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STUDY OF RESISTANCE OF VARIOUS GENOTYPES OF POTATOES TO DRY FUSARIUM ROT

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ИЗУЧЕНИЕ УСТОЙЧИВОСТИ РАЗЛИЧНЫХ ГЕНОТИПОВ КАРТОФЕЛЯ К СУХОЙ ФУЗАРИОЗНОЙ ГНИЛИ

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Abstract

This article presents the results of a study of 20 foreign potato breeding lines for resistance to dry fusarium rot. When artificially infecting the tuberous discs of the studied potato cultivars with a suspension of *Fusarium spp* spores in laboratory conditions, it was found that most of the studied genotypes had a high degree of resistance to this disease. Of the 20 potato samples studied, 2 lines had a very high, 11 lines had a high, 4 lines and 1 control variety had a relatively high, 1 line had an average and 1 line had a low degree of resistance to dry fusarium rot

Аннотация

В данной статье представлены результаты исследования 20 зарубежных селекционных линий картофеля на устойчивость к сухой фузариозной гнили. При искусственном инфицировании клубневых дисков исследуемых сортообразцов картофеля суспензией спор *Fusarium spp.* в лабораторных условиях установлено, что большинство изучаемых генотипов обладали высокой степенью устойчивости к данному заболеванию. Из 20 изучаемых образцов картофеля - 2 линии обладали очень высокой, 11 линий - высокой, 4 линии и 1 контрольный сорт - относительно высокой, 1 линия средней и 1 линия низкой степенью устойчивости к сухой фузариозной гнили.

Keywords: resistance, inoculation, dry fusarium rot, variety, potato breeding lines, infestation, degree of resistance.

Ключевые слова: устойчивость, инокуляция, сухая фузариозная гниль, сорт, селекционные линии картофеля, пораженность, степень устойчивости.

Введение. Картофель принадлежит к числу важнейших продовольственных и технических культур. Пищевая ценность картофеля определяется оптимальным соотношением органических и минеральных веществ: его клубни содержат витамины А, В, С, РР и К [1]. В последние годы в Казахстане наблюдается существенное снижение урожайности и качества картофеля. Урожайность культур не в полной мере обеспечивает потребности населения, так как средняя урожайность не превышает около 15-25 т/га [2]. Основными причинами относительно низкой урожайности являются несоблюдение технологии

возделывания и уборки культуры, а также потери, вызываемые различными вредителями и болезнями. Из них наиболее распространены грибные болезни: фузариозная и фомозная гнили, ризоктониоз, фитофтороз, парша, потери от которых могут достигать 45–80 % [3]. Фузариозная сухая гниль является одной из наиболее опасных болезней картофеля в период хранения. Болезнь наиболее характерна для тех клубней, что в жаркую погоду испытывали недостаток влаги [4].

Фузариозная гниль поражает как товарные клубни при длительном хранении, так и семенной материал. Заболевание начинается в основном на клубнях в виде темных и впалых поверхностных пятен. В мякоти клубня наблюдаются некротические участки светлого, коричневого или черного цвета. Когда гриб прогрессирует в клубне, на его поверхности появляются трещины и образуются морщины [5]. Старые мертвые ткани приобретают различные цвета, в них образуются полости, выстланные мицелием и спорами, и они сухие и шероховатые по текстуре [6].

Род *Fusarium* обычно характеризуется быстрорастущими колониями бледной или яркой окраски с войлочным воздушным мицелием и диффузным или спородохиальным спорообразованием. *Fusarium spp.* продуцируют веретенообразные, изогнутые, многосептатные макроконидии с заостренной верхушечной клеткой и заостренной базальной клеткой, имеющей вид ножки. У некоторых видов образуются более мелкие перегородчатые микроконидии. Однако в зависимости от вида могут присутствовать толстостенные хламидоспоры [7].

Согласно литературным данным [8], в настоящее время доминирующими видами в мире являются *F.sambucinum* (29,6%), *F.Sambucinum* (35,1%) и *F.oxysporum* (27,8%), которые встречаются примерно с одинаковой частотой. Также установлено, что *F.oxysporum* является одним из наиболее распространенных возбудителей сухой гнили клубней картофеля в мире [9].

Fusarium oxysporum содержит сложную группу видов, которые являются повсеместными обитателями почвы. Большинство патогенных штаммов также обладают превосходными сапрофитными способностями и могут выживать в виде хламидоспор в почве и растительных остатках и жить у альтернативных хозяев, не вызывая явных симптомов заболевания [10].

Увеличение производства картофеля невозможно без систематических мер защиты от сложных патогенов. Одним из наиболее эффективных способов решения проблем потери урожая, снижения качества семян и товарных клубней картофеля является создание сортов картофеля с высокой продуктивностью и устойчивостью к фитопатогенам различной этиологии.

Целью данной научно-исследовательской работы является изучение устойчивости новых казахстанско-китайских сортов и линий картофеля к фитопатогенным грибам рода *Fusarium.*

Методы и материалы. Исследования проводили на базе лаборатории биотехнологии растений кафедры «Биология, защита и карантин растений» Казахского агротехнического исследовательского университета имени С. Сейфуллина в рамках международной научной программы №3М/22 «Создание перспективных линий картофеля на основе генетических ресурсов КНР и Республики Казахстан».

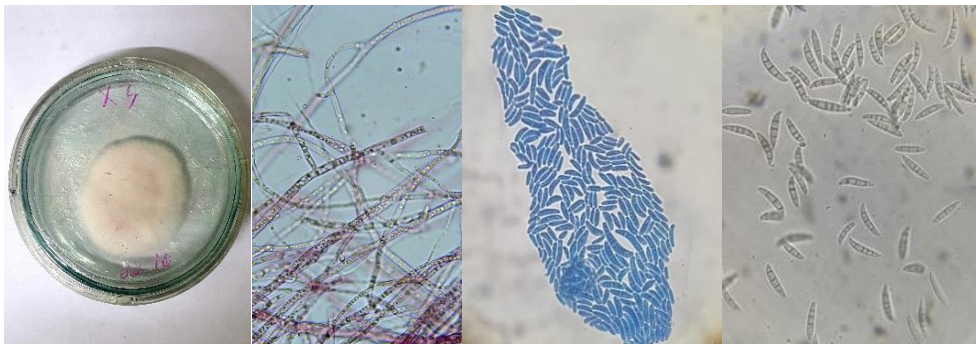
В качестве объектов исследования были использованы 20 различных сортов и селекционных линий картофеля: Аладдин (К-), Xisen 3, Xisen 6, Z-872-3, Z-872-4, Z-897-3, 17-212-19, 17-213-1, 17-216-9, 17-223-10, 17-242-8, 17-250-10, 17-241-4, 17-205-6, 17-225-12, 17-204-2, 19-1-4, 19-8-1, 19-14-4, 20-7-(3)В1№13. Вышеуказанный селекционный материал выращивался на экспериментальном участке ТОО Агрофирмы «Green Star» Целиноградского района Акмолинской области.

Чистые культуры микромицетов рода *Fusarium* выделяли из пораженной ткани клубней сорта Xisen 3 и культивировали на картофельно-глюкозном агаре (pH 5.6) при температуре 26°C и относительной влажности 60-70%. Типы патогенов определяли по морфологическим характеристикам спороношения конидий при микроскопическом вскрытии (модель

микроскопа Micromed P-1, с увеличением в 40 и 100 раз). Видовой состав фитопатогенных грибов определяли с использованием определителей В.И. Билая и М.А. Литвинова в соответствии с методикой [11, 12].

Для определения степени устойчивости селекционного материала к сухой фузариозной гнили инокулировали клубни картофеля. Отрезки клубней примерно 0,5 см толщиной были помещены в чашки Петри на поверхность фильтровальной бумаги и инокулированы суспензией спор изолята «Xisen 3» *Fusarium* в концентрации $1x10^4$конидий/мл. Повторность опытов – трехкратная. Контроль - дистиллированная вода. Первый день образцы инкубировали во влажной камере, последующие дни - оставались в помещении с температурой 20ºС и влажностью 70%. Учет результатов проводили на 7-е сутки. Для оценки устойчивости сортов и линий картофеля к фузариозу использовалось 9-балльная шкала [13].

Результаты и обсуждение. На первом этапе исследований было проведено оживление чистой культуры изолята Xisen 3. На рисунке 1 представлены результаты микроскопического анализа исследуемого изолята.



А В Г Д

Рисунок 1.Чистая культура и результаты микроскопического анализа возбудителя фузариоза: А-чистая культура патогена; В-конидиеносцы; Г, Д-конидии (увеличение 40 и 100х)

В результате микроскопического анализа было подтверждено, что конидии принадлежат к грибам рода *Fusarium*. Микроконидии имели овальную, цилиндрическую форму, по строению были одноклеточными, реже двуклеточными [14].

Далее для изучения степени устойчивости селекционного материала картофеля к фузариозной сухой гнили была проведена инокуляция клубневых дисков. Данные полученные в ходе опытов приведены ниже (таблица 1).

Таблица 1

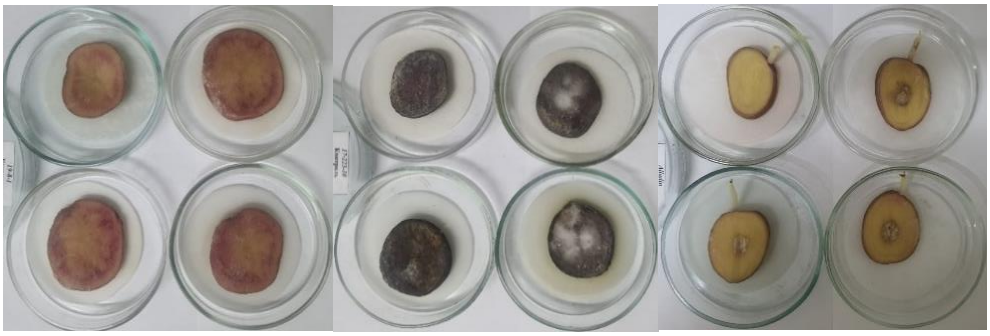
Результаты лабораторной оценки устойчивости сортов и линий картофеля к *Fusarium spp*

№	Сорт/линия	Пораженность, %	Степень устойчивости	Балл устойчивости
1.	Аладдин (К-)	17	Относительно высокая	7
2.	Xisen 3	12	Относительно высокая	7
3.	Xisen 6	8	Высокая	8
4.	Рэд Роуз	1	Высокая	8
5.	Z-872-3	0	Очень высокая	9
6.	Z-872-4	23	Средняя	5
7.	17-212-19	16	Относительно высокая	7
8.	17-213-1	13	Относительно высокая	7
9.	17-216-9	6	Высокая	8
10.	17-223-10	56	Низкая	3
11.	17-242-8	6	Высокая	8
12.	17-250-10	3	Высокая	8
13.	17-241-4	3	Высокая	8
14.	17-205-6	5	Высокая	8

15.	17-225-12	3	Высокая	8
16.	17-204-2	6	Высокая	8
17.	19-1-4	5	Высокая	8
18.	19-8-1	0	Очень высокая	9
19.	19-14-4	7	Высокая	8
20.	20-7-(3)B1 №13	11	Относительно высокая	7

П р и м е ч а н и е : (К-) – отрицательный контроль

Согласно данным таблицы 1, полученным после проведения искусственного заражения, из 20 селекционных образцов картофеля - 2 линии обладали очень высокой, 11 линий - высокой, 4 линии и 1 контрольный сорт - относительно высокой, 1 линия - средней и 1 линия - низкой степенью устойчивости к *Fusarium spp*. Сравнение высокоустойчивой и низкоустойчивой линий с контрольным сортом Аладдин приведено на рисунке 2.



