099.4	16774.7	23497.9	40240.4	53119.7	203.5
curb stones, meters	5742.2	10406.0	16139.2	10746.2	12557.8	218.7
window construction parts, m2	7310.7	4800.7	8809.5	7807.6	4969.5	68.0
Polyethylene pipelines, thousand sq.m.	165.9	152.3	190.4	310.6	297.6	179.4
carpets and carpet products, t	13.8	5.1	3.4	4.2	3.0	21.7
cotton fabrics, t	12.3	7.3	7.7	7.5	11.5	93.5
shoes, thousand pair	124.9	116.1	107.1	101.9	90.9	72.8
meat, t	1256.6	1256.2	1274.4	1069.3	1133.5	90.2
milk and dairy products (recalculated milk), t	2978.8	3013.6	404.7	376.5	362.1	12.2

A	1	2	3	4	5	6
cheese, t	153.7	119.9	397.5	498.5	358.4	233.2
village butter, t	27.6	37.8	35	61.9	47.4	171.7
vegetable oil, t	1035.0	974.4	1082.8	1273.5	1163.5	112.4
bread, t	19474.1	19492.1	19588.7	19678.6	18991.9	97.5
vodka, thousand l	570.2	451.4	413.5	486.0	587.0	103.0
brandy, thousand l	19.4	12.4	28.5	19.4	26.9	138.7
grape wine, thous. l	135.5	161.9	186.4	231.4	296.9	219.1
flour, t	8301.0	10069.4	9562.3	8085.1	8857.7	106.7
alimentary paste, t	123.0	35.0	26.2	9.9	4.2	3.4

Table 5

Volume of industrial production of the Republic of Artsakh (labor, service) and structure at current prices by regions 2015-2019 [2, p. 208-209]

	2015	2016	2017	2018	2019
Total	53541.9	58999.5	97490.3	125006.1	164999.8
	100.0	100.0	100.0	100.0	100.0
Stepanakert	26606.6	26568.9	27552.3	35534.8	79597.5
	49.7	45.0	28.3	28.4	48.2
Askeran	3037.6	3013.5	3375.6	4044.2	5146.2
	5.7	5.1	3.5	3.2	3.1
Hadrut	1606.6	1773.4	2034.1	2307.3	2689.4
	3.0	3.0	2.1	1.9	1.6
Martakert	14273.8	19074.5	55123.1	72988.2	65468.6
	26.6	32.3	56.5	58.4	39.7
Martuni	4589.9	4707.1	4691.0	4520.4	4565.0
	8.6	8.0	4.8	3.6	2.8
Shahumian	255.9	393.8	1266.3	1700.8	1735.7
	0.5	0.7	1.3	1.4	1.1
Shushi	467.9	469.2	447.3	478.4	778.5
	0.9	0.8	0.4	0.4	0.5
Qashatagh	2703.4	2999.1	3000.6	3432.0	5018.9
	5.0	5.1	3.1	2.7	3.0

Numerator - million drams, denominator - with interest only.

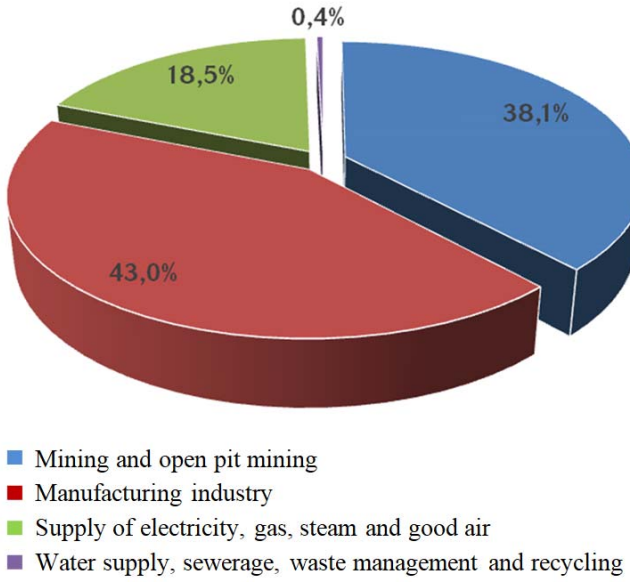

Fig. 1 The structure of the industrial production of the Republic of Artsakh according to the types of economic activity in 2019, [2, p. 213]

In the period from September 27 to November 9, 2020 as a result of the 44-day war, 75% of the territory of the Republic of Artsakh passed to Azerbaijan which resulted in a significant damage to the industry of Artsakh (Tables 6 and 7).

Table 6

The main indicators of the Artsakh industry in 2020-2021 January-August [3, p. 2-5]

Types of economic activity	Indicator code	Actual January-August		Growth rates in percentage
		2021	2020	
A	**1**	**2**	**3**	**4**
The whole industry	1	35551.7	X	43.6
including	1a	4825.3	X	44.3
	2	54092.7	81502.5	X
	2a	5673.6	10901.7	X
	3	51845.1	80561.2	64.4
	3a	22389.9	41447.7	54.0
	3b	303.4	4300.2	7.1
1. Mining and open pit mining	1	11824.5	40916.4	28.9
	1a	1722.7	6665.8	25.8
B	2	26896.8	40916.4	X
	2a	2329.0	6665.8	X
	3	24022.0	39494.3	60.8
	3a	21565.6	35550.7	60.7
	3b	-	2665.1	-
Extraction of metallic ores	1	11205.3	39576.2	28.3
	1a	1506.8	6465.3	23.3
	2	26061.7	39576.2	X
07	2a	2113.1	6465.3	X
	3	23231.8	38200.9	60.8
	3a	21565.5	35233.0	61.2
	3b	-	2665.1	-
1.2 Other branches of mining industry and open pit mining	1	372.2	1229.5	30.3
	1a	158.5	183.1	86.6
	2	530.7	1229.5	X
08	2a			
	3	158.5	183.1	X
	3a	485.8	1182.7	41.1
	3b	0.1	317.7	-
1.3 Activities related to the mining industry	1	247.0	110.7	2.2 times
	1a	57.4	17.4	3.3 times
09	2	304.4	110.7	X
	2a	57.4	17.4	X
	3	304.4	110.7	2.8 times
	3a	-	-	-
	3b	-	-	-
Manufacturing industry	1	12160.7	18738.6	64.9
	1a	1879.0	1864.0	100.8
C	2	14541.2	18738.6	X
	2a	2141.2	1864.0	X
	3	15168.4	19219.6	78.9
	3a	824.3	5897.0	14.0
	3b	303.4	1635.1	18.6
Food production	1	5066.2	9803.0	51.7
	1a	677.6	1177.8	57.5
10	2	6051.4	9803.0	X
	2a	743.3	1177.8	X
	3	6035.5	10227.3	59.0
	3a	384.4	2082.3	18.5
	3b	-	23.5	-
2.2 Beverage production	1	1241.2	1426.4	87.0
	1a	209.4	157.2	133.2
	2	1964.1	1426.4	X
11	2a	387.9	157.2	X
	3	1965.0	1550.6	126.7
	3a	421.9	613.8	68.7
	3b	283.6	139.0	2 times
2.3 Production of tobacco	1	429.4	-	-
	1a	192.3	-	-
	2	621.7	-	X
12	2a	192.3	-	X
	3	233.6	-	-
	3a	-	-	-

	1	2	3	4
	3b	-	-	-
2.4 Manufacture of other non-metallic mineral products	1	1337.7	945.1	141.5
	1a	283.0	174.6	162.1
	2	1657.2	945.1	X
	2a			
23	3	304.5	174.6	X
	3a	1671.3	741.6	2.3 times
	3b	2.3	30.4	7.6
2.5 Production of base metals	1	1721.4	-	-
	1a	222.1	-	-
	2	1943.5	-	X
	2a	222.1	-	X
24	3	2955.3	-	-
	3a	-	-	-
	3b	-	-	-
2.6 Manufacture of finished metal products, except machinery and equipment	1	1099.5	301.2	3.6 times
	1a	112.8	81.4	138.6
	2	965.7	301.2	X
	2a			
25	3	111.4	81.4	X
	3a			
	3b	972.9	301.2	3.2 times
2.7 Manufacture of furniture	1	247.4	174.5	141.8
	1a	47.2	16.4	2.9 times
	2	267.5	174.5	X
31	2a	40.1	16.4	X
	3	267.5	174.6	153.2
	3a	-	8.0	-
	3b	-	18.4	-
3. Supply of electricity, gas, steam and good air	1	11189.7	21343.5	52.4
	1a	1154.8	2323.3	49.7
D	2	12204.4	21343.5	X
	2a			
	3	1134.6	2323.3	X
	3a	12204.4	21343.3	57.2
	3b	-	-	-
4. Supply of electricity, gas, steam and good air	1	11189.7	21343.5	52.4
	1a	1154.8	2323.3	49.7
	2	12204.4	21343.5	X
35	2a	1134.6	2323.3	X
	3	12204.4	21343.3	57.2
	3a	-	-	-
	3a	-	-	-
5. Water supply, sewerage, waste management and recycling	1	376.8	504.0	74.8
	1a	68.8	48.6	141.6
	2	450.3	504.0	X
E	2a			
	3	68.8	48.6	X
	3a	450.3	504.0	89.3
	3a	-	-	-
6. Water collection, treatment and distribution	1	354.1	482.6	73.4
	1a	65.4	45.8	142.8
	2	424.2	482.6	X
	2a	65.4	45.8	X
36	3	424.2	482.6	87.9
	3a	-	-	-
	3a	-	-	-

Indicators show the following rates:

1- Volume of products (labor, services) at comparable prices, million drams

1a- including the reporting month

2. The volume of products (labor, services) at current prices, million drams

2a - including the reporting month

3 - Sale of finished products at current year prices, million drams, of which:

3a - in the CIS countries

3b - in other countries

Table 7

The main types of industrial products of the Republic of Artsakh in natural terms 2021 January-August [3, pp. 6-7]

		Actual product release				
		In the reporting month	From the beginning of the reporting year, 2021	Since the beginning of the last year, 2020	Growth rate since the beginning of the year	Growth rate since the beginning of the year
A	**B**	**1**	**2**	**3**	**4**	**5**
Power generation						
Electric power	million kWh	14.3	128.2	412.4	31.1	-284.2
Metallurgical industry						
Concentrate	ton	2268.0	27047.0	77459.2	34.9	-50412.2
Production of rubber and plastic products						
Polyethylene pipe	thousand linear m.	21.5	123.0	295.1	41.7	-172.1
Timber processing and production of wood products						
Sawn materials	cubic m.	608.3	2520.4	2279.1	110.6	241.3
Wooden cans	cubic m.	0.0	11.2	9.6	116.7	1.6
Production of other non-metallic mineral products and mining						
Concrete	cubic m.	2085.5	5698.6	4433.6	128.5	1265.0
Lime	ton	236.6	1712.9	5063.4	33.8	-3350.5
Plaster	ton	33.3	170.3	953.0	17.9	-782.7
Facing tiles made of natural stone	square m.	2553.5	16090.6	38916.1	41.3	-22825.5
Non-mineral building material	ton	33190.6	100023.2	119436.4	83.7	-19413.2
Crushed stone	cubic m.	18550.8	64518.7	47164.2	136.8	17354.5
Construction sand	cubic m.	4199.8	25064.5	72272.2	34.7	-47207.7
Sand and gravel mixture	ton	10440.0	10440.0	0.0	-	10440.0
Granite slabs	square m.	0.0	0.0	2.7	-	-2.7
Marble block	cubic m.	240.3	728.1	1807.3	40.3	-1079.2
Curb stones	linear m.	763.1	9700.5	12104.7	80.1	-2404.2
Asphalt concrete	ton	12462.0	35075.2	5840.3	6 times	29234.9
Production of metal construction structures						
Doors and windows	square m.	1942.9	25411.6	4566.7	5.6 times	20844.9
Doors	square m.	464.9	6828.8	1432.6	4.8 times	5396.2
Windows	square m.	1478.0	18582.8	3134.1	5.9 times	15448.7
Production of textile products, production of clothes and shoes						
Carpets and carpet products	ton	0.0	1.2	1.5	80.0	-0.3
Cotton fabrics	ton	0.4	4.0	5.8	69.0	-1.8
Shoes	hous. pairs	0.0	7.4	19.1	38.7	-11.7
Production of food and beverage products						
Meat	ton	94.3	696.2	909.3	76.6	-213.1
Vegetable oil	ton	43.5	477.6	779.9	61.2	-302.3
Canned food	ton	74.7	239.5	539.3	44.4	-299.8