А Б В

Рисунок 2**.** Степень пораженности линий 19-8-1 (А), 17-223-10 (Б) и сорта Аладдин (В)

Как видно из рисунка 1, клубневые образцы сорта Аладдин и линии 17-223-10 по степени пораженности фитопатогеном уступали образцам гибрида 19-8-1, что соответствовало результатам таблицы 1.

Выводы. На основании полученных данных можно сделать следующие выводы:

Были отобраны клубни картофеля с симптомами фузариоза. Определен родовой состав фитопатогенных грибов *Fusarium* с помощью микроскопирования и получен изолят с зараженного материала сорта Xisen 3;

Исследована устойчивость перспективных селекционно-генетического материала картофеля к фузариозу в лабораторных условиях. По результатам проведенных исследований из 20 изученных селекционных образцов картофеля - 2 линии обладали очень высокой, 11 линий - высокой, 4 линии и 1 контрольный сорт - относительно высокой, 1 линия - средней и 1 линия - низкой степенью устойчивости к сухой фузариозной гнили.

Исследованные фузариозоустойчивые линии картофеля послужат исходным материалом для дальнейшей селекционной работы и изучения устойчивости к данному фитопатогену на молекулярно-генетическом уровне.

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POSSIBILITIES AND PRIORITIES OF AGRITOURISM DEVELOPMENT IN GEORGIA

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Abstract

The article analyzes the development trends of agritourism in Georgia, evaluates the peculiarities of its development among the types of tourism. It is justified that there is a significant potential for the development of agritourism in Georgia with the possibility of offering a cheap and knowledgeable labor force, diverse and rich landscape, and differentiated agritourism products.

Correlative links between agritourism and agriculture are identified in the paper, it is considered appropriate to determine the opportunities and priority directions for the development of agritourism in Georgia based on the study of food potential. Preservation of the identity of the population of Georgia, balanced development of the economy in the regions, provision of business development with the increase of jobs and incomes of the population, etc.

The following tasks are solved in the work: on the example of the regions, the indicators of the development of agricultural branches are studied in dynamics, an analysis of the strengths and weaknesses of the agro-food potential, agritourism development is carried out, the relative advantages of the regional agritourism products are identified, the priority directions of agritourism development in the regions are proposed; Also, the analysis of the economic activities of the region and the incomes received from them has been carried out, accordingly it has been concluded that the development of agritourism in Georgia will have a positive effect on the protection of the environment and overcoming poverty.

The paper presents the influence of strategic directions of agrarian policy on the development of agritourism. Various research methods were used in the research process, fundamental theoretical provisions and concepts, data of the National Statistics Service and others were evaluated.

In the final part of the paper, the modern challenges of agritourism in Georgia are identified, the expected results of the development of this field are discussed and recommendations are offered on the strategic directions of sustainable development of agritourism.

Keywords: agritourism, agro-food potential, agrotourism product, agritourism development priority.

Introduction

There are favorable conditions for the development of agritourism in Georgia, because this country is characterized by very diverse natural and economic conditions, which have a special impact on the development of agriculture. The importance, supporting circumstances, necessity and prerequisites for the development of agrotourism are confirmed by the fact that the signs of the agricultural culture of Georgia are reflected in the mythological and ethnographic monuments, which are revealed in the customs and traditions related to this field, in religious rituals.

The diverse and contrasting nature of Georgia is characteristic for the development of agrotourism: the richest flora and fauna, a large hunting and fishing area, the size and uniqueness of the forest fund, mountain-ski tracks, rich historical and church-architectural monuments. The main essence of agrotourism lies in the fact that city dwellers (representatives of an over-urbanized environment) get to know rural life, learn folk traditions, live in an ecologically clean environment, get clean products, and more. The traditional way of producing products and its technologies, space, landscape, developed infrastructure together create an attractive environment. Uniqueness of locally produced products (natural taste and quality), household items and works of art. The popularity of agritourism is increasing every year. Tourists interested in this type of tourism are motivated by: seclusion with nature, climate, ecologically clean products, change of lifestyle and style. Tourists will pay attention to the local technology of soil cultivation and cultivation of agricultural crops, rules of

processing of agricultural raw materials. There are good prospects for the development of agritourism in Georgia, which are expressed in the following:

1. Georgia's natural conditions are extremely favorable for the development of agritourism;
2. The natural character of the farm, the structure of vegetation and animal husbandry, the use of backward technologies, the tradition of processing the produced products in the farm itself, the possibility of preparing delicious dishes with local products create a serious motivation for the residents of the city to make a decision in favor of agrarian tourism;
3. The total area of the houses of rural residents, the number and arrangement of rooms, providing them with necessary household equipment makes it possible to organize recreation conditions for tourists with relatively small expenses;
4. The analysis of household incomes and expenses in rural areas encourages the villagers to create an additional source of income, which is possible through the development of agrarian tourism.

For the purpose of socio-economic development, it is necessary to establish the image of Georgia as an agritourism country, to help the local agritourism industry to promote its products in the international market effectively; to create a favorable environment for the development of agritourism business; help the local young able-bodied population to get jobs. Agritourism is a relatively new sector of the tourism industry, which for the purpose of recreation provides for the travel of tourist groups to relax, and in many cases, to get to know local traditions and rural life in traditional settlements far from the center. This type of tourism is at the initial stage of development in Georgia. In this regard, each region of Georgia has great potential. It is focused on meeting the requirements of people with average and below-average financial capabilities, since it is distinguished by the fact that recreation can be done with relatively small expenses. The incomes of rural residents (renting housing, services, presentation of food products, national cuisine, sale of folk crafts) and their employment are increasing.

The development of agrotourism requires the development of an appropriate economic mechanism and institutional system, which should ensure its perfect management and regulation. This includes the creation of an appropriate economic and legal base and the development of relevant norms. It is extremely important to compile a regional atlas of agrotourism, which will be considered as the basis for realizing and providing marketing motivations. The creation of such an atlas is an undoubted novelty in the general system of foreign economic relations. The development of agritourism in Georgia requires the solution of many other specific and strictly targeted tasks, which in total should create a unified, centralized system and service of agrotourism, the realization of which will strengthen the economic and social potential of the country and raise its role and function in the world community. Consumer choice theory is known to examine the description and performance of human decision making. Based on the positions of this theory, the development of agrotourism is one of the best forms and means of tourism. Agrotourism gives a new impetus to the development of regions. Village self-government, representatives of cultural objects, residents who are ready for tourism business can be united in small and medium tour enterprises. A special program has been developed, according to which village houses are restored every year in accordance with the national style, as well as maintaining comfort and coziness. Such a tourist product meets the requirements of the paying consumer. Agrotourism programs should become part of the macro-economic plan of the regions, which will be a tool for the economic renewal of the territory and the rapid rise of agrotourism. The agro-tourism activities of Georgia should be carried out according to individual requests, that is, a single tourist package should be sold according to special tours, and all this should be reflected in the contract signed with the families registered in the village. Agrotourism, as one of the prospective directions, is not only a promoter of the development of tourism, but also a kind of multiplier for the economy of the region and the country. It can be considered as one of the factors of sustainable development of the village.

For the rapid development of agritourism, it is necessary to:

- Declaring agritourism as a priority direction;
- Liberal tax policy;
- Creation of a wide network of tourism information centers;

- Protecting the safety of tourists, creating an orderly banking and insurance system;
- Arranging seminars and trainings in municipal and rural areas;
- Active use of modern information technologies, creation of an electronic database and interactive tourist portals at the level of a separate region, where complete information about routes, historical places, private houses, etc. will be gathered;
- Investments for the production of bioproducts;
- Creation of tourism brand of Region and compliance with standards of hospitality; Providing the population with small equipment and tech services from the state.
- Relaxation in an ecologically clean environment and the demand for national cuisine products in the tourist market are gradually increasing.

Conclusion

Thus, the goal of the study of agrotourism, as a field of great, prospective and state importance, is to determine the opportunities and area of development of agritourism in Georgia, to create its systematic model, to develop the economic mechanism of management and regulation, and to determine the optimized levels of returns. For this purpose: it is necessary to create a system model of agritourism in Georgia and an automated, technological cycle of its management at different levels; to develop an economic mechanism for the development of agrotourism; create an electronic visit project and develop its management and regulation mechanism; to determine the possibilities and perspectives of the development of folk creative crafts in the overall system of agrotourism; to process the regional atlas of agrotourism; A training and educational program for the training and qualification of personnel for agrotourism was created; To create a systematic data bank (base) of agrotourism and its information technology system at the state level.

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Architecture

STUDY OF RUST INVOLVES ON WHEAT UNDER DRINKED CONDITIONS IN THE SHEKI-ZAQATALA REGION OF THE REPUBLIC OF AZERBAIJAN

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ИЗУЧЕНИЕ ПОРАЖЕННОСТИ РЖАВЧИНЫ НА ПШЕНИЦЕ В УСЛОВИЯХ БОГАРЫ В ШЕКИ-ЗАКАТАЛЬСКОМ РЕГИОНЕ АЗЕРБАЙДЖАНСКОЙ РЕСПУБЛИКИ

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Abstract

This study is aimed at studying the incidence of leaf rust (*Puccinia recondite tritici*) on wheat under rainfed conditions. Unlike other regions of the Republic of Azerbaijan, the Sheki-Zagatala zone is distinguished by a large amount of precipitation that falls during the probable period of rust manifestation. In general, the spread of diseases directly depends on the weather and climate. The incidence of rust in grain crops is most often observed during the rainy season. In 2021, at the experimental site of Perzivan of the Zakatala ZOS, an experiment was launched with 7 wheat sowing dates from 09.23-17.02 and a seeding rate of 130.0 kg per hectare. We studied 2 zoned varieties of soft winter wheat: Metin and Khezri, on which we carried out registration according to the growing season phases. Rust incidence during heading period in 2021 for all types of sowing dates, they should be classified as IV-strong and V-very strong damage groups. In addition, when analyzing seed seeds and seeds obtained from the 2021 harvest, a decrease in the absolute weight of seeds was observed, which greatly reduces the yield. Rust that appears before heading is especially dangerous. Such crops either die completely or produce extremely low yields. And in 2022, a survey of rust incidence was carried out on experimental plots of 3 varieties of winter soft wheat: Shafag-2, Khezri and Metin. It was found that the rust susceptibility of the Shafag-2 and Khezri varieties belongs to the III-medium group, and Metin to the II-weak group. In the fight against rust of grain crops, the cultivation of resistant varieties is mainly used. As world practice shows, this event is the most effective.

Аннотация

Данное исследование направленно на изучение пораженности бурой ржавчиной *(Puccinia recondite tritici*) пшеницы в условиях богары. В отличие от прочих регионов Азербайджанской Республики, Шеки-Закатальская зона отличается большим количеством осадков, выпадаемых в вероятные сроки проявления ржавчины. В целом распространение заболеваний напрямую зависит от погоды и климата. Поражаемость ржавчиной в зерновых культурах чаще всего наблюдается в дождливый период. В 2021 году на экспериментальном участке Перзиван Закатальской ЗОС был заложен опыт с 7-ю сроками посева пшеницы с 23.09-17.02 и нормой высева 130,0 кг на га. Исследовались 2 районированных сорта мягкой озимой пшеницы: Метин и Хезри на которых нами проведен учёт по вегетационным фазам. Пораженность ржавчиной в период колошения в 2021 году по всем видам сроков посева, надо отнести к IV-сильной и к V-очень сильной группам поражения. Кроме этого, при анализе семян посевного материала и семян, полученных от урожая 2021 года наблюдалось снижение абсолютного веса семян, что в сильной степени снижает урожай. Особенно опасна ржавчина, проявляющаяся до колошения. Такие посевы или гибнут совершенно, или же дают крайне низкий урожай. А в 2022 году учёт пораженности ржавчиной проведен на подопытных делянках 3-х сортов озимой мягкой пщеницы: Шафаг-2, Хезри и Метин. Было установлено, что поражаемость ржавчиной сортов Шафаг-2 и Хезри относятся к III-средней группе, а Метин к II-слабой группе. В борьбе с ржавчиной зерновых культур преимущественно применяют возделывание устойчивых сортов. Как показывает мировая практика, это мероприятие является наиболее эффективным.

Keywords: wheat, variety, sowing, rust, damage, harvest
Ключевые слова: пшеница, сорт, посев, ржавчина, пораженность, урожай

Введение. Одним из основных направлений Научно-Исследовательского Института Земледелия, является разработка теоретических основ и экспериментальных методов создания высокопродуктивных и качественных сортов зерновых культур интенсивного типа, комплексно устойчивых к засухе, высокой температуре, холоду, морозу, болезням и вредителям, а также полеганию, соответствующих разным агроэкологическим зонам Азербайджанской Республики [1, 4, 5].

Зерновые культуры в период вегетации заражаются целому ряду болезней. В условиях климата Азербайджана наиболее распространенными являются: бурая, линейная, желтая ржавчина, корневые гнили, септориоз, гельминтоспориоз, твердая и пыльная головня, нигроспороз, мучнистая роса пшеницы, твердая, пыльная, карликовая головня, гельминтоспориоз и фузариоз ячменя [3, 6].

Возбудителями ржавчины является грибы из порядка *Uredinales,* подкласса *Phragmobasidinae* класса базидиальных грибов. Эти грибы, так называемые, облигатные паразиты, развиваются только на живой ткани. Во всех районах, где возделываются зерновые культуры- хлебные злаки поражаются ржавчиной. Особенность ржавчины заключается в том, что при этой болезни, листья, листовые влагалища, стебли, а иногда и колосковые чешуйки покрываются мелкими выпуклыми подушечками- пустулами, окрашенными в ржаво красный или жёлтый цвет [7] (рис.1). В этих подушечках образуется масса одноклеточных спор ржавчинных грибов. Эти споры переносятся с одного растения на другое, и таким образом, заражают хлебные злаки в течение всего вегетационного периода растения, при наличии тепла и влаги. Ржавчина на пшенице- распространенное заболевания. На верхней стороне листовой пластинки, также на листовых влагалищах и стеблях образуются ржаво-бурые, более или менее овальные уредопустулы длиной 1-2 мм, шириной 0,5 мм. Они располагаются рассеянно, иногда- кольцеобразно. Уредоспоры характеризуются желто-бурой оболочкой и желтовато-оранжевым содержимым, более или менее шаровидные или слегка эллепсоидальные, с размером 17-29 х 16-24 мкм. Уредопустулы вначале прикрыты эпидермисом, но вскоре он разрывается и тогда появляются порошащие, ржаво-бурые массы спор. Позднее на нижней стороне листьев, также на листовых влагалищах и стеблях образуются двухклеточные телейтоспоры в рассеянных удлиненных черных пустулах, прикрытых эпидермисом [7] (рис.2).

Рис.1. бурая ржавчина

Рис.2. бурая ржавчина пшеницы: поражение листа, уредоспоры, телейтоспоры [7]

При поражении ржавчиной всех вегетативных органов, растение несомненно слабеет, происходит избыточная транспирация, усыхание части листьев, ослабление процесса ассимиляции. Вследствие этого зачастую получаем пониженный урожай. Помимо этого, в зараженных растениях замечается снижение количества зёрен в колосе, понижение величины и веса зерна, а также наблюдается легковесность и щуплость зерна [7].

Борьба с ржавчиной более затруднительная, чем с другими болезнями. Поэтому необходимо защищать растение в течение всего вегетационного периода. В борьбе с ржавчиной зерновых культур преимущественно применяют возделывание устойчивых сортов. Как показывает мировая практика, это мероприятие является наиболее эффективным. Основным фактором, регулирующим развитие заболевания ржавчиной в природе, является температура, с понижением которой инкубационный период болезни затягивается. При очень жаркой погоде развитие ржавчины прекращается. Влажность необходима паразитам только в момент инфекции растения. При слабом снежном покрове или в отсутствии его, в суровые зимы, ржавчина, как правило, не перезимовывает, так как погибает вместе с пораженными листьями озимых всходов. При температурах около 1-2^0 С, когда нормально перезимовывают и озимые, ржавчина обычно не погибает и даже слабо развивается. Оптимальными условиями для её развития является температура10-25^0 С, но при 30-31^0 С уредоспоры ржавчины не прорастают [2].

Инкубационный период бурой ржавчины, при оптимальных условиях, равен 6-8 дням, с понижением температур он может удлиняться до 18-20 дней. Особенность ржавчины в том, что она появляется в массе, охватывает большие площади и быстро распространяется от растения к растению. Отсюда и термин «год ржавчинны», как говорят иначе- эпифитотия ржавчины. При стопроцентном поражении посевов ржавчиной, уже в стадии кущения, урожай уменьшается на 97,4%, при таком же поражении при выходе колосьев в трубку урожай уменьшается на 91,3%, в случае сплошного развития ржавчины во время цветения урожай сокращается на 24,7% [1, 5].

Уместно будет отметить, что бурая ржавчина наиболее распространённая по сравнению с другими болезнями, так как обладает большой приспособленностью к условиям внешней среды и лучше выдерживает действие низких и высоких температур. Отношение к влажности воздуха у неё более безразличное, чем например, у жёлтой ржавчины. Наличие дождей для неё не является обязательным и требование к влаге часто компенсируется росой.

Идеальным решением вопроса защиты растений считают создание сортов с групповой устойчивостью к основным заболеваниям и вредителям, позволяющей не применять химические методы в защите растений. Кроме того, очень важно, чтобы продукты зерновых культур не были загрязнены остатками химикатов, а это возможно при ограничении применения химических методов, в связи с культивированием устойчивых сортов [2, 7].

Материалы и методы. На экспериментальном участке Перзиван Закатальской ЗОС был заложен опыт с 7-ю сроками посева пшеницы с 23.09-17.02 и нормой высева 130,0 кг на га. Исследовались 3 районированных сорта мягкой озимой пшеницы: Метин, Хезри и Шафаг-2 на которых нами проведен учёт по вегетационным фазам. Для учёта взяты варианты сроков посева: 23.09, 04.10, 05.11, 04.12 и 17.02. Площадь делянки 160м^2. Повторность 4-х кратная, взята для учёта 2-х повторностей 2-ой и 4-ой. Во время исследования, проходя по длинной стороне делянки, предварительно разбивалась делянка на 2 погонных метра в 5-ти местах и подсчитывалось количество растений на них. Затем из этого количества брались 10 больных растений, на которых подсчитывалось общее количество листьев и пораженных ржавчиной, с вычислением соответствующего % заражения.

Полученные результаты. В целом распространение заболеваний напрямую зависит от погоды и климата года. Поражаемость ржавчиной в зерновых культурах чаще всего наблюдается в годы с обильными осадками.

Ввиду сильного иссушения листьев пшеницы, обследование проведено не в период молочной зрелости, а в период колошения (таб. 1).

Таблица 1

Пораженность ржавчиной в период колошения в 2021 году

Срок посева	Сорта пшеницы	Количество учётных растений на 10 погон. метрах	Количество листьев на 100 больных растений		% поражения	Поражение по ярусам	Вид ржавчины
			общее	больных			
23.09	Метин	165	563	401	71,2	средний	бурая
04.10	Метин	166	613	535	88,5	целиком	бурая
04.10	Хезри	171	664	558	84,0	нижний	бурая
05.11	Метин	138	769	698	90,7	целиком	бурая
04.12	Метин	164	711	652	91,6	целиком	бурая
04.12	Хезри	160	689	555	80,5	целиком	бурая
17.02	Хезри	137	654	476	76,3	нижний	бурая

Для дачи оценки поражения ржавчиной нами взята таблица, принятая государственной комиссией по сортоиспытанию зерновых культур, которая приведена ниже:

Таблица 2

Группировка сортов пораженности болезнями, учитываемыми по степени поражения

Пораженность в %	Характеристика поражения	Группа поражения
1-7	Очень слабая	I
8-27	Слабая	II
28-52	Средняя	III
53-77	Сильная	IV
Свыше 77	Очень сильная	V

Как видно из таблицы 1 пораженность ржавчиной, в период колошения в 2021 году,

сортов озимой пшеницы Метин и Хезри по всем видам сроков посева надо отнести к IV-сильной и к V- очень сильной группам поражения.

Кроме этого, при анализе семян посевного материала и семян, полученных от урожая 2021 года, наблюдается снижение абсолютного веса семян.

Таблица 3

Анализ семян посевного материала

№	Сорта пшеницы	Время посева	Норма в кг	Абсолютный вес семян	
				Посевной материал	Урожай
1	Метин	04.10	130.0	57,3	44,8
2	Хезри	04.10	130.0	49,7	45,4

В 2022 году учёт и пораженность ржавчиной проведен на подопытных делянках 3-х сортов озимой мягкой пщеницы.

Таблица 4

Пораженность ржавчиной по 3 сортам пшениц в 2022 году

№	Сорта пшеницы	% заражения по фазам				Средний % поражения	Группа поражения	Вид ржавчины
		кущение	колошение	цветение	Молочная зрелость			
1	Хезри	-	15	24	54	31	III-средняя	бурая
2	Шафаг-2	-	36	38	62	45	III-средняя	бурая
3	Метин	-	3	2	6	4	II-слабая	бурая

Как видно из таблицы поражение ржавчиной из районированных сортов Шафаг-2 и Хезри, которых надо отнести к III-средней группе, а Метин к II-слабой группе.

Заключение. В отличие от прочих регионов Азербайджанской Республики, Шеки-Закатальская зона отличается большим количеством осадков, выпадаемых в вероятные сроки проявления ржавчины. В целом распространение заболеваний напрямую зависит от погоды и климата. Поражаемость ржавчиной зерновых культур чаще всего наблюдается в годы с обильными осадками. В 2021 году на экспериментальном участке Перзиван Закатальской ЗОС был заложен опыт с 7-ю сроками посева пшеницы с 23.09-17.02 и нормой высева 130,0 кг на га. Исследовалось 2 районированных сорта мягкой озимой пшеницы: Метин и Хезри на которых нами проведен учёт по вегетационным фазам. Пораженность ржавчиной в период колошения в 2021 году, по всем видам сроков посева, надо отнести к IV- сильной и к V- очень сильной группам поражения. Кроме этого, при анализе семян посевного материала и семян, полученных от урожая 2021 года, наблюдалось снижение абсолютного веса семян, что в сильной степени снижает урожай. Особенно опасна ржавчина, проявляющаяся до колошения. Такие посевы или гибнут совершенно, или же дают крайне низкий урожай. А в 2022 году учёт и пораженность ржавчиной проведен на подопытных делянках 3-х сортов озимой мягкой пщеницы: Шафаг-2, Хезри и Метин. Было установлено, что поражаемость ржавчиной сорта Шафаг-2 и Хезри относятся к III-средней группе, а Метин к II-слабой группе. В борьбе с ржавчиной зерновых культур преимущественно применяют возделывание устойчивых сортов. Как показывает мировая практика, это мероприятие является наиболее эффективным.