A	B	1	2	3	4	5
Cheese	ton	29.2	234.3	264.5	88.6	-30.2
Milk	ton	29.7	239.3	220.6	108.5	18.7
Yogurt	ton	99.1	642.0	659.2	97.4	-17.2
Cottage cheese	ton	8.4	57.7	85.4	67.6	-27.7
Sour cream	ton	41.0	335.8	370.7	90.6	-34.9
Buttermilk	ton	9.8	39.1	22.0	177.7	17.1
Butter	ton	1.8	13.8	15.9	86.8	-2.1
Flour	ton	349.0	3465.5	4714.2	73.5	-1248.7
Bread	ton	880.9	7331.4	12861.6	57.0	-5530.2
Confectionery	ton	11.1	60.5	64.3	94.1	-3.8
Alimentary paste, t	ton	0.0	0.0	18.7	-	-18.7
Vodka	hous. l.	119.5	573.2	382.8	149.7	190.4
Brandy	hous. l.	9.3	21.2	6.8	3.1	14.4
Wine	hous. l.	19.1	80.2	70.7	113.4	9.5
Non-alcoholic beverages	thous. l.	268.1	1550.3	1222.2	126.8	328.1

Conclusion

Due to the high growth rates of industrial production in the (pre-war) Republic of Artsakh the share of industrial production in GDP reached up to 30% in 2015-2019 which was almost twice as high as in the case of the Armenian industry. The main branches of industry are the processing industry and the mining industry, the operation of open pits the share of which in 2019 exceeded 80% of the volume of industrial production. In the period from September 27 to November 9, 2020, as a result of the Armenian-Artsakh 44-day war, 75% of the territory of Artsakh was occupied by Azeris which caused irreversible damage, especially to industry. The restoration and further development of the industry of the Artsakh Republic is largely conditioned by the solution of the status of Artsakh, as well as by the elaboration and implementation of complex programs for the development of industry in Artsakh.

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ՀԵՏՊԱՏԵՐԱԶՄՅԱՆ ՇՐՋԱՆՈՒՄ ԱՐՑԱԽՈՒՄ ԱՐԴՅՈՒՆԱԲԵՐՈՒԹՅԱՆ ԶԱՐԳԱՑՄԱՆ ՀԵՌԱՆԿԱՐՆԵՐԸ

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[1]Երևանի պետական համալսարան
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Զարգացած շուկայական տնտեսություն ունեցող երկրների փորձը վկայում է, որ արդյունաբերական ձեռնարկությունների և ֆինանսավարկային կառուցների ինտեգրման լավագույն ձևերից է ֆինանսաարդյունաբերական խմբերի ստեղծումը: Ընդհանուր առմամբ, ֆինանսաարդյունաբերական խմբերը նախադրյալներ են ստեղծում ավելի կառավարելի տնտեսություն ունենալու համար, կենտրոնացնում են ռեսուրսները անհրաժեշտ ուղղությամբ, օգնում են հաստատել ավելի արդյունավետ կապեր պետության և մասնավոր հատվածի միջև: Ֆինանսաարդյունաբերական խմբերի ստեղծումն ու գործունեությունը լայն հնարավորություն կտան արդյունաբերական ձեռնարկություններին Արցախի Հանրապետությունում վերականգնել խզված տնտեսական կապերը, օպտիմալացնել ապրանքների և ֆինանսական հոսքերի շարժը, կատարել կապիտալ ներդրումներ՝ արդիականացնելով արտադրական տեխնոլոգիաներն ու հիմնական միջոցները:

Աշխատանքում ներկայացվում են նախապատերազմյան (2015-2019 թթ.), ինչպես նաև 2020-2021 թվականների հունվար-օգոստոս ամիսներին՝ Արցախի Հանրապետության արդյունաբերության հիմնական ցուցանիշները և զարգացման միտումները:

Բանալի բառեր. քաղաք, ուրբանիզացիա, արդյունաբերություն, ենթակառուցվածք, արտադրանք:

ПЕРСПЕКТИВЫ РАЗВИТИЯ ПРОМЫШЛЕННОСТИ В РЕСПУБЛИКЕ АРЦАХ В ПОСЛЕВОЕННЫЙ ПЕРИОД

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Опыт стран с развитой рыночной экономикой показывает, что одним из лучших способов интеграции промышленных предприятий и финансово-кредитных структур является создание финансово-промышленных групп.

В целом, финансово-промышленные группы создают предпосылки для более управляемой экономики, концентрируют ресурсы в нужном направлении и помогают установить более эффективные связи между государством и частным сектором. Создание и функционирование финансово-промышленных групп предоставит промышленным предприятиям Республики Арцах широкую возможность восстановить разорванные экономические связи, оптимизировать движение товаров и финансовых потоков, осуществить капитальные вложения, модернизируя производственные технологии и основные средства.

В данной статье представлены основные показатели промышленности Республики Арцах и тенденции развития как за довоенный период (2015-2019 гг.), так и за январь-август 2020-2021 гг.

***Ключевые слова*:** город, урбанизация, промышленность, инфроструктура, продукция.

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COMPARATIVE RESEARCH OF INDICATORS OF FRESH WATER UTILIZATION ASSESSED IN DIFFERENT COUNTRIES AND REGIONS

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Abstract

Freshwater is a symbol of the concept of “life” in the modern world because the existence of human society, as well as flora and fauna is conditioned by this unique resource. However, water productivity differs greatly which indicates the existence of insufficient socio-economic tools for that resource and low efficiency of using those tools as it is shown by the study of freshwater resources in different countries and regions of the world as well as economic unions. Especially through the qualitative indicator of the utilization of freshwater resources, it is possible to find out the factors influencing the freshwater and the state of its utilization in a certain country or region of the world which makes it possible to develop an effective policy in the field and rational use of this unique resource. The importance of this issue and the ways of policy improvement became a subject of discussion in the program of the RA Government for 2021-2026.

***Key words**:* fresh water, annual freshwater withdrawals, water productivity, freshwater consumption indicators, classification of countries according to freshwater consumption indicators, the best and the worst indicators, irrigation system.

Introduction

The "Freshwater utilization" section of the World Development Indicators published by the World Bank on fresh water resources, their quantity, utilization and a number of other indicators, presents the main indicators of the sector. This publication, as a matter in fact, includes almost all indicators related to the water resources in almost all countries worldwide. Such a publication is valuable not only in terms of providing information on freshwater resources, but also in providing an opportunity to compare data on freshwater resources in different countries, which can lead to clear and accurate conclusions about the development of the water sector. It is noteworthy that these data make it possible not only to make comparisons between transboundary water using two or more countries, but also to complete data for different groups of countries based on these data, thereby formulating the water sector policy and its components. All this is possible due to the general and unified methodology developed on the fresh water utilization which is especially important in the development of complex targeted programs for the water resources usage in the Republic of Armenia. In this sphere, there are not only different interpretations of the concepts and terminology used, but also often diametrically opposed statements about the same phenomenon by different authors, which complicate the process of implementation of programs of fresh water utilization and policy development.

The study of productivity indicator of freshwater in the Republic of Armenia, the analysis of its dynamics, as well as the problem of reducing water losses are especially important.

Problem statement and methodology

The publication of the World Bank makes it possible to unify the terms used creating the methodological basis of this sphere of study, to take them out of their "national case" and to internationalize the sphere.

In the "Freshwater" section, the World Bank's experts define the following key concepts and their content, or, in other words, how these databases were formed. This methodology has been developed through the definition of the following concepts.

Renewable internal freshwater resources flows refer to internal renewable resources (internal river flows and groundwater from rainfall) in the country.

Annual freshwater withdrawals, total (billion cubic meters). Annual freshwater withdrawals refer to total water withdrawals not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for agriculture and industry are total withdrawals for irrigation and livestock production and for direct industrial use (including withdrawals for cooling thermoelectric plants). Withdrawals for domestic uses include drinking water, municipal use or supply and use for public services, commercial establishments and homes. Data are for the most recent year available for 1987-2002.

Annual freshwater withdrawals, agriculture (per cent of total freshwater withdrawal). Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals are total withdrawals for irrigation and livestock production for agriculture. Data are for the most recent year available for 1987-2002.

Annual freshwater withdrawals, industry (per cent of total freshwater withdrawal). Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for industry are total withdrawals for direct industrial use (including withdrawals for cooling thermoelectric plants). Data are for the most recent year available for 1987-2002.

Annual freshwater withdrawals, domestic (per cent of total freshwater withdrawal). Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for domestic uses include drinking water, municipal use or supply, and use for public services, commercial establishments and homes. Data are for the most recent year available for 1987-2002.

Water productivity, total (constant 2010 US$ GDP per cubic meter of total freshwater withdrawal). Water productivity is calculated as GDP in constant prices divided by annual total water withdrawal.

People using at least basic drinking water services, urban (per cent of urban population). The percentage of people using at least basic water services. This indicator encompasses both people using basic water services as well as those using safely managed water services. Basic drinking water services is defined as drinking water from an improved source and provided collection time is not more than 30 minutes. Improved water sources include piped water, boreholes or tube wells, protected dug wells, protected springs and packaged or delivered water.

People using at least basic drinking water services, rural (per cent of rural population). The percentage of people using at least basic water services. This indicator encompasses both people using basic water services as well as those using safely managed water services. Basic drinking water services is defined as drinking water from an improved source, provided collection time is not more than 30 minutes. Improved water sources include piped water, boreholes or tube wells, protected dug wells, protected springs, and packaged or delivered water [1].

This paper will study the statistical series on freshwater resources and make analyses and comparisons on this basis. They have made it possible to identify the state of freshwater utilization both in individual countries and in separate groups of countries. The efficiency of usage of fresh water resources and water productivity indicators in the Republic of Armenia was especially emphasized in the context of interstate combinations, and especially in identification of shortcomings in the sector and the elimination of current omissions through effective management.

Study outcomes

Taking into account the fact that the Republic of Armenia is a full member of the Eurasian Economic Union (EEU), Table 1 shows the indicators of freshwater withdrawal and use in the EEU member states. According to Table 1, the freshwater resources of the Republic of Armenia (6,9 billion cubic meters) are the smallest among the EEU member states, and the largest resources are in the Russian Federation (4312,0 billion cubic meters) or the EEU freshwater resources per country averaged 893,2 billion cubic meters. According to the data on the annual withdrawal of fresh water in the Republic of Armenia, it exceeds the indicator of Belarus by 2,2 times, while the population of Belarus exceeds the population of the Republic of Armenia by 3 times. This circumstance is

conditioned by the fact that the annual freshwater withdrawal indicator in Armenia (as a percentage of domestic resources) is 42,9 per cent, and in Belarus it is 4,5 per cent, in the Russian Federation it is the lowest – 1,4 per cent. It is noteworthy that in the structure of the use of fresh water withdrawn annually, the average breakdown of the water use in the EEU countries is as follows: agricultural - 70,25 per cent, industrial -17,50 per cent and household and drinking purposes – 12,25 per cent. Among the EEU member states, the largest share of fresh water used in agriculture in the total volume of consumption is in the Kyrgyz Republic (93 per cent), followed by the Republic of Armenia (90 per cent), then by Kazakhstan (66 per cent), while the largest volume of fresh water used in industry is in Belarus (32 per cent), then in Kazakhstan (30 per cent) and in Armenia and Kyrgyzstan they have the same size – 4 per cent each. Among the EEU countries, the highest water productivity was recorded in Belarus ($ 43), followed by the Russian Federation ($ 26) and the third in Kazakhstan ($ 9). In Armenia it was 4,0 US dollars, and in Kyrgyzstan – 1,0 US dollar.