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Astronomy

A MODERN VIEW OF FORMER RIVERS ON MARS

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Abstract

Now the surface of Mars is a waterless desert, over which storms rage, raising sand and dust to a height of tens of kilometers. Under modern conditions, open bodies of water cannot exist on Mars. And water on the planet is contained either in the soil layer as permafrost, or in the form of open ice and snow; a very small amount of water is present in gaseous form in the atmosphere. The large reservoirs of water ice on Mars are the polar caps. Studies of Mars by spacecraft have shown that there is a huge amount of ice, and possibly liquid water, under the surface layer at a shallow depth. Analysis of the collected data allowed us to come to the conclusion that liquid water existed in significant quantities on the surface of Mars several billion years ago. That is, in the past, Mars had a full-fledged hydrosphere and a rather powerful atmosphere with a pressure near the surface of more than 0.4 bar. Later, the planet's climate changed. It lost much of its atmosphere and water, turning into a cold world. On the surface of Mars, there are numerous winding valleys with a long length, reminiscent of the dried-up channels of terrestrial rivers. A significant portion of the water that once flowed along currently dry riverbeds must now be under the surface of the planet. It is also possible that some channels are the result of the action of not liquid water, but a mixture of mud, ice and steam that flow only episodically. It is possible that the meandering valleys formed moving masses of glaciers. There is every reason to believe that there is still a lot of water on Mars, and it still exists in the form of permafrost. A perspective image of the Echus Chasma region suggests that liquid water was present on this part of the Martian surface up to a billion years ago. Later, the planet cooled down, the lakes froze, and glaciers formed, which "cut" the Kasei Valles with their streams.

Keywords: Mars, riverbeds, meandering valleys, glaciers, eternal permafrost.

Now the surface of Mars is a waterless and lifeless desert, over which storms rage, raising sand and dust to a height of tens of kilometers. During these storms, the wind speed can exceed a hundred meters per second. The current average pressure of the Martian air, which is 0.006 of the pressure of the Earth's atmosphere, is slightly less than the triple point of water. This means that now open bodies of water cannot exist on Mars, and water on the planet is contained either in the soil layer as permafrost, or in the form of open ice and snow, and also, in a very small amount, in gaseous form in the atmosphere. An open body of water, if it existed, would inevitably freeze, and begin to evaporate under the influence of solar radiation. The most famous reservoir of water ice on Mars is the northern polar cap [18, 20]. The southern polar ice cap is believed to have significantly less water ice and contains up to 4% CO_2 dry ice.

However, the latest studies of Mars by the "Mars Global Surveyor" and "Mars Odyssey" spacecraft proved that there is a huge amount of ice, and possibly liquid water, under the surface layer at a shallow depth. The very thin atmosphere of Mars now also contains water vapor. And certain signs of flowing water seasonally [15, 16, 19, 22] are also found on the surface of the planet. That is, once there should have been permanent bodies of water on Mars, and perhaps even an entire ocean. They could even have conditions for the formation of life [7, 12, 13, 21, 23, 24]. Analysis of the data collected by the "Mars Reconnaissance Orbiter" mission allowed us to come to the conclusion that liquid water existed in significant quantities on the surface of Mars only 2-2.5 billion years ago [10,

22, 32]. This suggests that in the past Mars had a full-fledged hydrosphere and a fairly powerful atmosphere with a pressure near the surface of more than 0.4 bar.

Later, the planet's climate changed. It lost a significant part of the atmosphere and water, turning into a cold world [1, 3, 5]. The presence on the surface of Mars of numerous meandering valleys with a long length, with tributaries and islands resembling the dried-up channels of terrestrial rivers, should indicate that earlier on the surface of Mars there were such conditions under which it was possible for liquid water to exist on the surface [2, 4, 6]. A significant portion of the water that once may have flowed along currently dry riverbeds (Fig. 1) should now be under the surface of the planet. Although these data require clarification and detailing, the presence of large reserves of water in permafrost under the surface would be quite expected and logically predicted. Now it is not known exactly how long the favorable conditions for the existence of liquid water on the surface of Mars lasted, and whether the channels were the result of the long-term action of evenly flowing water, or their appearance is explained by some catastrophic short-term actions of huge masses of water that for some reason moved from one place to another. Usually, these Martian channels are deep enough and too straight to be river channels in the usual sense.

Fig. 1. On the left – pictures of Maadim valleys; in the middle – the Nirgal channel; on the right – Candor Chasma Canyon (http://photojournal.jpl.nasa.gov/).

They are very little like the channels of earthly rivers, but at the same time they are close enough to the valleys of glaciers. Perhaps glaciers are responsible for their formation. Another hypothesis for the formation of Martian channels is the assumption of the existence of an era of hydrothermal activity that took place in the relatively recent past. According to estimates, rather large (30-100 m thick and up to 10 km in diameter) lenses of liquid water, which are heated by local tectonics, can form in the layer of permafrost. In some cases, the lens may overheat and boil. Under such conditions, displacement of a certain volume of water to the surface can lead to the formation of a catastrophic mudflow, which can create a deep canyon. According to this hypothesis, the channels are the result of the action of not liquid water, but a mixture of mud, ice and steam that flow only episodically.

There are other hypotheses. The most prominent features of the Martian terrain of this type are the Maadim and Nirgal valleys (Fig. 1, left and middle). Evidence that water once flowed deep beneath the surface of Mars has been revealed by faults, ejecta and landslides found on the planet's surface. Most likely, the water flowed through long underground channels of natural origin, which collapsed after millions of years and thus appeared on the surface. And although erosion has worked

both on them and on the surrounding landscape, even now you can find traces of water streams that probably existed for a long time. Previously, when studying the traces of liquid water activity on Mars, special attention was paid to the details of the relief, which were probably once either a riverbed, or the bottom of lakes, or a clear manifestation of water erosion. Now another evidence of the watery past of Mars appeared during observations of the incised Candor Chasma canyon (Fig. 1, right) with a spatial resolution better than 1 m, during which very interesting geological details became visible. For example, work [11] presents data that made it possible to find thin strips of light material along fault lines stretching for several kilometers (Fig. 2). It was believed that initially it was, conventionally, a "pipe" through which a liquid (water, liquid carbon dioxide with or without water) flowed with substances dissolved in it. Substances from the flow precipitated and accumulated on the walls of the "pipeline". After hundreds of millions of years, erosion has greatly changed the area, and what was beneath the surface is now on the surface. This led to the appearance of light stripes on a dark background.

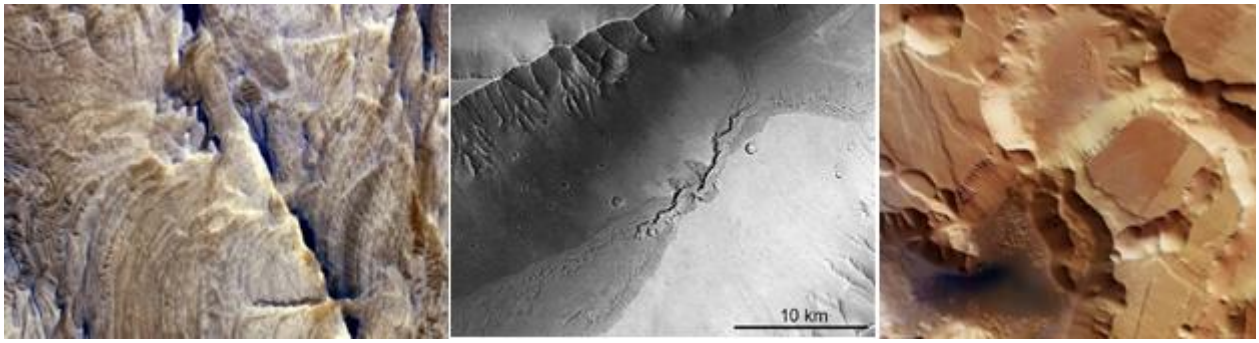

Fig. 2. On the left – bright areas of rocks on the image of the HIRISE camera from the “Mars Reconnaissance Orbiter” orbital module. In the middle – is Kasei Valles. On the right – a photo from “Mars Express” on 25.06.2006 shows drain in the Noctis Labyrinthus (http://photojournal.jpl.nasa.gov/).

These deep subterranean regions could be a kind of oasis for various biological activities that may have occurred there [8, 11]. Therefore, they (along with areas of Mars covered with clays) can be another promising place to look for traces of life. Moreover, the same stripes along the cracks and fractures of the surface were detected not only in the images of Candor Chasma, but also in several other areas of the planet. In some places, the surface of the planet is covered with multi-layered rocks, similar to terrestrial sedimentary rocks, which remained after the retreat of the sea.

Among the formations discovered on the surface of Mars, channel-like flow ditches and so-called meander valleys deserve special attention [14, 17, 27, 29, 30]. Their appearance and the presence of tributaries can hardly be explained otherwise than by suggesting that they are dried riverbeds. Of course, rivers cannot flow on the surface of Mars at this time, and now there can be practically no liquid water there. After all, with such a small pressure existing on the planet at this time, water boils at very low temperatures. However, no other liquid could hardly have formed the observed channels. After all, for example, lava cools very quickly, and liquid carbon dioxide cannot exist even in terrestrial conditions. And meanders could appear only in the presence of previously existing water flows in the form of rivers. And since there are no necessary conditions for this now, they could have been in the past. For this, it is necessary to assume that in earlier epochs the atmospheric pressure on Mars was much higher than at this time, and in the distant past it was a warmer and wetter planet.

However, there is another explanation for meanders. Perhaps they were left by the moving masses of glaciers, which leave deep furrows on the Earth's surface as well. In addition, it turned out that dark areas are not always depressions. And some of them, such as Syrtis Major, are elevated plateaus with slopes in all directions. Detailed studies show that many of these channels originate from the Mariner Valley and may have been formed during some flash flood. Some other features of the relief are clearly reminiscent of areas smoothed by glaciers. Judging by the good preservation of

these forms, which did not have time to collapse or be covered by subsequent layers, they have a relatively recent origin: within the last billion years. That is, there is every reason to believe that there is a lot of water on Mars and that water exists even now in the form of permafrost.

Detailed images of the surface of Mars, obtained by the Mars Odyssey orbital station, made it possible to detect several "living" glaciers in the mid-latitudes, quite far beyond the icy polar caps of the planet. On the one shown in Fig. 2 (in the middle) of the picture, you can note a rather interesting circumstance, when the lines of the ledges in the valleys of the Martian glaciers look, unlike such formations on Earth, practically undamaged and not blurred. This can be explained, for example, by the fact that glaciers on Mars did not melt (like on Earth), but immediately turned into steam due to the very rarefied Martian atmosphere (i.e., sublimated). Judging by the good preservation of the forms in the area of Noctis Labyrinthus (Fig. 2, right), which did not have time to be destroyed or covered by subsequent layers, they have a relatively recent origin (within the last billion years).

One of the largest channel systems on Mars is the Kasei Valles (Fig. 2, left). It contains abundant evidence of glacial and fluvial activity that accompanied much of the planet's geological history. The scours on the floor and traces of erosion in this valley were most likely caused by glacial, not water, erosion. The absence of craters in the channels indicates their geological youth, with valleys 100 m deep and up to 3 km wide. The glacier that created this valley was fed by the waters of the Echus Chasma region (Fig. 3), which was heated from below by volcanoes [25, 26, 31].

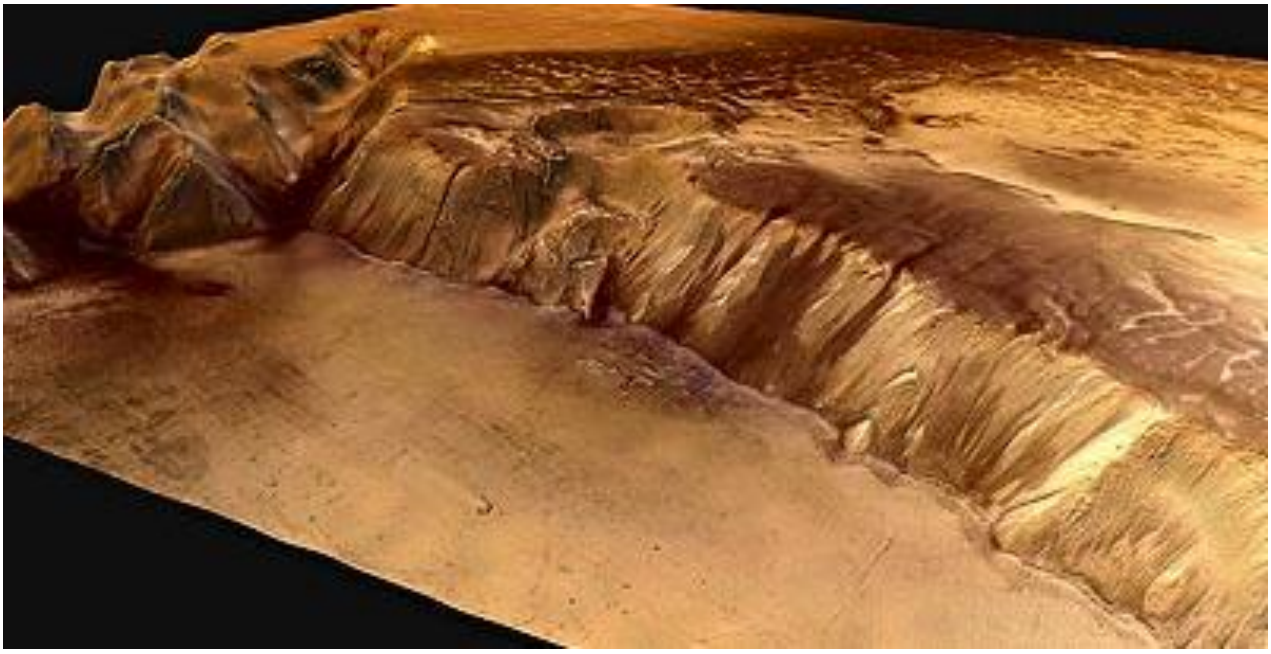

Fig. 3. The region of Echus Chasma (http://photojournal.jpl.nasa.gov/).

It was this volcanic activity that led to the appearance of large flows of melt water quite recently from a geological point of view: up to 20 million years ago. A perspective image of the Echus Chasma region suggests that, at least on this part of the Martian surface, liquid water was present up to a billion years ago. Later, the planet cooled down, the lakes froze, and glaciers formed, which "cut" the Kasei Valles with their streams. One of the proofs of this theory is that the bottom of the "channels" is located below the hypothetical level of the Martian ocean. This is impossible for water but performs well for ice.

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Biological sciences

A STUDY OF THE IMPACT OF PHYTIC ON THE QUALITY OF WHEAT GRAINS

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Abstract

The issue of increasing the use of wheat grain to humans is still a matter of concern, because of its accessibility and multifunctional in use. As food and its nutrient consumption is necessity for life, the content of the products thoroughly considered issue. All cereals contain phytic acid, which is highly chelating inhibitor to numerous metal ions, especially zinc, calcium, iron and protein residues. For example, iron and zinc deficiencies are common issue in nutritional value of cereals. Bioavailability of Zn2 + has been reported to be the most adverse effect in humans. The presence of phytate in plant-based foods can be factor in the reduction of Zn2 +, and damaging homeostasis, which results diseases such as dwarfism and hypogonadism. Therefore, it is crucial to investigate ways to lower phytic acid, in order to maintain nutritional content of crops.

Keywords: wheat grains, mutant lines, phytic acid

INTRODUCTION

Phytic acid is a compound contained in many plant food products, including plants, legumes, nuts, and seeds. It is the storage type of phosphorus, an essential mineral component used in the processing of energy, as well as in the forming of structural elements such as cell membranes. Phytic acid is primarily present in whole grain bran or outer shells. This is of a concern as a part of new drugs, since it shows the characteristics of a regulator of several metabolic processes, namely calcium-phosphorus normalization and ionic balance, as well as being an exogenous antioxidant [1]. Phytic acid-1, 2, 3, 4, 5, 6-hexakis, distinguished by 12 ionizable protons, which may react to multivalent cations with these metal ions, including Fe3 +, Mn2 +, Zn2 +, Ba +, etc. Because the minerals such as copper, calcium, magnesium, zinc and iron contain a chelating agent. Most of the phytate-mineral complexes in natural physiological environments are insoluble, and hence, non-absorbable. Phytic acid's capacity to chelate such important minerals is a matter of concern for the human nutrition [2]. The daily intake of phytic acid is estimated to be approximately 200 to 800 mg in developed countries and approximately 2000 mg in developing countries, while the lower amounts of phytic acid (approximately 10 mg/100 g) the minimize mineral absorption and cause anti-nutritional effects.

The phytate's chemical properties well defined in the literature: phytic acid consists of myo-inositol rings to which six classes of orthophosphates connected with ester bonds. Phosphate groups in positions 1, 3, 4, 5 and 6 have an equatorial orientation compared to the myo-inositol ring while the phosphate group in the second carbon atom has maximal orientation. The word 'phytic acid' applies to full protonated free acid, and the names phytate and phytin are also used to apply to mixed phytic acid salts, such as magnesium, potassium, and calcium. However, given the low phytic acid content relative to starch, sugar, fat and food, it plays a significant role in assessing phosphorus cations for bioavailability, as well as other amino acids and carbohydrates. Phytic acid's function in feeding largely attributed to the heavy negative charge in the inositol ring from different phosphate groups. It is the negative charge of phytic acid in the intestinal environment reduces the solubility and assimilation of phosphorus and calcium, a number of other cations (iron, zinc), as well as proteins, and triggers a number of undesirable physiological chain reactions. In monocotyledonous seeds, the accumulation site of phytic acid is the aleurone layer, especially the aleurone plant. When more than 80 per cent of phytic acid is contained in germ, corn varies from other cereals. Phytate is most widely regarded as a substance thought to decrease mineral absorption, but often recognized, as a potentially beneficial substance close to vitamins. Phytic acid is highly capable of chelating multivalent metal

ions, particularly zinc, calcium, iron and protein residues. Binding can result in insoluble salts with low mineral bioavailability. Phytate interaction with proteins occurs in seeds during maturation, as phytate accumulates in cereals' protein-rich aleurone layer. Phytate-phosphorus is therefore less nutritious because phytate does not hydrolyze it in the human body. [3].

Myo-inositol hexaphosphoric acid (IP6) is a significant storage source of phosphorous in many plants. Its composition is molecular in weight 660.03. It is made of $C_6H_{18}O_{24}P_6$. The phytic acid structure shown in the Fig. 1 and then Fig. 2 demonstrates phytic acid formation with the various forms of dealing with both metal cations (minerals) and residues in protein.

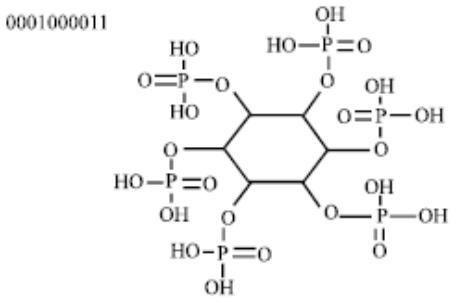

Figure 1. Structure of phytic acid

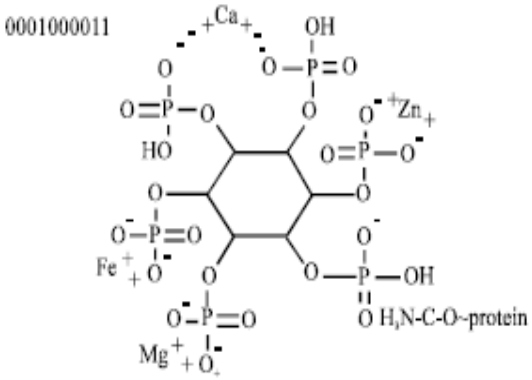

Figure 2. Structure of phytic acid with the different possibilities to interact with both metal cations (minerals) as with protein residues [4]

In a structure similar to snowflakes, it includes the closely attached element phosphorus. In human beings and species with one stomach, the phosphorus is not readily bioavailable. In addition to blocking phosphorus supply, the arms of the molecule of phytic acid readily connect with other components, such as calcium, magnesium, iron and zinc, and render them all unavailable.

The seeds' PA content influenced primarily by genetic and environmental factors. Weather conditions, the cultivation of crops and fertilizers and soil characteristics, including physical, chemical and biological aspects of soils, typically include environmental factors [5]. The anticipated effects of change in the environment can also affect the PA content in seeds, particularly increasing temperatures and CO2 emissions. However, knowledge on P-uptake, translocation, removability, P-partition and PA aggregation in rice grain is constrained on the impact of genetic and climate influences.

In this regard, the phytic acid threshold tends to be more favorable than detrimental for the crop after the rates of the Phytate have reduced, meaning that more than phytate is usable in the plant. To ensure optimal safety, phytats should be as limited as practicable, preferably to 25 mg or less per 100 g or approximately 0.035% of the food-bearing phytate eaten. Micronutrient losses decreased at this point.

Table 1 – Phytate content on common foods as a percentage of dry weight.

Sources	(% dry wt.)
100% Wheat bran cereal	3.29
Soy beans	1.00-2.22
Pinto beans	0.60-2.38
Navy beans	0.74-1.78
Parboiled brown rice	1.60
Oats	1.37
Peanuts	1.05-1.76
Barley	1.19
Coconut meal	1.17
Whole corn	1.05
Rye	1.01
Wheat flour	0.96
Brown rice	0.84-0.94
Chickpeas	0.28-1.26
Lentils	0.27-1.05
Milled (white)rice	0.20

PA reported as a natural plant antioxidant and a protector against oxidative stress in seeds, despite the negative consequences on human nutrition. PA exports and translations of mRNA, RNA processing, repair of DNA and vesicular traffic are interested in your yeast. PA's negative impacts on nutrition highlighted, while PA's beneficial role in plant biology was underplayed. In cases of high dietary consumption of phytic acid, the possible advantages of phytic acid occurs. A high consumption correlated with a reduced absorption of minerals. It is important to find ways to minimize harmful consequences and enhance the positive results, so that to get the best of both.

Nutritional Quality Content of wheat grain

Wheat grain, as well as its derivatives, considered significant mineral sources for humans and animals. Minerals are key components of metabolism in plants and often are contained in seeds. Minerals play an important role for plant growth and production either as vital nutrients or through their impact on enzyme systems. The wheat grain 1.6 percent contains of minerals however, after milling, the amount falls to 0.4 percent to white flour [6]. There is variation among various sections of wheat grains in the content of mineral elements. With the exception of quantities of C and O in grains, the grain cortex mainly contains K, P and Se while quantities of Cl, Si, S, Mg, and Ca are low. There is a high concentration of P, K and Mg in the aleurone layer of wheat grains, while Si, Se, S, Ca, Cl and Fe are low. The minerals concentration was low excluding C and O in the endosperm layer. A number of factors, including the land, the climate and cultural practices, affect the mineral content of cereal grains. The mineral element content of wheat cultivars is genetically different. Whereas the mineral wheat produced in various environments revealed differences in content of ash, K, Mn and Mg, there were only minor differences in content of Fe, Zn, P and Cu.

It has been demonstrated that organic and traditional farming has significant consequences for mineral grain quality. In wheat varieties cultivated under inorganic conditions, the extractability of P and Mg was significantly higher than in organically grown ones. The excessive use of fertilizers is the source of higher levels of P and Mg in inorganic conditions. Significant correlation observed between P and Mg contents. There were also significant variations between organically grown and inorganically grown cultivars in the levels of Ca, Cu, Mn, P and Zn. Inorganically, substantially higher Cu and Mn content than organically grown wheat has been found. A minimal loss of aleuron 5 layer will increase the nutrient value of the wheat flour during the milling process. Often depending on the degree of milling, the bioavailability of the minerals from cereals. The average Zn concentration of wheat whole grain in various countries is between 20 and 35 mg, according to a variety of surveys and survey studies [7]. Seed Zn is mainly present in the embryo- and aleuronic layer, while

Zn concentrations have very small endosperm. In the embryo and aleuronic layer, the Zn concentrations found at approximately 150 mg.kg−1 and only 15 mg.kg−1 in the endosperm. Appropriate genetics specifically developed in wheat germplasms, which greatly enhance Fe and Zn rates in wheat grain. The concentrations of grain Fe and grain Zn strongly correlated in the wheat lines analyzed. Although a genotype affected considerably the environmental interplay between Fe and Zn rates, the aggregation of Fe and Zn grains remained a significant genetic element.