The Republic of Armenia has 99,9 per cent of the urban population provided with at least basic drinking water services and Belarus has the lowest rate of 96,0 per cent, for rural population this indicator is the highest in Armenia with 100 per cent and Kyrgyzstan with the lowest rate of 82 per cent.

Table 1

Indicators of freshwater extraction and consumption in the EEU member states

	Flows	Annual freshwater withdrawals					Water productivity, GDP/water utilization	People using at least basic drinking water services	
	billion cu. m	billion cu. m	Per cent of internal resources	Per cent for agriculture	Per cent for industry	Per cent of domestic	2010 $ per cu. m	Per cent of urban population	Per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
Armenia	6,9	3,3	42,9	90	4	6	4	99,9	100
Belarus	34	1,5	4,5	32	32	36	43	96,0	98,3
Kazakhstan	64,4	20	31	66	30	4	9	98,1	92,3
Kyrgyz Republic	48,9	7,7	15,8	93	4	3	1	97,1	82,0
Russian Federation	4,312,0	61	1,4	..	..	..	26	98,6	92,6
Average for EEU countries	893,24	18,70	19,12	70,25	17,50	12,25	16,60	97,94	93,04
Total for EEU countries	4466,2	93,5	2,09	..	..	..	..	..	..

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

From a regional point of view, the study of indicators of freshwater withdrawal and utilization for Armenia and its neighboring countries is of considerable interest. Such a comparative analysis is important not only from the point of view of the study of indicators between the countries of the region, but also due to the fact that it is conditioned by the circumstance that these indicators can be used to determine which country “supplies” its neighboring country with the necessary resources, as

water flows from one country to another. According to geographical factors, freshwater from a country with a higher geographical location flows through rivers to countries with a lower geographical location. This is evidenced by the data presented in Table 2, which shows that the flow of fresh water in Azerbaijan amounted to 8,1 billion cubic meters, while the annual withdrawal of fresh water in that country amounted to 12 billion cubic meters, or this index relative to domestic resources accounted for 147,5 per cent. This means that about half of the fresh water withdrawn in Azerbaijan is produced in neighboring countries, particularly in the Republic of Armenia. It is sufficient to say that only 42,9 per cent of the internal fresh water flow of the Republic of Armenia (6,9 billion cubic meters) is extracted and the rest – 3 to 6 billion cubic meters per year flows to the neighboring country. It turns out that the Republic of Armenia greatly contributes to the development of Azerbaijan's economy by supplying the country with one of the most expensive resources in the modern world: fresh water free of charge.

In terms of the use of domestic fresh water resources, the most tense situation among the neighboring countries of Armenia is in the Islamic Republic of Iran where 72,5 per cent of domestic resources are used, in Turkey the figure is 18,5 per cent, and in Georgia – 3,1 per cent. Despite such a picture, the water productivity index in Armenia was $ 4, in Azerbaijan - $ 4, in Iran - $ 6, in Turkey - $ 20 and in Georgia - $ 9. In other words, in Turkey one cubic meter water productivity is 5 times higher than that in Armenia. If we assume that the productivity of fresh water in Armenia would be not 4, but 20 US dollars, then the amount of GDP in our country could be not 13, but 65 billion dollars.

Table 2

Indicators of freshwater extraction and consumption in the neighboring countries of Armenia

	Flows	Annual freshwater withdrawals					Water productivity, GDP/water use	People using at least basic drinking water services	
	billion cu. m	billion cu. m	Per cent of internal resources	Per cent for agriculture	Per cent for industry	Per cent of domestic	2010 $ per cu. m	Per cent of urban population	Per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
Armenia	6,9	3,3	42,9	90	4	6	4	99,9	100
Azerbaijan	8,1	12,0	147,5	84	19	..	4	99,3	81,6
Georgia	58,1	1,8	3.1	..	22	..	9	100	96,2
Iran	128,5	..	72,5	..	..	..	6	97,4	89,0
Turkey	227	42	18,5	81	..	..	20	98,6	99,6
Average for countries	85,7	14,8	56,9	85,0	15,0	6,0	8,6	99,0	93,3
Total for countries	428,6	59,1	13,8	..	..	..	..	..	..

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

What is the pattern between the annual quantities of freshwater withdrawal and indicators of freshwater productivity? It is natural to think that the smaller is the quantity of freshwater withdrawal, the more efficient (productive) it should be. This principle is the basis of the theory of resource scarcity as a pricing factor. However, as shown in Table 3, such a logical assumption is true only under certain conditions or circumstances. In our example, there are many direct and indirect conditions and circumstances that "deviate" from this most important economic regularity or connection. In the field of water economics, the assertion that the economics of supply rather than demand is primary here [2, p. 79-100, 126-147]. The essence of the latter is that in any country or region fresh water resources are limited, they can not be artificially increased, for example, it can be done for consumer goods (clothes, shoes, etc.) or services. The next circumstance is conditioned by the essence of fresh water as a special consumer value, for fresh water is not a "common" product, especially when used in households, because any citizen of any country has a natural right to access fresh water resources. Undoubtedly, while studying the relation between the volumes of the withdrawn water and water productivity the structure of the economy of a given country is important. The share of agriculture in GDP, the way and efficiency of organizing the economy, the share of internal resources (formed in the given country) in the structure of withdrawn water, and the ideas and attitudes of the society and its members toward the water as an important resource is also important.

Table 3

Classification of the best and worst countries in terms of annual freshwater production (billion cubic meters)

	Flows	Annual freshwater withdrawal					Water productivity, GDP/water use	People using at least basic drinking water services	
	billion cu. m	billion cu. m	per cent of internal resources	per cent for agriculture	per cent for industry	per cent of domestic	2010 $ per cu. m	per cent of urban population	per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
India	1,446.0	647,5	44.8	90	2	7	4	96	91
China	2,813.0	594,2	21,3	64	22	13	17	97,7	86,2
United States	2,818,0	418,7	14,9	36	51	13	39	99,8	97
Pakistan	55,0	183,5	333,6	94	1	5	1	94,2	89,9
Mexico	409,0	85,7	20,0	76	9	15	15	100	96,6
Vietnam	359,4	81,9	22,8	..	4	..	2	98,6	92,6
Philippines	479,0	81,6	17,0	82	10	8	3	97,7	90
Japan	430,0	81,2	18,9	67	14	19	76	..	..
Brazil	5,661,0	74,8	1,3	60	17	23	35	99,5	89,7
Egypt, Arab Rep.	1,8	73,8	4,100,0	86	3	12	4	99,5	98,8
Russian Federation	4,312,0	61,0	1,4	..	..	..	26	98,6	92,6
Thailand	224,5	57,3	25,5	90	5	5	7	99,9	100

1	2	3	4	5	6	7	8	9	10
Italy	182,5	53,8	29,5	..	..	18	62	99,5	99,4
Uzbekistan	16,3	49,2	300,9	..	3	..	1	99,6	96,1
Turkey	227,0	42,0	18,5	81	..	..	20	98,6	99,6
Central African Republic	141,0	0,1	0,1	..	17	..	24	64,7	33,7
Fiji	28,6	0,1	0,3	..	11	..	48	97,8	88,7
Barbados	0,1	0,1	87,5	..	8	..	66	..	..
Gabon	164,0	0,1	0,1	..	10	..	137	89,6	55,1
Dominica	0,2	0	10	5	0	95	23	..	..
St Lucia	0,3	0	14,3	71	0	29	38	97,8	98,2
Grenada	0,2	0	7,1	15	0	85	60	..	..
St Kitts and Nevis	0,0	0	51,3	1	0	99	71	..	..
St Vincent and the Grenadines	0,1	0	7,9	0	0	100	94	..	..
Seychelles	..	0	..	..	28	..	119	..	..
Malta	0,1	0	44,4	64	2	34	307	100	100
Antigua and Barbuda	0,1	0	8,5	16	22	63	308	..	..
Maldives	0,0	0	15,7	0	5	95	828	98.3	99,9
Monaco	..	0	..	0	0	100	1,430	100	..
Luxembourg	1	0	4,3	1	5	95	1,431	100	98,8

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

It follows from Table 3, that the world's largest freshwater is withdrawn in India where water productivity is one of the lowest in the world (GDP against one cubic meter water is $ 4). Water productivity in China, which takes the second place, is $ 17, and in the United States, which is in the third place, is $ 39. It is also obvious that the share of internal flows in the volume of withdrawn water has a significant impact on the amount of water productivity in the mentioned countries. For these countries, this index was 44,8 per cent, 21,3 per cent and 14,9 per cent respectively. That is, the lower the weight of internal flows in the volume of withdrawn fresh water, the higher the water productivity. This pattern is clearly seen in the example of Pakistan, which is in the fourth place, where a small portion of annually withdrawn freshwater is domestic water, and most of the water used by that country comes from the water resources of neighboring countries. According to that, the water productivity index is 1,0 US dollar. The data presented at the end of Table 3 (countries with the worst annual freshwater withdrawal are tabulated) show that water productivity is relatively high in countries with low freshwater inflows and/or low inflows in withdrawn water resources. Let's just mention that in two countries with the highest water productivity, in Monaco and Luxembourg, it was 1430 and 1431 US dollars, respectively.

The results of our study show that freshwater resources are highly unequally distributed within individual countries or countries that are part of separate regions.There are many countries where the “lion's share” of annually withdrawn of freshwater is formed in the territory of that state, and in others due to the outflow of water from the geographical areas of those states. In other words, for this group of countries there is a great dependence on the volumes of annual freshwater withdrawal from

neighboring countries. This is the reason why in such cases disputes and conflicts (even military) over the "fair" distribution of water resources arise between neighboring countries.

The classification of the best and worst countries by the indicator of annual freshwater withdrawal (percentage of internal resources) is given in Table 4. According to the data, there is no significant correlation between indicators of annual freshwater withdrawal (percentage of domestic resources) and water productivity. This is the case, for example, for Bahrain, where the highest dependence on annual freshwater withdrawal (percentage of domestic resources) is a fairly high water productivity indicator of $ 214. Meanwhile, for Egypt and Turkmenistan, which, according to the mentioned classification take the "best" second and third places, the water productivity indicators are 4 and 2 USD, respectively. The table shows the list of countries (the first part of the table) whose freshwater withdrawal is highly dependent on the inflow of water resources from neighboring countries. The second part of the table also does not show a direct dependence between the "internal resources" and the fresh water withdrawal.