Bioavailability of Fe and Zn

The question of growing the use of wheat grain for people is still a matter of concern. The intake of food and nutrients is the foundation of life, but the quality of goods is very important here. Thus, the shortage of iron (Fe) affects two billion or every third individual worldwide, while the WHO reports that 17.3% of the world's population is at risk of inadequate zinc intake [8]. Nutrient malnutrition is still one of the main health problems in the world and marked by an increasing number of people voicing the disease in its different forms. About 30% of humanity — infants, teenagers, teens, adults, and the elderly in the developed world — now suffers from one or more of the several types of malnutrition. The poor dietary quality is by far the main risk factors for this global disease and each nation faces a severe malnutrition public health problem. Iron (Fe) is an element that is biologically important to humans and that participates in a broad variety of metabolic processes, such as transporting oxygen, deoxyribonucleic acid (DNA). Approximately 70 percent of iron in the body attached to hemoglobin in red blood cells and myoglobin in muscle cells. The residual iron either attached to other proteins (blood transferrin, or bone marrow ferritin) or contained in certain body tissues. Zinc (Zn) is also an important micronutrient for all living species, since it plays both catalytic and structural functions in a broad range of proteins. Fe metabolism disorders include a broad variety of diseases, with various clinical causes, ranging from anemia, iron deficiency, and probably neuro sensitive diseases, among the most common nutrient-related diseases in humans. The iron deficiency is the first and the zinc deficiency is the third in terms of the worldwide scale and disease incidence.

The malnutrition of iron and zinc, which well known as a major health issue, is caused largely by cereal diets that are micronutrient deficient but are prevalent in countries with lower and middle incomes. Malnutrition and nutritious diseases have an impeded growth of the intrauterine system affecting 23.8% of all births each year, and malnutrition of protein-energy affects 26.7% of children under the average of five worldwide, as well as more than 60% of the world's population, Fe, and more than 25% Zn [9]. As Fe and Zn often derived from the same food sources in the human diet that are high in nutrients, the lack of such foods generally leads to simultaneous metal failure.

Selective breeding focusing on increased yields generally assumed to have led to a dilution effect on grains with a lower metal concentration. The human body requires 51 nutrients, and at least one of these shortages will cause metabolic complications, contributing to ill health and chronic diseases. Such nutrients only come from agricultural products. The cereal monoculture system, however, has intensified the issue of micronutrient deficiency by growing the production of certain crops that would supply the weaker population with micronutrient foods. Additionally, the planting of high yielding crops had a major "breeding impact" concerning nutrients as important as Zn and Fe. Current varieties have higher yields; however, their wild variants are two or three times poorer in zinc, respectively. Wheat is naturally relatively small in zinc, though. In addition, considering that its use expected to rise by more than 70 percent in the future with demographic development, this is a concern. Depending on the preparation, process and supplier’s different types of elemental iron are usable. H2-reduced iron is a type of elemental iron widely spread in small particle size commercially. Reduced iron is easily soluble in water or heavy acids owing to its low reactivity and is most likely to hamper its bioavailability. The total solubility of the metallic iron and the rate at which it dissolves in the stomach's acid milieu is volatile, meaning that an unknown proportion is required for absorption. Only soluble iron enters the 'common pool' of nonheme iron that interacts with dietary inhibitors or enhancers and ultimately decides how much is absorbed. This condition is not apparent in conventional bioavailability experiments utilizing an extrinsic tag or tracer — a minute volume of radioactive iron added — that expected to join the typical pool and respond identically with the dietary soluble

nonheme iron found within. This illustrated in many products and soluble iron salts such as ferrous sulfate for the natural iron [10].

Bio fortification is amongst the most cost-effective and ecologically solutions to preventing and alleviating nutrient malnutrition in humans, or the process of genetic enhancement that specifically targets the mineral status in the grains of staple food crops by breeding. For instance, it shows that, with the use of bio-fortified wheat in the human diet, the consumption of Zn was significantly higher relative to the non-bio fortified diet. Furthermore, the bio fortification of crops by breeding has many benefits, such as long-term and reliable means of supplying more micronutrients, preserving the enhanced nutritional condition of malnourished citizens. In addition to increasing nutrient concentration in food crops, high bioavailability is significant for human nutrition. Wheat foods are rich in antinutrients, particularly phytic acid (Phy), which impede the absorption or use of nutrients in the digestive system. Overall, staple food crops and grains have very poor bioavailability of Fe and Zn. To improve the bioavailability of Fe from 5% to 20%, it is approximately equal to the fourfold improvement of overall Fe. It observed genetically much simpler to increase of the bioavailability of Fe and Zn compared to through their overall concentration by traditional breeding by this amount. The molar ratio with Phy commonly used to calculate the mineral bioavailability in the human diet [11]. The control of Fe status in the human organism regulated by absorption, while Zn homeostasis achieved by absorption but also gastrointestinal secretion and endogenous Zn excretion.

Bio-enrichment is the method of using conventional breeding or modern biotechnology to grow food crops with a high content of trace elements. Two important agricultural methods for improving the concentration of zinc and iron in grain are plant breeding and fertilizing Zn and Fe. Given the fact that genetic modification provides further prospects for a substantial improvement in the bioavailability of Zn and Fe in food, the acceptance of GMO technology by customers and regulatory bodies is rather restricted and, in the foreseeable term, it is doubtful that genetically engineered production and selling of these crops would be widely approved Agronomic bio-enrichment obtained by the application of trace elements to the soil and/or directly to plant leaves. Agronomic bio-enrichment, unlike genetic modification, is theoretically more efficient, inexpensive, and simpler to execute than other approaches. On the subject of wheat, scientists estimate that zinc concentration in the grain of a standard wheat crop is 20 to 35 mg/kg or even lower. To obtain the required criterion for wellbeing, which is 40-50 mg/kg, such concentrations cannot meet the everyday needs of the human body. Zn's bioavailability in the wheat grain is around 25%, whereas Fe's bioavailability estimated to be 5%. The occurrence of antinutrients such as phytate in grains correlated with the bioavailability of Fe and Zn. Each breeding or bio-enrichment system will suggest not just the amount of trace elements but also the degree of their bioavailability. Such compounds promote iron and zinc absorption and remobilization in plants. A mixture of nitrogen fertilizers, for example, with the addition of Zn and Fe into the soil or via the leaf improves both the production and absorption of these components, promoting the translocation of copper and iron from flag leaves to plants [12].

Correlation between phytate content and mineral availability

The production in physiologic pH values of insoluble metal cation-phytate complexes regarded as the core explanation for low mineral supply, because such complexes will not absorb into the gastric. There are considerable variations in the actions of the individual minerals; most studies indicate a reverse connection between phytate and mineral availability. Zn 2+ was the most negatively affected basic mineral by phytate. The role of phytate in herbal foods recognized as an essential factor in decreasing Zn 2+ absorption. Phytate induces dose-dependent absorption of Zn 2+. However, certain reports do not agree, in particular on different foods, and their individual components. Moreover, the supply of Zn 2+ in dietary environments not only limited by phytate but also adversely affected Zn 2+ homeostasis. There is still some debate regarding the impact of phytate on dietary iron availability. The fact that iron is consumed lower in general, the presence of multiple ironphytats of varying solubility and two forms of food iron, heme and nonheme iron, may be the reason for much of the debate. Heme iron is ideally absorbed and absorbs more by dietary factors, but nonheme iron is less readily absorbed, and certain dietary factors impair its absorption. Given the strong resistance of

phytate to iron absorption in several human tests, generally recognized today that phytate is the major, though not the only contributor to a decrease in human iron supply. The impact of phytate on the abundance of iron and in particular, the abundance of iron Zn2+. However, it tends to be less prominent due to the fact that, phytate is comparatively strong in Ca 2+ content in plant-based foods, the capacity of the colone to dephosphoryl phytatic bacterial flora, and the possibility that Ca 2+. Relatively few research has discussed phytate impact on daily usage of Cu 2+, Mn 2+ and Mg 2+.

Materials and methods

Spring bread wheat variety grains Eritrosperum-35 (*T.aestivum L.*) irradiated at 100 and 200 Gy doses. Six lines from the initial 100 Gy radiation dose and 200 Gy chosen after collecting the M5 plants. 12 lines of the mutant Eritrosperum-35M5 were chosen from the radiation exposure of 100-Gy and 200-Gy, and these were numbered:105(1), 108(1), 113(5), 118(1), 136(1), 140(2), 144(2), 149(2), 150(7), 152(1), 152(8), 153(4).

Crop samples of each mutant line evaluated based on the following yield parameters: grain weight per plant (GWP) row, grain number per main spike (GNS) and grain weight per major spike (GWS) on local spring-bread wheat variants of Eritrosperum-35. The weight of 1000 grains (TGW) measured as the mean weight of three sets of 100 grains per line relative to that of the parental type. The strongest genotypes chosen based on their yielding components.

Grain samples were rinsed into sodium dodecyl sulfate (0,1 percent), deionized water and dried to a constant weight of 65 to 70 ° C, then ground with a mixer mill (100 and 200- Gy dosed M5 mutant lines and initial variety cv Eritrosperum-35). The 0,2 g sample was digested using digestive methods with a mixture of acid nitricide (5:1, v / v) (65% HNO3) and hydrogen peroxide (30% H2O2). The following temperatures are used for sample digestion: heating to 70 ° C for 40 min, 45 min for 90 ° C, 3 hours for 130 ° C, 1 hour for 150 ° C, cooling and waiting until a temperature of up to 25 ° C has been reached. Twice-distilled water reduced in the sample to 20 ml. Analytic results for atomic absorption spectroscopy (Analytic Jena, NovAA350, Germany) used for the concentration of iron and zinc. Mineral nutrient ratios tested for approved reference values from 0.3 per cent HNO3 distilled State standardized samples. Three repetitions of extract and analysis carried out.

For PhyC determination used by making some modifications to the protocol (Megazyme, 2016) provided. A 2,0 g grain sample was milled into whole-meal flour and was digested with 10 mL of HCl (0.66 M) inside 15 mL Falcon tubes, placed in a mixer and leave overnight (15 h) at room temperature. The 1 mL of the extract centrifuged at 13,000 r.p.m. for 10 min. The solution in a new tube was neutralized by the addition of 0.3 mL of a 2:1 (NaOH 0.75 M: HCl 0.66 M) mixture. A control blank sample was included with 0.1 mL of HCl 0.66 M. After that, following the enzymatic dephosphorylation reaction to calculate the free and total phosphorus (P) content of the samples. The preparation of the phosphorus calibration curve constructed according to Megazyme protocol. The calculation of P and PhyC and was expressed as g/100g.

The concentration of phosphorus calculated as follows:

$$c = \frac{\text{mean M x 20 x F x } \Delta \text{ A phosphorus [g/100 g]}}{10\,000 \times 1.0 \times v} \quad (1)$$

Where: Mean M = mean value of phosphorus standards [µg/Δ A phosphorus]; 20 = original sample extract volume [mL]; F = dilution factor; ΔA = absorbance change of sample; 10 000 = conversion from µg/g to g/100 g; 1.0 = weight of original sample material [g]; v = sample volume (used in the colorimetric determination step); c = phosphorus [g/100 g] / 0.282

The phytic acid content estimate implies that the volume of phosphorus obtained is solely produced from phytic acid and that this is 28.2 per cent phytic acid.