Table 4

Classification of the best and worst countries in terms of annual freshwater production (in per cent of domestic resources)

	Flows	Annual freshwater withdrawals					Water productivity, GDP/water use	People using at least basic drinking water services	
	billion cu. m	billion cu. m	per cent of internal resources	per cent for agriculture	per cent for industry	per cent of domestic	2010 $ per cu. m	per cent of urban population	per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Bahrain	0	..	5,967,5	..	..	..	214	..	..
Egypt, Arab Rep.	1,8	73,8	4,100,0	86	3	12	4	99,5	98,8
Turkmenistan	1,4	..	1,983,6	..	..	..	2	100	97,6
United Arab Emirates	0,2	2,8	1,866,7	..	2	..	154	..	..
Saudi Arabia	2,4	22,6	943,3	88	3	9	32	..	..
Libya	0,7	5,8	822,9	83	5	12	8	..	..
Sudan	4	26,9	673,3	96	0	4	3	73,8	53,2
Qatar	0,1	0,2	387,5	..	2	..	700	..	..
Mauritania	0,4	1,3	337,0	..	2	..	5	89,3	49,9
Pakistan	55	183,5	333,6	94	1	5	1	94,2	89,9
Uzbekistan	16,3	49,2	300,9	..	3	..	1	99,6	96,1
Syrian Arab Republic	7,1	14,1	198,3	..	4	..	..	99	95,2
Israel	0,8	..	189,2	..	..	..	249	100	100
Yemen, Rep.	2,1	3,5	168,6	..	2	..	5	79,1	54,7
Azerbaijan	8,1	12	147,5	84	19	..	4	99,3	81,6

1	2	3	4	5	6	7	8	9	10
Peru	1,641,0	13,6	0,8	89	2	9	12	95,6	75,6
Panama	136,6	1	0,8	43	1	56	39	98,1	92,9
Norway	382	3	0,8	28	41	31	180	100	100
Bolivia	303,5	2,1	0,7	92	2	7	13	99,4	78,1
Guyana	241	1,4	0,6	94	1	4	3	100	93,9
Suriname	99	0,6	0,6	70	22	8	7	98,2	90
Colombia	2,145,0	11,8	0,5	54	19	27	27	99,9	86,4
Angola	148	0,7	0,5	..	34	..	144	71,2	27,4
Bhutan	78	0,3	0,4	94	1	5	7	98	96,7
Fiji	28,6	0,1	0,3	..	11	..	48	97,8	88,7
Sierra Leone	160	0,2	0,1	..	26	..	16	75,8	50,1
Central African Republic	141	0,1	0,1	..	17	..	24	64,7	33,7
Congo, Dem. Rep.	900	0,7	0,1	..	21	..	49	69,3	22,8
Gabon	164	0,1	0,1	..	10	..	137	89,6	55,1
Papua New Guinea	801	0,4	0,0	..	43	..	53	85,8	34,6

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

Among the World Bank indicators on fresh water, without underestimating the role and effectiveness of other indicators, it should be noted that the efficiency of the use of this important natural resource is characterized by water productivity. Although freshwater has no alternative consumer value in the modern world, which makes it an exceptionally unique resource, water productivity varies greatly from country to country (Table 5). It is easy to see from the data in the table that the main indicator characterizing the efficiency of utilization of fresh water differs hundreds of times by countries. It should be noted that the Republic of Armenia is also not distinguished by the efficiency of utilization of fresh water being included in the list of the worst countries according to that indicator (21st place at the end).

Table 5

Classification of the best and worst countries in terms of GDP/water use

	Flows	Annual freshwater withdrawals					Water productivity, GDP/water use	People using at least basic drinking water services	
	billion cu. m	billion cu. m	per cent of internal resources	per cent for agriculture	per cent for industry	per cent of domestic	2010 $ per cu. m	per cent of urban population	per cent of rural population
	2014	2014	2014	2015	2014	2015	2015	2018	2018
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Luxembourg	1	0	4,3	1	5	95	1,431	100	98,8
Monaco	..	0	..	0	0	100	1,430	100	..

1	2	3	4	5	6	7	8	9	10
Maldives	0	0	15,7	0	5	95	828	98,3	99,9
Equatorial Guinea	26	..	..	..	..	..	715	78,1	30,8
Qatar	0,1	0,2	387,5	..	2	..	700	..	..
Singapore	0,6	..	..	..	..	..	654	100	..
Denmark	6	0,6	10,6	25	20	55	492	100	100
Ireland	49	0,8	1,5	..	7	83	456	97	98,1
Switzerland	40,4	2	5	8	32	60	379	100	100
United Kingdom	145	8	5,5	13	14	71	337	100	100
Antigua and Barbuda	0,1	0	8,5	16	22	63	308	..	..
Malta	0,1	0	44,4	64	2	34	307	100	100
Congo, Rep.	222	..	..	..	..	..	280	87,1	45,7
Israel	0,8	..	189,2	..	..	..	249	100	100
Sweden	171	2,7	1,6	4	58	38	243	100	100
Armenia	6,9	3,3	42,9	90	4	6	4	99,9	100
Azerbaijan	8,1	12	147,5	84	19	..	4	99,3	81,6
Egypt, Arab Rep.	1,8	73,8	4,100,0	86	3	12	4	99,5	98,8
India	1,446,0	647,5	44,8	90	2	7	4	96	91
Eritrea	2,8	..	20,8	..	..	..	3	89,7	27,8
Guyana	241	1,4	0,6	94	1	4	3	100	93,9
Mali	60	5,2	8,6	98	0	2	3	92,2	68,3
Philippines	479	81,6	17	82	10	8	3	97,7	90
Sudan	4	26,9	673,3	96	0	4	3	73,8	53,2
Lao PDR	190,4	3,5	1,8	..	5	..	2	94,4	75,6
Myanmar	1,003,0	..	..	..	..	..	2	93	76,9
Nepal	198,2	9,5	4,8	98	0	2	2	89,1	88,7
Turkmenistan	1,4	..	1,983,6	..	..	..	2	100	97,6
Vietnam	359,4	81,9	22,8	..	4	..	2	98,6	92,6
Afghanistan	47,2	..	..	..	..	..	1	95,9	57,3
Kyrgyz Republic	48,9	7,7	15,8	93	4	3	1	97,1	82
Madagascar	337	13,6	4	96	1	3	1	85,8	36,3
Pakistan	55	183,5	333,6	94	1	5	1	94,2	89,9
Tajikistan	63,5	11,2	17,6	91	4	6	1	96,2	75,6
Timor-Leste	8,2	..	14,3	..	..	..	1	98,3	69,7
Uzbekistan	16,3	49,2	300,9	..	3	..	1	99,6	96,1

The source was compiled by the authors based on data from The World Bank. World Development Indicators, 09.09.2021. The electronic resource is available at http://wdi.worldbank.org/table/3.5

Let us now take a closer look at the movement of the water productivity indicator recently considering it as the main indicator for assessing the efficiency of the utilization of fresh water resources which is calculated in terms of the ratio of GDP of a country to the water resources used to achieve that GDP, as well as attaching the importance to the role of fresh water in the development of the RA economy. Table 6 shows the movement of GDP, freshwater intake and water productivity (GDP/ water intake amount) in Armenia in 2000-2019 according to which the index of water

productivity in Armenia increased during the mentioned period 4,7 times, from 1,02 US dollars in 2000 to 4,77 US dollars in 2019. However, the comparison of the water productivity index of the Republic of Armenia with the water productivity indices of other countries reveals the inefficiency of that index in the Republic of Armenia.

Table 6

Movement of GDP, indicators of freshwater intake and water productivity (GDP/water intake) in Armenia in 2000-2019

Years	GDP		Water intake		Water productivity, GDP / water intake	The average annual number of de jure population, 1000 people
	Million US dollar	Per capita, US dollar	Million cubic meter	Per capita, cubic meter		
1	2	3	4	5	6 (u. 2 / u. 4)	7
2000	1,912,0	593	1,871,2	580,9	1,02	3,221,1
2005	4,900,0	1,523	2,770,6	861,1	1,77	3,217,5
2010	9,260,0	2,844	2,126,4	653,1	4,35	3,256,1
2011	10,142,0	3,363	2,438,3	808,6	4,16	3,015,6
2012	10,619,4	3,512	2,941,1	972,6	3,61	3,024,1
2013	11,121,3	3,680	2,955,1	977,9	3,76	3,022,0
2014	11,609,5	3,852	2,860,2	949,0	4,06	3,013,8
2015	10,553,3	3,512	3,271,7	1,088,9	3,23	3,004,6
2016	10,546,1	3,524	3,181,9	1,063,4	3,31	2,992,3
2017	11,527,4	3,869	2,865,4	961,7	4,02	2,979,4
2018	12,457,9	4,196	2,714,4	914,2	4,59	2,969,0
2019	13,672,7	4,615	2,865,4	967,2	4,77	2,962,5

The source was compiled by the authors based on data from National accounts of Armenia, 2013, RA Statistical Committee (SC), 2013, page 23, National accounts of Armenia, 2020, RA SC, 2020, page 9, Chronological series published by the RA SC - https://armstat.am/am/?nid=12&id=14004

The index of water productivity calculated by the World Bank, in fact, characterizes the size of the country's GDP achieved from the use of one cubic meter of water. This index can be considered as one of the key parameters of the use of fresh water resources, or, in other words, it can be defined as a measure of the efficiency of utilization of water resources. According to the latest publications of the World Bank on this index, it fluctuates strongly both by individual continents and individual countries. The difference is especially big in the international combinations of indices of individual countries. Thus, this index, calculated for 2015, has the lowest value (in US dollars in 2010 per one cubic meter of water) in countries such as Afghanistan, Madagascar, Pakistan, Kyrgyzstan, Tajikistan, Uzbekistan (GDP/water use ratio is 1,0), Laos DF, Myanmar, Nepal, Turkmenistan and Vietnam is 2,0, Eritrea, Guyana, Mali, Philippines and Sudan is 3,0, and in Armenia, Azerbaijan, Egypt and India – 4,0. Note also that, grouped by income level, this figure is equal to 4,0 for a group of low-income countries, as well as for a group of middle-income countries, 15 and 57 for a group of high-income

countries. For comparison, the following countries have the highest water productivity indices: Luxembourg (1431), Monaco (1430), Maldives (828), Equatorial Guinea (715), Qatar (700), Singapore (654), Denmark (492), Ireland (456), Switzerland (379), United Kingdom (337), Antigua and Barbuda (308), Malta (307) Republic of the Congo (280), Israel (249) and Sweden (243) [1]. In the neighboring countries of the Republic of Armenia, water productivity indices were 9 in Georgia, 6 in the Islamic Republic of Iran and 20 in Turkey [1].

The study of relevant data also proves the low efficiency of fresh water use in the Republic of Armenia [3]. It follows from their analysis that from 2011 to 2019 freshwater losses were significant. Thus, in 2012 the loss accounted to 754,0 million cubic meters (which accounted for 25,6 per cent of water intake in 2012), and in 2019 the total losses amounted to 741,7 million cubic meters or only 25,9 per cent of the water intake that year. That is, in the mentioned period the index of water losses increased by 0,3 points.

The analysis proves that the data on fresh water losses in Armenia are conditional, as they do not reflect the real situation. The reason for the latter is that the economic structures in the system of water use do not promote the reduction of losses, but on the contrary, they contribute to the inefficient use of water resources.

The program of the Government of the Republic of Armenia for 2021-2026 [4] emphasizes the increase of efficiency of the water systems and water resources management of the country which testifies the need to expand the management toolkit in the field of water relations and increase their efficiency. In particular, it is mentioned that the policy of water sector of the government is aimed at providing the population with supply of drinking water (water supply) and drainage (wastewater treatment), reliable, stable, safe and accessible irrigation water supply services and the development of reforms in the water sector.

The activities of the government are based on ensuring the modernization of water systems, attracting investments, increasing the efficiency of the management of state-owned water systems, improving the legislation regulating the sector and efficient and economical use of water resources.

Projects of reservoir construction will continue to manage surface runoff. Due to them, we will have additional water resources, a management system of efficient water flow by creating opportunities for the supply of gravity irrigation water. 15 reservoirs will be designed and their construction will begin.

In order to solve the existing problems in the field of irrigation, in order to improve the situation, it is envisaged to:

- carry out necessary legislative and structural reforms;
- continuously equip irrigation systems with modern water metering equipment and equip with data collection and control system;
- carry out a comprehensive technical audit and develop and apply capital investment approaches and criteria on its basis;
- implement capital investments for the rehabilitation of irrigation systems and investment policy.

The government will promote the use of new technologies to save water including the introduction of drip irrigation and sprinkler irrigation systems as well as the use of compensation mechanisms of irrigation water charge.

By 2023, it is planned to complete the reconstruction of inter-economic and in-house irrigation networks. With the construction of irrigation systems, 7,3 million kWh of electricity will be saved annually and irrigated lands will increase by 1373 hectares. In 105 settlements of five provinces about 259,1 km of internal economic systems will be restored. Extremely destroyed and emergency sections of 8,2 km long and 54,1 km long 22 second-class canals will be restored. Due to this, the access to

irrigation water supply will be expanded, the losses in the rehabilitated areas will be gradually reduced by about 7 per cent and a stable, uninterrupted water supply will be provided to those lands.

The government will implement investment programs in the field of drinking water. By the end of 2023, urgent restoration works of water supply and drainage systems of 11 cities, 6 rural settlements and 41 rural settlements and restoration of distribution networks will be carried out.

Conclusion

As a result of the study, the general tendencies of utilization of fresh water in different countries and regions of the world, the patterns and regularities, the index of water productivity in this or that country, the main factors influencing it and the degree of dependence of individual countries on drinking water resources in neighboring countries were revealed. The importance of increasing the efficiency of utilizing water resources in the Republic of Armenia and the issue of increasing the efficiency of water resources and systems management in that sphere were especially emphasized. The ways that will make the achievement of solution of the mentioned problems possible were also mentioned.

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ՔԱՂՑՐԱՀԱՄ ՋՐԻ ՕԳՏԱԳՈՐԾՄԱՆ ՄԻՋԵՐԿՐԱՅԻՆ ԵՎ ՏԱՐԱԾԱՇՐՋԱՆԱՅԻՆ ՑՈՒՑԱՆԻՇՆԵՐԻ ՀԱՄԵՄԱՏԱԿԱՆ ՈՒՍՈՒՄՆԱՍԻՐՈՒԹՅՈՒՆ

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Ժամանակակից աշխարհում քաղցրահամ ջուրը «կյանք» հասկացության խորհրդանիշն է, քանի որ ինչպես մարդկային հասարակության, այնպես էլ բուսական և կենդանական աշխարհի գոյությունը պայմանավորված է այդ բացառիկ ռեսուրսով: Սակայն ինչպես ցույց է տալիս աշխարհի առանձին երկրներում և տարածաշրջաններում, նաև տնտեսական միություններում, քաղցրահամ ջրի պաշարների օգտագործման ցուցանիշների ուսումնասիրությունը, ջրի արտադրողականությունը խիստ տարբերվում է, ինչը վկայում է այդ ռեսուրսի նկատմամբ անբավարար սոցիալ-տնտեսական գործիքակազմի առկայության և այդ գործիքակազմի կիրառման ցածր արդյունավետության մասին: Հատկապես քաղցրահամ ջրի պաշարների օգտագործման որակական ցուցանիշի՝ ջրի արտադրողականության միջոցով հնարավոր է

դառնում պարզելու այս կամ այն երկրի կամ տարածաշրջանի քաղցրահամ ջրի և դրա օգտագործման վիճակի վրա ազդող գործոնները, ինչն էլ հնարավոր է դարձնում ոլորտում արդյունավետ քաղաքականության մշակումը և այդ եզակի ռեսուրսի ռացիանալ օգտագործումը: Այս հիմնախնդրի կարևորությունը և զարգացման ուղիները քննարկման առարկա դարձան նաև ՀՀ կառավարության 2021-2026 թվականների ծրագրում:

Բանալի բառեր. քաղցրահամ ջուր, քաղցրահամ ջրի տարեկան արդյունահանում, ջրի արտադրողականություն, քաղցրահամ ջրի օգտագործման ցուցանիշներ, երկրների դասակարգում ըստ քաղցրահամ ջրի օգտագործման ցուցանիշների, լավագույն և վատագույն ցուցանիշներ, ոռոգման համակարգ:

СРАВНИТЕЛЬНОЕ ИССЛЕДОВАНИЕ ПОКАЗАТЕЛЕЙ ИСПОЛЬЗОВАНИЯ ПРЕСНОЙ ВОДЫ В СТРАНАХ СРЕДИЗЕМНОМОРСКОГО РЕГИОНА

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В современном мире пресная вода является символом понятия «жизнь», поскольку существование человеческого общества, а также сохранение флоры и фауны обусловлено этим уникальным ресурсом. Однако, как показывают исследования ресурсов пресной воды в разных странах и регионах мира, а также в экономических союзах, показатели продуктивности использования воды сильно различаются, что указывает на наличие недостаточных социально-экономических инструментов, применяющихся для управления этим ресурсом, а также низкую эффективность использования этих инструментов. В частности, с помощью качественного показателя использования ресурсов пресной воды – показателя продуктивности, можно исследовать факторы, влияющие на состояние использования данного ресурса в определенной стране или регионе мира. Это, в свою очередь, позволит разработать эффективную политику в области рационального и целевого использования уникального ресурса. Актуальность данной проблемы и пути совершенствования политики в области управления водными ресурсами и водным хозяйством стали предметом обсуждения в рамках недавно принятой программы Правительства РА на 2021-2026 годы.

Ключевые слова: пресная вода, годовой забор пресной воды, продуктивность воды, показатели потребления пресной воды, классификация стран по отдельным показателям потребления пресной воды, наилучшие и наихудшие показатели, оросительная система.

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ISSUES OF QUALITY ASSURANCE OF TRAINING SPECIALISTS FOR WATER INDUSTRY AT TECHNICAL UNIVERSITIES

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Abstract

One of the controversial and complex business problems remains the evaluation of the value system and its separate components both in the past and nowadays. The Accreditation Council of Higher Education has defined the quality as compliance with the state educational standards which has been accepted by accreditation and authorities of quality assurance. To effectively organize a teaching process for engineering professions it is necessary to have professional and teaching staff able to combine research-and-educational and practical activities, modern research and teaching laboratory facilities, effective system of conducting educational practice and to provide admission of most prepared applicants to appropriate departments of the higher educational institutions. The higher education institutions of Armenia and Artsakh Republic in recent years have become main subjects of effective activities. The peculiarities of training the specialists of water industry by the example of Shushi University of Technology are discussed in this paper.

Key words: higher education, quality, national wealth, water systems, laboratory.

Introduction

In the course of time various methods of assessment used in practice have been developed and employed. Both the principles and approaches to wealth assessment are being improved and the list of objects to be assessed is being expanded. The Eiffel Tower in Paris was recognized as the most expensive architectural structure in Europe, the value of which in 2011 is estimated at € 434 billion [1]. According to the expert evaluation of the tower which is a symbol of France ranks after the Tower of another European architectural marvel - the Coliseum, a symbol of Rome, which was about 5 times less expensive (€ 91 billion). The study, which also involved experts from the Italian Chamber of Commerce, found that the price of the Eiffel Tower in 2011 was equivalent to 25% of France's GDP. In addition to European monuments, experts have decided to estimate the residence of the US President - the White House, the value of which, according to the study in 2011, was $ 81 billion.

A new study by the Italian Chamber of Commerce estimates the Eiffel Tower $ 544 billion, placing it far ahead of other historic sites, including the White House ($ 110 billion), the Roman Colosseum (about $ 90 billion), Milan Cathedral (about $ 81 billion) , The Tower of London (about $ 70 billion), Prado Museum in Madrid (about $ 58 billion) and British Stonehenge (about $ 10 billion) [2]. The significant increase of the value of the Eiffel Tower is due to its leading growth on the French economy, mainly due to the increase in tourist flows, as well as the growth of activities related to tourism.

The value of the most expensive company in the world (Apple) (capitalization) in 2011 was estimated $ 624 billion which in 2021 already became $ 2,4 trillion [3].

It is interesting to note that the assessment of these facilities took into account not only the cost of construction materials needed for their construction or the land on which they were built. The image of these structures, the brand and the reputation were appreciated more. Among the dozens of parameters used during the assessment was the “tourism rate” which includes, in particular, the number of tourists who visited these facilities as well as the number of jobs created by these facilities. The Eiffel Tower, for example, has about ten million tourists each year, a European record for any visitor to the monument. It was estimated how much the country could lose if that country did not have that structure. In the case of France, that amount was a quarter of GDP.

Intangible assets are a significant part of assets of each country and the company and brands and service marks make up a significant portion of the latter. For example, the value of the “Apple” brand has exceeded $ 100 billion and $ 178 billion in 2021. Coca Cola Company band was estimated $ 59,9 billion in 2011 and is estimated $ 73 billion in 2021 [3].

The rating is based on the assessments of brands, duplicates and independent European experts in the field of intellectual property. To compile the rating, Euro brand surveys more than 3 thousand European, Asian and American companies running business in 16 spheres. The educational perspective of human development, among other means of education, is the development of cognitive activities, knowledge transfer, capacity building and skills development including quality assessment. Among the European standards and guidelines for the quality assurance of vocational education institutions, the system of assessment of student education is included which must meet the following conditions: equal application of publicly accepted standards, existence of established regulations and procedures.

Let us turn to the analysis of the concept of quality which has various interpretations. It has a number of dictionary explanations. However, when it comes to the quality of higher education, it turns out that there is no clear definition of the latter. However, quality has the following definitions [4].

a) any important or distinguishing feature;

b) degree of merit or perfection;

c) an action that makes or helps to make a feature as it should be;

d) distinguishing feature or characteristic;
e) unique ability or feature.

As an adjective the quality has the following definitions [4].
a) high degree;
b) high social status.

Harvin and Green explored the nature and application of quality in their work according to which quality is often perceived as a relative concept [4]. There are certain situations where the quality is relative.

First. Quality is directly related to the environment. It has different meanings for different people and the same person may perceive quality differently at different times. In the higher education system, the problem is complicated by the fact that it is formed with the participation of the parties: students, teaching and administrative staff, accreditation bodies, supervisors and evaluators. One of the peculiarities is that the society is also an evaluator.

Second. In some versions quality is considered an absolute value. As a result, noncompliance and independence of quality are present.

Third. Quality is measured by the number of thresholds that must be overcome to obtain a degree of quality.

Harvin and Green suggest 5 approaches to quality definition:

1. Exclusive approach to quality: it is considered as a peculiarity. Quality usually refers to some different elite product, and in the field of education it is closed to the idea of “excellence” – “high quality” to which not all are competent.
2. Quality as a perfection: it is considered as a sustainable result.
3. Quality as conformity of goals: it is considered as the satisfaction of the customer's goals and desires. Theoretically, customers present their requirements. In the field of education, this means the ability of the university to fulfill its mission.
4. Quality as a value is considered as income or investment. If the same product can be purchased at a lower price, or a better product can be purchased at the same price, then the customer buys just that. At the same time, with rising tuition fees, students are beginning to demand quality in exchange for higher tuition fees.
5. Quality shift: it is the classic idea of quality. In the field of education, the shift refers to the possibility of increasing the attractiveness of education or the acquisition of a new knowledge.

The authors of another approach, Campbell and Rossynay, describe quality as a multidimensional and subjective concept [5]. Based on the five approaches they proposed, the concept of quality is introduced by Harvin and Green [4].

- Quality as an exception. This is a traditional scientific view on the matter because it aims to be the best.
- Quality as a “zero error”. The idea of zero error is more easily defined in mass industry where product standards can be defined in more detailed descriptions. Since the “product” of higher education institutions - the graduates, can not be the same, this view can not be applied to the field of higher education.
- Quality as “compliance with goals”. The view from this point of view is that the product or service meets the requirements, needs and desires of the customer. At the same time, students, industry, academia, government, society and all those who are “consumers” of higher education to one degree or another may have differing opinions about “purpose” or “relevance”.

- Quality as a "stakeholder". Certain quality norms, standards and any institution that meets them are considered as high quality.
- Quality as attractiveness or improvement. This concept focuses on the facts of continuous improvement and is guided by the motto that achieving quality is a major issue for the representatives of the field of science and it is the workers of the field of science who know best what quality is. The disadvantage of this concept is that it is quite difficult to "measure" the improvement and that this improvement can be difficult to see from the outside world.

UNESCO defines quality in higher education as a multidimensional, multilevel and dynamic concept that addresses institutional goals and missions, as well as system-specific norms, programs or standards [6, 7]. Therefore, quality can have different meanings depending on:

- the interests of stakeholders of higher education;
- the manner of use: mission, goals, processes, costs, revenue, etc.
- the features of the scientific world that are worthy of appreciation;
- the historical period of development of higher education.

The following definition of quality was used here:

- Quality as excellence: traditional and elite view according to which only the best criteria can be considered real quality.
- Quality as compliance with goals: a concept that emphasizes the need to meet the criteria set by a qualification or quality assurance body focusing on the effectiveness of the process, the plans to achieve the goals or the mission.
- Quality as attractiveness or improvement. Focuses on continuous quality improvement, emphasizing the responsibility of higher education institutions to use their institutional autonomy and freedom more effectively.