Results and discussion

Analysis of the mutant wheat productivity

In order to increase the bioavailability of cereals, the reduction of the PA content is necessary to minimize phytic acid prevents the absorption of micronutrients. Reduced PA volume improves the

absorption of Zn and Fe efficiently. By applying Gγ radiation with rays, lpa characteristics of mutants impaired in PA biosynthesis can be applicable strategy for increasing the bioavailability of essential micronutrients such as Fe and Zn. Such mutants could significantly improve human nutrition and develop low-PA crops. Gamma ray mutations has perspective to block the synthesis or accumulation of PA during seed development.

In order to meet the aim of this research work, lines of wheat species of Erythrospermum-35 were mutated with 100 and 200 γ rays, 12 of them taken to illustrate results 105(1), 108(1), 113(5), 118(1), 136(1), 140(2), 144(2), 149(2), 150(7), 152(1), 152(8), 153(4). The results of productivity analysis obtained from 12 mutant lines depicted in Fig.3-8 regarding to their number and weight per main grain spike. In Fig.3 and Fig.4, numbers of lines of spring wheat Erythrospermum-35 of *Triticum aestivum L.* taken order to compare the content with the estimated values. As it can be seen in both figures, mutated lines of wheat in comparison to standard sample numbers, which is 30.33, of grain per spike is higher in whole. Whereas, when comparing two different treated lines of wheat by 100 γ and 200 γ rays, the wheat spikes with higher resolution occurred slightly more, with 43 for 100 γ and 45.63 for 200 γ in average amount. It means lines, which treated with gamma rays, affected wheat grain positively by increasing in quantity.

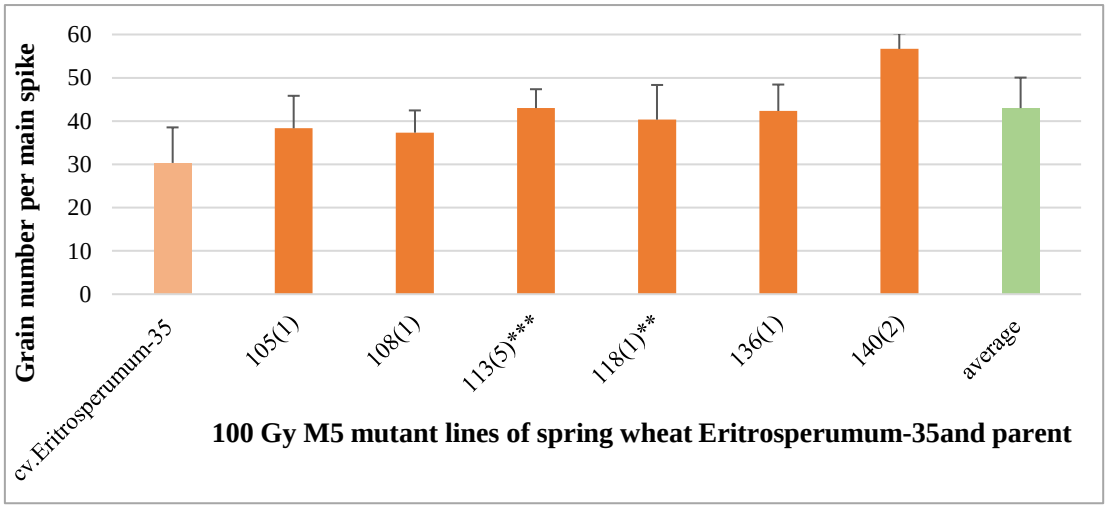

Figure 3. Grain number per main spike in 100 Gy mutant lines of spring wheat Erythrosperumum-35

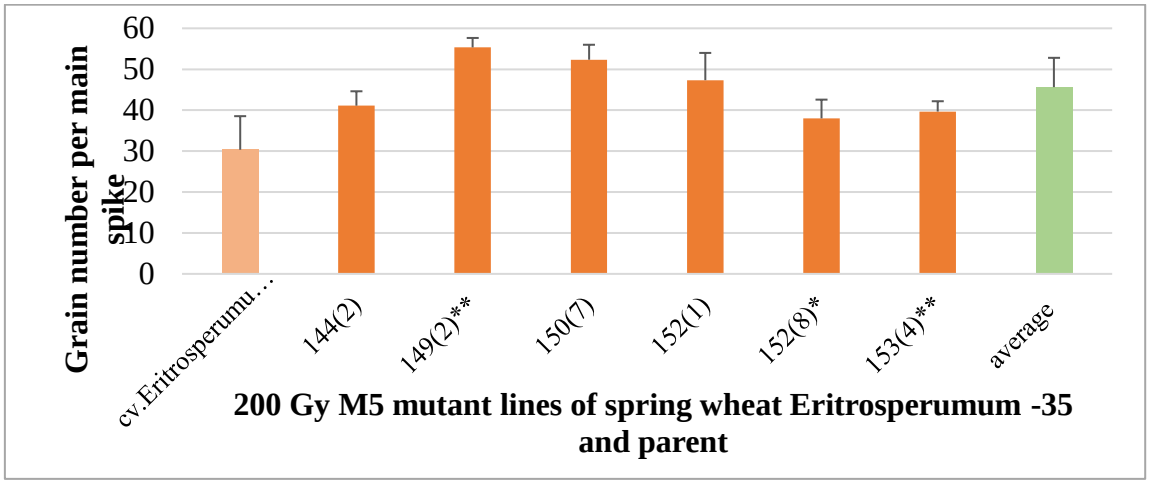

Figure 4. Grain number per main spike in 200 Gy mutant lines of spring wheat Erythrosperumum-35

In this work of mutant lines, observed their grain weight per main spike and grain weight per plant, as well as 1000 grains of each line were measured in grams. In Fig. 5 and Fig.6 grain numbers

were illustrated per main spike shows low contrast with standard weight in g. For 100 γ average was 2.15 g, and in 200 γ average was 2.11 g. It is higher than standard weight, which is 1.97 g. In the 100 Gy dose group high number resulted in 140 (2) mutant line, whereas in 108 (1), 118(1) shown a smaller number of weights per main spike than standard weight. In overall, there noticed slight increase in weight. the second group of mutant wheat lines grain weight with 200 Gy dose responded to be 2.63 g high in 149 (2) lines, and 144 (2),152 (8), 153(4) observed decreased in weight number in comparison to standard weight per main spike. In the first mutant dose, group four lines showed increase, whereas I the second group three lines increased.

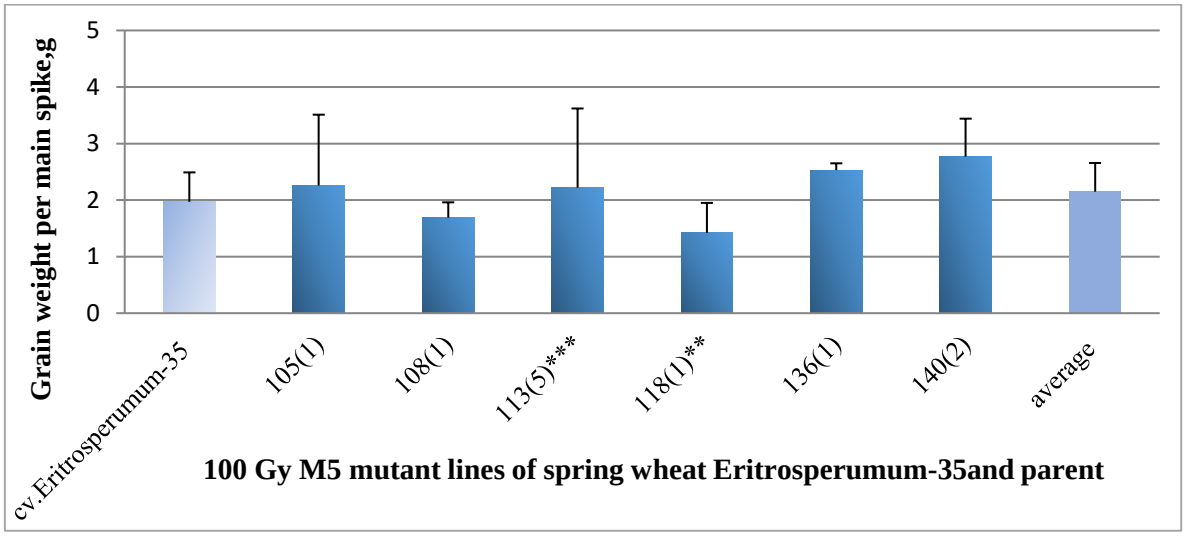

Figure 5. Grain weight per main spike in 100 Gy mutant lines of spring wheat Erythrosperumum-35

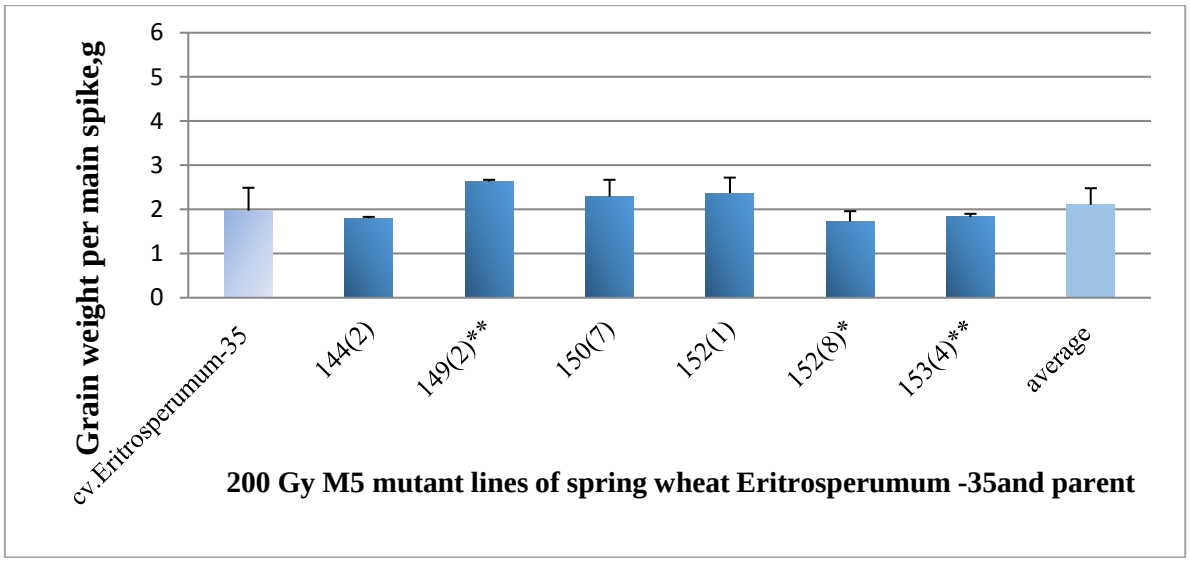

Figure 6. Grain weight per main spike in 200 Gy mutant lines of spring wheat Erythrosperumum-35

Weight of grain, as major contributor to the yield of grain and explicitly links to two significant productivity properties, such as the weight of grain and the grain shape. In figure 7 and 8 the grain weight per plant in lines related to 100 Gy and 200 Gy reported to show distinct changes. In both groups grain weight per plant increased than control sample. In difference of average value to control, 100Gy group differentiated to 1.97 g, and difference in 200Gy lines 1.88 g. In figure 7 highest increase observed in 136 (1) line among others, at least in 105(1). Also, in the 200 Gy graph one high result observed in 149(2) lines, and the low in 144(2) grain weight per plant. The results links to

significant change occurrence in order to enhance productivity parameter of the wheat of the irradiation of ray doses. These results are not similar to grain weight to main spike, however the measurements in 1000-grain weight in two different dose lines coincides.