Each approach has its advantages and disadvantages corresponding to some extent to any period or being in the national context.

Several universities in the UK have agreed that quality reflects the effectiveness of university education, that is the urgency and effectiveness of opportunities to achieve students' learning, teaching, assessment and achievement [8].

Van Kemened presents transcendental, product-centered, customer-centered and production-centered approaches to quality. In the case of the transcendental approach, quality is absolute and can be evaluated objectively. Quality is, without a doubt, the best. Winkenburg calls it the "perfect image approach" [7].

Pircig defines quality as follows: "Quality is neither intellect nor matter, but a third essence that is independent of these two ... although quality cannot be defined, we know what it is" [8].

Today in Armenia and Artsakh national wealth and its individual elements are not sufficiently valued, so we have no idea about that greatness. Higher education is the sphere in which human capital is created, so it is possible to study the system of evaluation of their activities.

Conflict setting

The presence of different approaches to the problem under study allows to define the specifics of the results of the graduation attestation for different universities. The main direction of economic policy is the provision of jobs in conditions of stable inflation (for this idea Jan Timbergen was awarded the Nobel Prize in 1969) - the field of higher education becomes the focus of employment of high-quality professionals which undoubtedly contributes to curbing the emigration of professionals.

In the current situation, the most important problem is a certain expansion from higher education - the whole educational system and science. It is necessary to turn universities to centers providing scientific and technical progress. The university was and remains the main link in the types of various mechanisms for promoting and developing innovations which is due to the high efficiency of the production of theoretical-experimental-industrial samples of such structures. Such a system best allocates financial resources in the "idea-result" chain.

The aim is to define the priority steps aimed at training of highly qualified university specialist-graduates for water industry of the Republic of Artsakh.

Research results

Work in this direction is carried out, in particular, at Shushi University of Technology (hereinafter referred to as the University). In particular, the majority of the University lecturers are involved in the work of hydraulic facilities in the water sector including irrigation, water supply, design of hydroelectric power plants, technical state inspection over their construction and providing operation safety. They designed and built the water supply system of Stepanakert, studied the technical conditions of Sarsang reservoir dam with a volume of 625 million m^3 and carried out engineering control over the construction of irrigation systems. Based on the obtained data, numerous monographs, textbooks and teaching materials were published and dissertations were defended. In this regard, the teaching staff of the University has sufficient practical experience, which, combined with theoretical knowledge, creates sufficient preconditions for the organization of professional courses in the field of water management at a proper level.

The University established modern educational-research laboratory bases as part of scientific institutes and expert centers. These laboratories are not only more up-to-date but they will also contribute to the development of science. Students there will not only take practical training within the curriculum, but also participate in research as part of a research team. In this regard, we consider the establishment of training centers jointly with scientific institutes and expert centers a major issue. In particular, on the basis of the hydraulic laboratory of the Institute of Water Problems after Academician I.V.Yeghiazarov, a modern training center has been organized which is one of the best scientific-experimental laboratories in the region.

The laboratory base provides an opportunity to implement both the educational orientation included in the framework of university curricula. Educational activities included both laboratory and teaching-practical training of professional subjects as well as the organization of educational-production internships. The laboratory is a two-story building: the floor measures 18x60 m^2 and the height of ceiling of each floor is approximately 8 m.

The models created in the laboratory allow conducting research to determine Reynolds, Bernoulli coefficient of frictional resistance; local loss coefficients; leakage from holes; filtration coefficient; free jet distance; potable water cleaning using local sling materials; water depths on the overflow dam and slope; parameters of the stilling pool and operating valves; values of free surface coordinates and average velocities of individual cross-sections in the fast-flowing section; study of the accumulated air behavior, the maximum level to be established in the reservoir during the removal of floods etc.

Models of water systems can also be used in a set of experimentations for determining trench drain and fast-flow conveyance capacity; the occurrence of aeration and under such conditions cross-section dimensions of drainage channel; the amount of silt entering in the channel (mainly as quartz sand and partially in the form of clay) and dependency of water velocity and sedimentation basin dimensions necessary for their settling; the amount of water required to remove the sludge. Presented

models of other hydro schemes available in the laboratory can be used as training facilities for students studying water-related professions. At the same time, they can be used to select topics for master's theses and to conduct relevant experimental studies.

The role of the laboratory in organizing research work at the third level of education may also be important. Let us present some priority topics that can be done here.

1. Anti-flood structures

In countries with mountainous and foothill areas, mudslides cause great damage to the economy. They destroy highways, railways, engineering communications and settlements. They are accompanied by numerous human life losses. Research on anti-flood hydraulic structures can be carried out in the directions of flood-carrying, flood-draining canals, mud-dams, dams, barrages, etc. Mudflow canals and river beds are widespread among the measures to protect the roads, settlements and other important objects from mudslides. Their purpose is to safely remove mudslides from the approaches of protected buildings. However, no reliable methods have been developed so far to determine the size of mudflow canals and the current carrying capacity of these canals. That is why most of the flood canals are filled with mudslides some time after their operation they cease to serve their purpose. As a result, resources used become meaningless and protected objects suffer great losses. The appropriate equipment available in the laboratory makes studying various flood canals possible to determine their appropriate size and current concentration at different flood outlet and slope values. As a result, it is possible to develop reliable calculation methods of canal for this or that baseline condition. Flood protection structures are installed in the upper reaches of floodplains and river tributaries. While their functioning, they protect the various objects and settlements, located in lower reaches, from destruction. In Armenia, the Lori and Zangezur highways, railways and settlements, including Alaverdi and Kapan towns are protected by flood protection structures. They are widespread in Europe, China and many parts of the Americas. These structures are earth or concrete dams made of various prefabricated structures etc. Despite the widespread use of mudslides protective structures, they all have a number of serious drawbacks:

a) Most frequently occurring small-to-medium sized debris flows or mudslides are a part of most dangerous to life and property because of their high speeds and the sheer destructive force of mudflows. As a result, a large part of the upper volume of the mudflow retarding structure is filled with the debris carried by the flows and its periodical cleaning takes considerable resources;

b) the structures, retarding the whole flow, in the lower reach of the river, disrupt the natural state of the environment which is fraught with such undesirable grave consequences as ecological-riverbed damaging phenomena.

Taking into consideration these shortcomings, the above mentioned laboratory may carry out investigations on the development of fundamentally new types of flood protection structures. The first serious results and the copyright have already been obtained.

2. River bed-formation phenomena

During spring and autumn floods of rivers, overflowing of the riverbed intensifies, especially the river banks. As a result, shore protection and other coastal structures often collapse. The laboratory has an experimental device designed to study riverbed formation phenomena and to test models of specific structures. In particular, the device can be used for carrying out tests on the stability of a number of mouth parts of rivers flowing into Lake Sevan. On the same model it is possible to carry out riverbed formation studies during the floods of the Araks River.

3. Construction of new experimental devices

In the hydraulic laboratory it is planned to build in the near future:

(a) models of gravity water pipes on which new proposed air removal devices are to be tested;

(b) experimental equipment for testing small hydro turbine units of small hydropower plants.

With a similar approach, in the Institute of Mechanics of the National Academy of Armenia there is a "Soil Mechanics" training-research laboratory and in the National Agrarian University of Armenia – a laboratory of chemical and environmental expertise.

Conclusion

Preparing highly qualified manpower for the water industry of Artsakh Republic is first and foremost necessary to solve regional geopolitical realities which have been formed over the last 30 years confrontation, when the problems of formation and utilization of water resources are gaining not only economic, social, environmental, but first of all political significance. Training of qualified personnel for various engineering professions is not an easy task and for the secondary education system has not yet fully restored. The above-mentioned achievements in the educational process (sufficient potential of the teaching staff, availability of laboratory base) continue to be at risk. The average age of the University instructors is very high, besides they are mainly of Yerevan universities. In this regard, it is high time to train highly qualified young instructors and build modern laboratories in Artsakh. The solution to this problem should be directed to the professional potential that still exists today.

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ՏԵԽՆԻԿԱԿԱՆ ՀԱՄԱԼՍԱՐԱՆՆԵՐՈՒՄ ՈՐԱԿԻ ԱՊԱՀՈՎՄԱՆ ԽՆԴԻՐՆԵՐԸ ՋՐԱՅԻՆ ՈԼՈՐՏԻ ՄԱՍՆԱԳԻՏՈՒԹՅՈՒՆՆԵՐՈՎ ԿԱԴՐԵՐԻ ՊԱՏՐԱՍՏՄԱՆ ԳՈՐԾԸՆԹԱՑՈՒՄ

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Տնտեսագիտության վիճահարույց և բարդ հարցերից մեկը, ինչպես նախկինում, այնպես էլ այժմ, շարունակում է մնալ արժեքային համակարգի և դրա առանձին տարրերի գնահատումը: Բարձրագույն կրթության հավատարմագրման խորհուրդը որակը սահմանել է որպես համապատասխանություն ընդունված չափանիշներին, ինչն էլ ընդունվել են հավատարմագրող և որակի ապահովման մարմինների կողմից: Ինժեներական բարդ մասնագիտությունների ուսումնական պրոցեսը արդյունավետ կազմակերպելու համար, անհրաժեշտ է ունենալ գիտամանկավարժական և գործնական գործառույթները համատեղող պրոֆեսորադասախոսական կազմ, ժամանակակից ուսումնագիտական լաբորատոր բազաներ, ուսումնական պրակտիկաների կազմակերպման արդյունավետ համակարգ, ապահովել առավել պատրաստված դիմորդների ընդունելությունը բուհերի համապատասխան մասնագիտություններ: Հայաստանի և Արցախի բարձրագույն ուսումնական հաստատությունները վերջին տարիներին դարձել են արդյունավետ գործունեության հիմնական սուբյեկտներ: Շուշիի տեխնոլոգիական համալսարանի օրինակով, սույն աշխատանքում քննարկվում են ջրային ոլորտի մասնագիտությամբ կադրերի պատրաստման առանձնահատկությունները:

Բանալի բառեր. բարձրագույն կրթություն, որակ, ազգային հարստություն, ջրային համակարգեր, լաբորատորիա:

ПРОБЛЕМЫ ОБЕСПЕЧЕНИЯ КАЧЕСТВА В ТЕХНИЧЕСКИХ УНИВЕРСИТЕТАХ В ПРОЦЕССЕ ПОДГОТОВКИ КАДРОВ ДЛЯ ВОДНОЙ ОТРАСЛИ

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Одним из наиболее спорных и сложных вопросов экономики как в прошлом, так и в настоящее время является оценка системы ценностей и ее отдельных элементов. Совет по аккредитации высшего образования определил качество как соответствие принятым стандартам, которые были приняты органами по аккредитации и обеспечению качества. Для эффективной организации учебного процесса по сложным инженерным специальностям необходимо иметь профессорско-преподавательский состав, сочетающий научно-педагогические и практические функции, современные учебно-лабораторные базы, эффективную систему организации учебных практик, обеспечить прием наиболее подготовленных абитуриентов на соответствующие специальности вузов. Высшие учебные заведения Армении и Арцаха в последние годы стали основными субъектами эффективной деятельности. В данной статье рассматриваются особенности подготовки кадров для водной отрасли на примере Шушинского технологического университета.

Ключевые слова: высшее образование, качество, национальное богатство, водные системы, лаборатория.

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ISSUES OF FOOD SAFETY IN ARTSAKH REPUBLIC AND WAYS OF THEIR SOLUTION

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Abstract

The current global and regional developments and especially the third 44-day Artsakhi war have posed new challenges and problems both for the entire economy and a priority sector agriculture of Artsakh due to which significant losses of arable land, livestock, agricultural machinery and other property as well as decrease in workforce have been noted.

The study of the issues of development, adoption and implementation of realistic and scientifically justified strategic programs for the solution of the issues of food safety of the population is of particular importance in the current situation.

Key words: food safety, agricultural product, population, amount of loss, monitoring system of safety, regulation and strategic plan of providing food safety.

Food safety is presented in the economic literature as a set of legal, organizational, logistical and other measures aimed at providing the sufficient amount of food with necessary quality and safety for population which is available to every member of society, including the most vulnerable parts of the population and can be consumed by them at any time and in any situation including both during emergencies and martial law.

In other words, food safety is the state of the economy of any country when the necessary amount of food is available and the population has the opportunity to obtain it.

Food safety of each country is provided if there is such level of economy which guarantees the physical and economic availability, quality and safety of food corresponding to health norms of the population [1].

The report called «The world state of food safety and nutrition» of this year is the first in its kind which presented the estimation of world condition in the era of pandemic according to which the pandemic continues to reveal weak points of our food system which threaten the lives of people all over the world and livelyhoods and declared about sharp increase of global hunger [2].

In the historial summit «Nutrition for growth» on food systems of UNO on September 23 of current year in New York the world leaders were obliged to fight against global starvation, climate change and biomodification [3].

According to a report released by the Food and Agriculture Organization of the United Nations (FAO) on October 7, the world food price index was 130,0 points in September which is 1,2% higher than in August of this year and 32,8% higher than the value in September of the previous year [4] .

The 12 - months inflation in Armenian consumption market (from 2020 September to 2021 September) was 8,9%, the prices of food and soft drinks increased by 15,4% in Armenia and by 13,9 % in Artsakh [5, 6].

The issues of identifying problems of food safety and taking effective measures to solve them have also become on the agenda in the EAEU member states including Armenia.

Two main approaches are currently being actively discussed in the Union one of which is related to the regulation of using a collective model for implementation of economic potential of all EAEU countries and another to the provision of agricultural products and food exclusively to national production resources [7].

The food security of each country is mainly ensured through the development of agriculture, food production and food import systems.

The issues of developing and implementing effective measures to clarify and solve the problems of food safety have become more urgent for Artsakh as global and regional challenges have been doubled due to significant losses in arable land, livestock, farm mechanization and other property as well as the reduction of work force in the agrarian sector.

In particular, if in the past Artsakh exceeded the minimum rate for the production of grain crops per capita thus exporting part of the harvest to the Republic of Armenia, now all the existing potential is directed to meeting the needs of the local population.

The 44-day war has terribly affected the quick decline of economy especially in agriculture which fell by 21,7 percent in 2020 and by 47,2 percent in the first half of this year.

Artsakh has had more than 130 000 hectare of arable land before the war from which about 75% was left under the control of the enemy. About 20% of fruit gardens, irrigation water supplies, livestock, significant part of arable land and farm machinery were lost according to preliminary calculations.

The losses are quite serious which indicates their negative impact on the economy.

There are about 35,000 hectares of arable land in Artsakh at present according to preliminary estimation. Proper and competent management of this resource will allow us to fully ensure the food security of the people of Artsakh over time.

Of the 7,000 hectares of perennial plantations in Artsakh before the war we have about 2,500 hectares of gardens now including 500 hectares of newly planted and ripe pomegranate gardens, 900 hectares of vineyards, 650 hectares of mulberry gardens and 450 hectares of walnut and seed fruit gardens.

Significant losses were in fruit harvesting. Due to hostilities in Artsakh harvest activities were not held in autumn last year. Main losses were in pomegranate harvest, after we had losses of eastern date, grapes and other fruits [8].

In the current non-ordinary situation, the main tasks of the Government of the Republic of Artsakh in the field of food security are the provision of physical and economic availability of food, safety of food for the consumption of population, access to diversified food, creation, storage and replenishment of state food reserves.

Improving the monitoring system of food safety can be used to ensure food safety. It should include the collection and analysis of information on the supply of vital food to the population as well as forecasting the situation in the field of food safety and implementation of preventive measures of food crisis and certain actions towards eliminating the results of crisis.

It should be noted that the current monitoring systems of food safety in Artsakh do not correspond to the modern methodology. Therefore, the government should focus on the rapid introduction of up-to-date methodologies of monitoring systems which are apt to further improvement. It should also include elements of introducing ability development and data system which will enable to identify which monitoring methodology needs to be improved.

It is possible to equalize the level of profitability for farms in the whole territory of Artsakh in current conditions. It is necessary to implement a mapping of agricultural lands for this purpose including climatic conditions, soil composition and structure as well as information on the cultivation of the most profitable crops offered for the given areas or orientation of animal husbandry.

The mapping of agricultural lands of the Republic of Artsakh will allow to develop differentiated ways of development of areas favorable or unfavorable for agriculture, to provide the necessary consultation on the management of more profitable agriculture as well as to take measures to promote their implementation.

The above mentioned directions of the strategy of food safety should be outlined and included in the action plans of the Republic of Artsakh.

It is possible to work out and adopt the regulation and action plan of food safety of AR from political perspective by the end of the year including all the bases and actions to be taken to ensure the availability and use of food as well as emergency management in critical situation.

It is necessary to adopt the strategy of sustainable development of rural agriculture of Artsakh Republic for 2021-2031 to approve the list of measures ensuring their implementation which should totally present the guidelines of agrarian policy to be implemented in the coming decade.

The issues set and measures to solve them may be presented in the following logical sequence:

1. To provide the minimum level of food availability and self efficiency of nutritional diversificated food

1.1. To improve the production of local food of vital importance

1.2. To improve the indices of food balance for certain goods when importing substitution is economically efficient

2. To raise the availability of diversified food

2.1. To create preserve and complement state food reserves

2.2. To prevent food wastes and losses

2.3. To create close relations with partners thus providing cooperation with other initiatives such as providing food to schoolchildren and teaching on nutrition

3. To implement monitoring of food safety

3.1. To improve the monitoring system of food safety

3.2. To define criteria, to determine unfavorable areas and map them and develop action plan for their further development

Digital agriculture needs to promote agricultural innovations based on technology that lead to significantly higher productivity, increased resistence to climate change and other natural disasters, access to high-quality markets, new market opportunities, improved food quality and resource efficiency.

In order to outline the economic policy in the new situation, Artsakh needs first of all a widespread "business inventory" today. Not all the business "cut" chains have been clarified yet, the amount of the losses has not been finally defined and, which is more important, it is still difficult to get an idea of what the so-called "remaining economy" is and what we can get from it.

It is clear that Artsakh's economy can never be the same again, especially in terms of structure. It is clear that, for example, once wheat exporting Artsakh will now need grain itself, that the model of food safety will change and many things will change. There will be many new issues related to the protection of property rights, unemployment, lack of land and product realization. And you have to start thinking about all that earlier.

In the current situation, it is very important to form a perception that we are not restoring the economy of Artsakh which is familiar to us, but we are building a new economy on the remaining opportunities. This will not only allow us to avoid the despair expected at every step, but will also allow us to think more freely and broadly, to try to take advantage of possible new perspectives that may be opened due to the changed reality of geopolitical presence and the presence of peacekeepers.

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ՊԱՐԵՆԱՅԻՆ ԱՆՎՏԱՆԳՈՒԹՅԱՆ ԱՊԱՀՈՎՄԱՆ ՀԻՄՆԱԽՆԴԻՐՆԵՐԸ ԵՎ ԴՐԱՆՑ ԼՈՒԾՄԱՆ ՈՒՂԻՆԵՐԸ ԱՐՑԱԽԻ ՀԱՆՐԱՊԵՏՈՒԹՅՈՒՆՈՒՄ

Կ.Ա. Ներսիսյան, Ռ.Յու. Ավագյան
Շուշիի տեխնոլոգիական համալսարան

Գլոբալ և տարածաշրջանային ներկա զարգացումները, հատկապես արցախյան երրորդ 44-օրյա պատերազմը նոր մարտահրավերներ ու խնդիրներ են առաջադրել ԱՀ-ի ինչպես ամբողջ տնտեսության, այնպես էլ նրա գերակա ոլորտը համարվող գյուղատնեսության առջև, կապված պատերազմական գործողությունների հետևանքով վարելահողերի, անասնագլխաքանակի, գյուղտեխնիկայի և այլ գույքի զգալի կորուստների, աշխատուժի թվաքանակի կրճատման հետ:

Ներկա պայմաններում առանձնակի կարևորություն է ձեռք բերում բնակչության պարենային անվտանգության ապահովման հիմնախնդիրների և դրանց լուծման համար իրատեսական ու գիտականորեն հիմնավորված ռազմավարական ծրագրերի մշակման, ընդունման և իրագործման հարցերի ուսումնասիրությունը:

Բանալի բառեր. պարենային անվտանգություն, գյուղատնտեսական արտադրանք, բնակչություն, կորուստների չափեր, անվտանգության մոնիտորինգի համակարգ, պարենային անվտանգության ապահովման հայեցակարգ և ռազմավարական ծրագիր:

ПРОБЛЕМЫ ОБЕСПЕЧЕНИЯ ПРОДОВОЛЬСТВЕННОЙ БЕЗОПАСНОСТИ И ПУТИ ИХ РЕШЕНИЯ В РЕСПУБЛИКЕ АРЦАХ

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Нынешние глобальные и региональные развития, особенно третья 44-дневная война в Арцахе, выдвинули новые вызовы и задачи как для всей экономики страны, так и для считающейся приоритетной отраслью экономики, сельского хозяйства, в связи с значительными потерями пахотных земель, поголовья скота, сельхозтехники и другого имущества, сокращением численности рабочей силы.

В нынешних условиях особую важность приобретает изучение проблем обеспечения продовольственной безопасности населения, а также вопросы разработки, принятия и реализации научно обоснованных стратегических программ для их решения.

Ключевые слова: Продовольственная безопасность, сельскохозяйственная продукция, население, размеры потерь, система мониторинга безопасности, концепция обеспечения продовольственной безопасности и стратегическая программа.

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Submitted by the resolution of coordinating board of scientific journal of BHT on 19.07.2021

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1. Sheet format A4, margins up, down, left, right 18 mm.
2. Articles should be submitted in English, the font is Times New Roman, abstracts- Armenian-Unicode /GHEA Grapalat/, Russian -Times New Roman, English – Times New Roman. Line spacing – 1,15.
3. The title of the article is given in 11 capital letters **Bold** p.t. on the right top of the page. They are entitled in the sections of **AGRICULTURE, ARCHITECTURE AND CONSTRUCTION, ECONOMICS, INFORMATION AND COMMUNICATION TECHNOLOGIES, MACHINE INDUSTRY AND LOGISTICS, NATURAL SCIENCES, WATER SYSTEMS** for the bulletin.
4. There is UDC with no less than six numbers in 11 p.t. on the left part of the page one line down the section.
5. The title is given in capital letters 14 **Bold** p.t. a line down in the middle.
6. The author's name and, if desired, the initials of second name and full surname are given in 11 **Bold** p.t. two lines down from the right.
7. The name of the organization (organizations) is given in 11 p.t. a line down from the right.
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14. The abstract (**Abstract**) of the article is written in 12 p.t. two lines down. **Abstract** is written in 12 p.t. **bold.**
15. **Key words** are given in 12 p.t. two lines down. ***Key words*** are written in Italic (*Italic*) in 12 **bold** p.t.
16. The main text of the article is given in 12 p.t. two lines down which should obligatorily have the following sections: **Introduction**, **Conflict setting**, **Research results**, **Conclusion**: The article may also include other sections, in particular **Materials and methods, Experimental procedures, Discussion** and others. The names of the sections are written in 12 **bold** 10 mm Tab. The text of the section is given in 12 p.t. 10 mm Tab. Each section is given two lines down from the previous.
17. Formulas are given in **Math Type** program in the middle and are enumerated in brackets to the right.
18. Pictures, diagrams and tables may be used in texts. The pictures and diagrams are numbered by transit numbering pointed as "**Pic**.". They can be placed in the middle in 11 **Bold** p.t. down the pictures (diagrams) having **Pic.** in front and the ordinal number of the picture (diagram). Down the title corresponding explanations can be given in 10 p.t. in the middle. Tables are numbered by transit numbering pointed as **Table.** The names and descriptions of tables and symbols are given above them in 11 **bold p.t.** in the middle and **Table** and its serial number are written in 11 **bold**

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1. Էջի ֆորմատը՝ A4, լուսանցքները՝ 18 մմ (աջ, ձախ, վերև, ներքև):
2. Հոդվածի լեզուն՝ անգլերեն, տառատեսակը՝ Times New Roman, ամփոփագրերը՝ հայերեն (Unicode/GHEA Grapalat), ռուսերեն (Times New Roman): Միջտողային հեռավորությունը՝ 1,15:
3. Էջի վերին աջ անկյունում, գլխատառերով, 11 **bold** տառաչափով գրվում է խորագիրը: Տեղեկագրի համար դրանք են՝ **AGRICULTURE, ARCHITECTURE AND CONSTRUCTION, ECONOMICS, INFORMATION AND COMMUNICATION TECHNOLOGIES, MACHINE INDUSTRY AND LOGISTICS, NATURAL SCIENCES, WATER SYSTEMS**.
4. Հաջորդ տողի ձախ անկյունում գրվում է ՀՏԴ-ն (UDC)՝ առնվազն վեց նիշ՝ 11 տառաչափով:
5. Հաջորդ տողի մեջտեղում գլխատառերով գրվում է հոդվածի վերնագիրը՝ 14 **bold** տառաչափով:
6. Երկու տող ներքև, աջից, 11 **bold** տառաչափով գրվում է հեղինակի Անունը, ցանկության դեպքում՝ Հայրանվան առաջին տառը, Ազգանունը:
7. Հաջորդ տողում՝ աջից, 11 տառաչափով գրվում է կազմակերպության անվանումը:
8. Հաջորդ տողում՝ աջից, 11 տառաչափով գրվում է կազմակերպության հասցեն:
9. Երկու կազմակերպության կողմից հոդվածը ներկայացված լինելու դեպքում, 7-րդ և 8-րդ կետերը, հաջորդ տողից, կրկնվում են:
10. Հաջորդ տողում՝ աջից, 11 տառաչափով գրվում է հեղինակի էլեկտրոնային հասցեն:
11. Հաջորդ տողում՝ աջից, 11 տառաչափով գրվում է հեղինակի ORCID -ը:
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14. Երկու տող ներքև, 12 տառաչափով գրվում է հոդվածի ամփոփագիրը (**Abstract**): **«Abstract»** բառը գրվում է 12 **bold** տառաչափով:
15. Երկու տող ներքև, 12 տառաչափով գրվում է բանալի բառերը (***Key words***): «***Key words***» բառերը գրվում են շեղատառով (*Italic*)՝ 12 **bold** տառաչափով:
16. Երկու տող ներքև, 12 տառաչափով գրվում է հոդվածի տեքստը, որը պարտադիր պետք է ունենա հետևյալ բաժինները՝ **Introduction**, **Conflict setting**, **Research results**, **Conclusion**: Հոդվածը կարող է ներառել նաև այլ բաժիններ, մասնավորապես՝ **Materials and methods, Experimental procedures, Discussion**, այլ: Բաժինների անվանումները գրվում են 12 **bold** տառաչափով՝ 10 մմ խորքից: Հաջորդ տողից, 10 մմ խորքից, 12 տառաչափով գրվում է բաժնի տեքստը: Յուրաքանչյուր բաժին սկսվում է գրվել նախորդից երկու տող ներքև:
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համարակալվում են «աղ.» նմուշառմամբ: Դրանց անվանումները գրվում են 11 **bold** տառաչափով՝ մեջտեղից՝ աղյուսակի վերևում, իսկ անվանման վերևում՝ աջից, 11 **bold** տառաչափով, գրվում է «**Աղյուսակ** և աղյուսակի հերթական համարը»: Աղյուսակի մեջ գրառումներն իրականացվում են 10 տառաչափով (անհրաժեշտության դեպքում՝ 9 տառաչափով):

19. Հոդվածի վերջում, երկու տող ներքև, ներկայացվում է օգտագործված գրականության ցանկը (**References**)՝ համարակալված ըստ հղումների հերթականության: Աղբյուրները բերվում են [..] նմուշառմամբ: Հոդվածների վրա հղումները ներառում են հեղինակ/ներ/ի Ազգանունը, Անվան, Հայրանվան սկզբնատառերը, հոդվածի անվանումը, փակագծերի մեջ հոդվածի հրատարակման տարին: Այնուհետ դրվում է «//» նշանը և գրվում է հանդեսի անվանումը, քաղաքը, հրատարակման համարը, էջերը: Իսկ գրքերի, մենագրությունների դեպքում՝ էջերի ընդհանուր քանակը: Աղբյուրները ներկայացվում են բնօրինակ և անգլերեն թարգմանված տարբերակներով (ներկայացվում է գրականության 2 ցանկ՝ բացառությամբ այն դեպքի, երբ բոլոր հղումները անգլերեն լեզվով հրատարակված նյութերի վրա են):
20. Առանձին էջի վրա տրվում են հոդվածի ամփոփագրերը հայերեն և ռուսերեն լեզուներով: Արտերկրից ներկայացվող հոդվածների ամփոփագրերի թարգմանությունը, անհրաժեշտության դեպքում, իրականացնում է տեղեկագրի խմբագրությունը: Ամփոփագրի հայերեն տարբերակը ներկայացվում է 11, իսկ ռուսերեն տարբերակը՝ 12 տառաչափով: Ամփոփագրին, ներկայացվող լեզվով կցվում են բանալի բառերը:
21. Առանձին էջի վրա բերվում են հեղինակ/ներ/ի մասին տվյալները (պաշտոն, հեռախոս, գիտական աստիճան, գիտական կոչում, էլ. հասցե):
22. Հոդվածները ներկայացվում են info@bulletin.am հասցեով:
23. Անգլերեն տարբերակից բացի, հեղինակը ներկայացնում է նաև հոդվածի հայերեն կամ ռուսերեն տարբերակը (բացառությամբ արտերկրից ներկայացվող հոդվածների): Ամփոփոգրում, վերնագրից հետո բերվում են հեղինակ/ներ/ի Անվան, Հայրանվան սկզբնատառերը և Ազգանուն/ներ/ը:
24. Հոդվածները ստուգվում են գրագողության դեմ:
25. Հեղինակը կրում է գաղտնի տեղեկատվություն հրապարակելու ողջ պատասխանատվությունը:
26. Հոդվածները տպագրության են երաշխավորվում խմբագրական խորհրդի կողմից՝ խմբագրական խորհրդի անդամի երաշխավորությամբ կամ գրախոսման կարծիքի հիման վրա: Կարծիքը պետք է պարունակի եզրակացություն գիտական նորույթի վերաբերյալ:
27. Բացասական եզրակացություն ստացած հոդվածները տեղեկագրում հրատարակման ենթակա չեն:

Утверждено решением Координационного совета журнала ИВТ от 19.07.2021.

ТРЕБОВАНИЯ К ОФОРМЛЕНИЮ СТАТЬИ

1. Формат страницы - А4, поля - 18 мм (справа, слева, сверху, снизу).
2. Язык статьи - английский, шрифт: **Times New Roman**, аннотации: армянский - (**Unicode/GHEA Grapalat**), русский - (**Times New Roman**). Междустрочный интервал - 1,15.
3. В правом верхнем углу страницы, заглавными буквами, шрифтом 11 **bold** пишется рубрика. Для Известий это**: AGRICULTURE, ARCHITECTURE AND CONSTRUCTION, ECONOMICS, INFORMATION AND COMMUNICATION TECHNOLOGIES, MACHINE INDUSTRY AND LOGISTICS, NATURAL SCIENCES, WATER SYSTEMS.**
4. В левом углу следующей строки проставляется индекс УДК (минимум шестизначное число), размер шрифта 11.
5. В середине следующей строки заглавными буквами пишется название статьи, размер шрифта - 14 **bold**.
6. Две строки ниже, справа, шрифтом 11 **bold** пишутся инициалы Имени (при желании - Отчества) и Фамилия автора.
7. На следующей строке, справа, пишется название организации, размер шрифта - 11.
8. На следующей строке, справа, пишется адрес организации, размер шрифта - 11.
9. В случае представления статьи двумя организациями, пункты 7 и 8 повторяются со следующей строки.
10. На следующей строке, справа, пишется адрес электронной почты автора, размер шрифта - 11.
11. На следующей строке, справа, пишется ORCID автора, размер шрифта - 11.
12. На следующей строке, справа пишется название государства, гражданином которого является автор, размер шрифта - 11.
13. Две строки ниже, в том же порядке, пишутся данные других авторов, если они есть.
14. Две строки ниже, пишется аннотация статьи (**Abstract**), размер шрифта - 12. Слово **Abstract** пишется шрифтом 12 **bold**.
15. Две строки ниже, с размером шрифта 12 пишутся ключевые слова (***Key words)***. Слова «***Key words»*** пишутся курсивом (*Italic*), размер шрифта - 12 **bold**.
16. Две строки ниже, с размером шрифта 12, пишется текст статьи, который обязательно должен иметь следующие разделы: **Introduction**, **Conflict setting**, **Research results**, **Conclusion**. Статья может включать и другие разделы, в частности, **Materials and methods, Experimental procedures, Discussion** и т.д. Названия разделов пишутся шрифтом 12 **bold** с отступом 10 мм. Со следующей строки, с отступом 10 мм пишется текст раздела, размер шрифта - 12. Каждый раздел начинается двумя строками ниже предыдущего.
17. Формулы представляются по программе **MathType**, отдельной строкой, посередине и пронумеровываются в правой части, в скобках.
18. В тексте могут быть рисунки, графики и таблицы. Рисунки и графики нумеруются сквозной нумерацией по образцу - "Рис." Их названия пишутся шрифтом 11 **bold** посередине, внизу рисунков (графиков), с указанием спереди **Рис.** и порядкового номера рисунка (графика). Под названием, посередине, могут быть написаны соответствующие объяснения, размер шрифта - 10. Таблицы нумеруются сквозной нумерацией по образцу - "Таб.". Их названия пишутся шрифтом 11 **bold**, посередине - над таблицей, а над

названием - справа, шрифтом 11 **bold** пишется "**Таблица** и порядковый номер таблицы". Записи в таблице производятся размером шрифта 10, (при необходимости - размер шрифта 9).

19. В конце статьи, две строки ниже представляется список использованной литературы (**References**), пронумерованный по последовательности ссылок. Источники приводятся по образцу [..]. Ссылки на статьи включают Фамилию, инициалы Имени и Отчества автора (-ов), название статьи, год издания статьи в скобках. Затем ставится знак "//" и пишется название журнала, город, номер издания, страницы. А в случае книг и монографий - общее количество страниц. Источники представляются в оригинальной версии и в переводе на английский язык (представляются два списка литературы, за исключением случаев, когда все ссылки делаются на материалы, опубликованные на английском языке).
20. На отдельной странице приводятся аннотации статьи на армянском и русском языках. Перевод аннотаций статей, представляемых из-за рубежа, при необходимости осуществляет редакция журнала. Армянский вариант аннотации представляется 11 шрифтом, русский - 12 шрифтом. К аннотации прилагаются ключевые слова на том же языке.
21. На отдельной странице приводятся данные об авторе (-ах): должность, телефон, ученая степень, ученое звание, адрес электронной почты.
22. Статьи представляются по адресу info@bulletin.am.
23. Помимо английской версии, автор также представляет армянский или русский вариант статьи (за исключением статей из-за рубежа). В аннотации после названия статьи приводятся инициалы Имени автора (-ов), Отчества и Фамилия (-ии).
24. Статьи проверяются на плагиат.
25. Автор несет полную ответственность за публикацию конфиденциальной информации.
26. Статья рекомендуется к публикации редакционным советом по рекомендации члена редакционного совета или на основании его рецензии. Рецензия должна содержать заключение о научной новизне.
27. Статьи, получившие отрицательное заключение, не подлежат публикации в журнале.

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