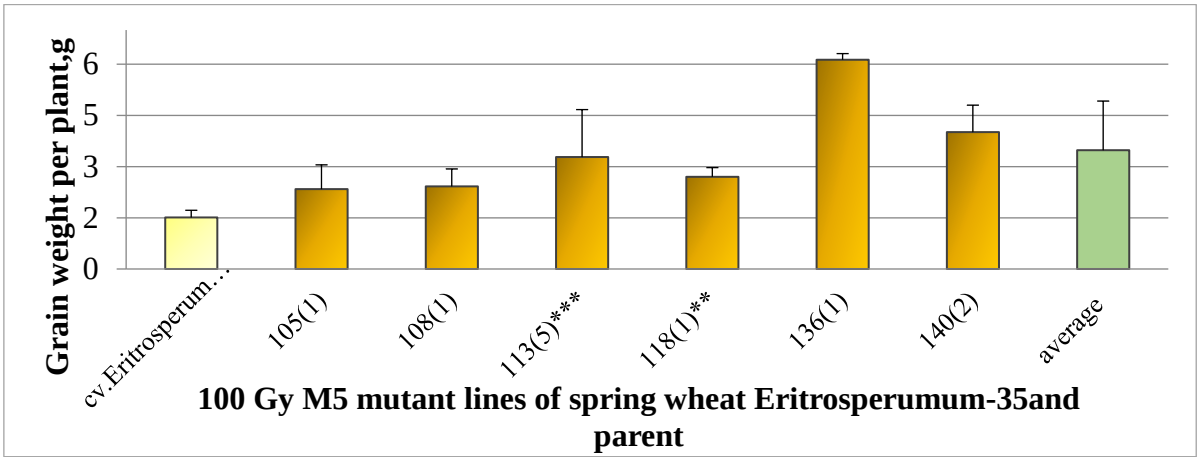

Figure 7. Grain weight per plant in 100 Gy mutant lines of spring wheat Erythrospermum-35

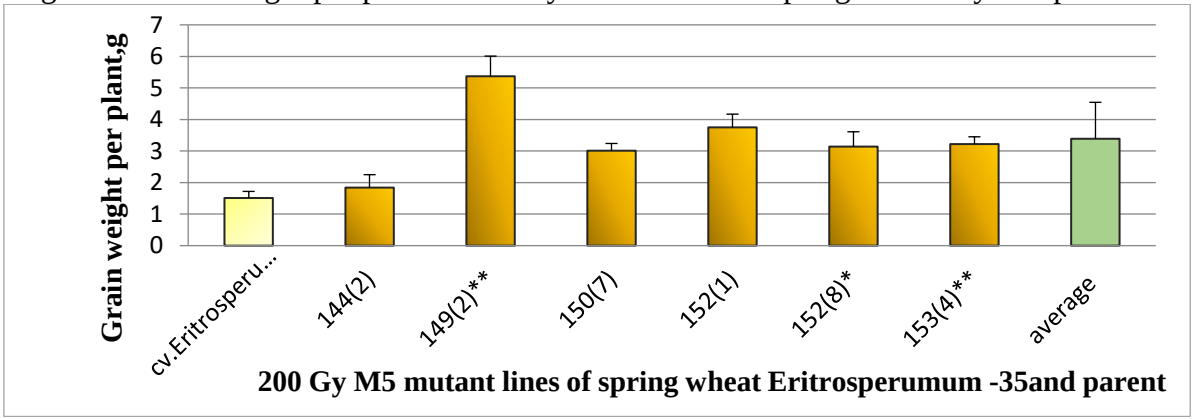

Figure 8. Grain weight per plant in 200 Gy mutant lines of wheat Erythrospermum-35

Figure 9 and 10 represents grain weight of 1000 grains in grams. These numbers reported in graphs below matches with results presented in weight of grain per plant, which shows increase in total in relation the control sample. In both parameters, all lines exhibited rise in weight. The average in 100 Gy reported to be 46.58 and 45.99 in 200 Gy mutants. The high depicts registered in 136(1), 140(2), 149 (2), 150(7). The standard weight of 1000 non-mutant grains is 34.12g, but in 100 γ grains 46.58 g and in 200 γ 45.99 g in average measures. In the 100 γ mutant lines the noticeable are 140(2), which showed the highest, and 118(1) the least measures in 100 γ. In 200γ rays high weight in 149(2) and the less in 144(2).

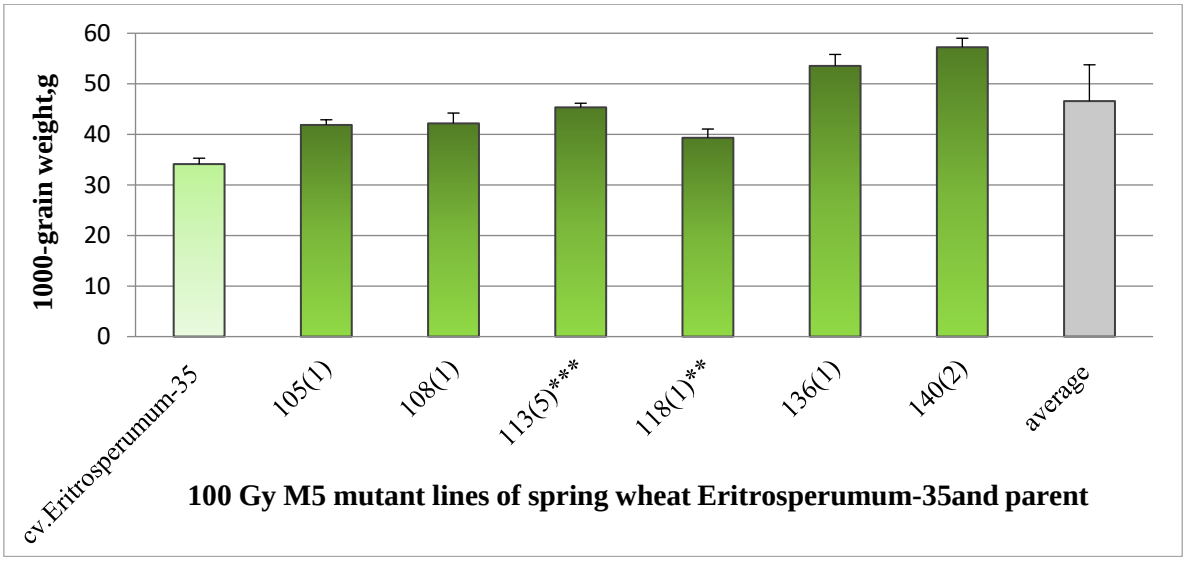

Figure 9. 1000-grain weight of 100 Gy mutant lines of spring wheat Erythrospermum-35

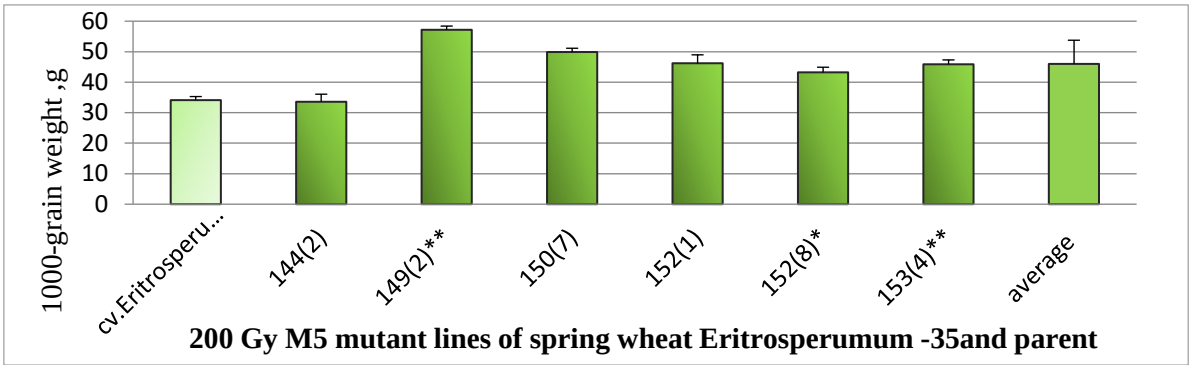

Figure 10. 1000-grain weight, g of 200 Gy mutant lines of spring wheat Erythrospermum-35

Comparison of Fe and Zn measures in mutant lines

The bioavailability of staple food and grain items in the wheat crop of Fe and Zn. Zinc is about 25%, whereas the bioavailability of Fe calculated at 5%. Anti-nutrient incidence in grains such as phytate related to the bioavailability of Fe and Zn. The bioavailability of Fe and Zn in comparing with its overall concentration by traditional breeding by this quantity shown to be much easier genetically.

The role of phytate in plant originated foods recognized as an essential factor in decreasing Zn 2+ absorption. Phytate induces dose-dependent absorption of Zn 2+. Not only the sum of trace elements but also the degree of their bioavailability indicated by increasing breeding or bio-enrichment techniques. These compounds facilitate plant absorption of iron and zinc, and remobilization. Because the occurrence of antinutrients such as phytate in grains correlated with Fe and Zn's bioavailability, the investigation of elements like Zn or Fe needed to calculate by itself, and in relation to phytic acid.

To investigate mineral content in mutant lines related to phytic acid, the Zn and Fe concentrations measured. The concentrations have taken in mg/kg measures, related to absorb gamma rays of 100 and 200. In Fig.11 and Fig.12 iron concentration represented for standard line with 35.36 mg\kg, in comparison to that feature the average in both range of gammas are much higher than in standard with 39.70 mg/kg in 100 γ and 41.15 in 200 γ. However, there some lines with decrease to standard measure in 108 (1), 140 (2), 136 (1), 150 (7). The superior concentration of 100 γ observed in 113(5) mutant lines, and the less in 140 (2). In 200 γ mutant grains several lines showed high iron content, like in 149(2),153(4), but vast decrease in 150 (7) line. Overall, results in 200 γ are greater than in 100γ resolution, as expected.

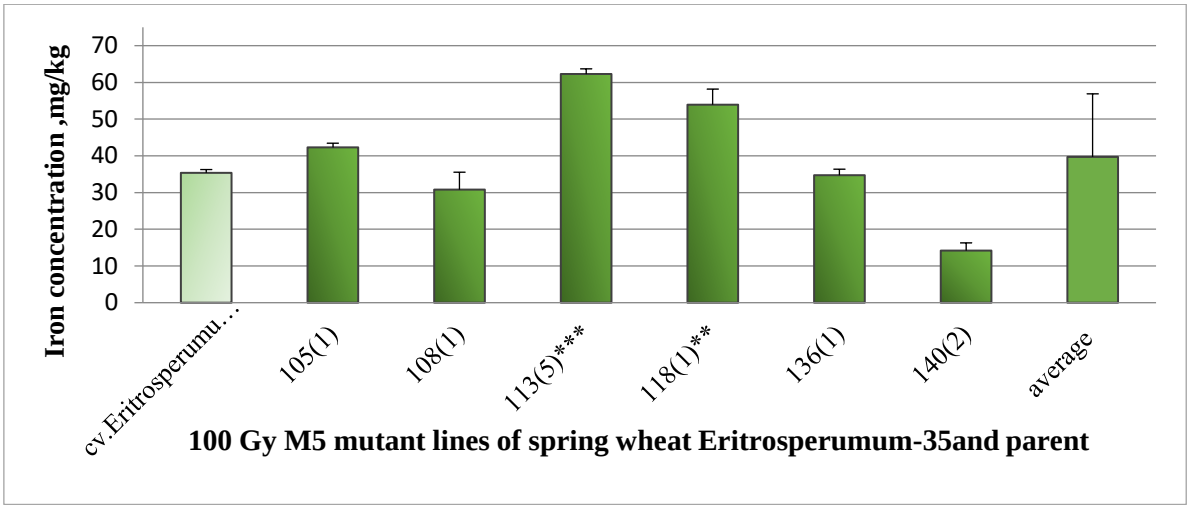

Figure 11. Iron concentration of 100Gy mutant lines of spring wheat Erythrospermum-35

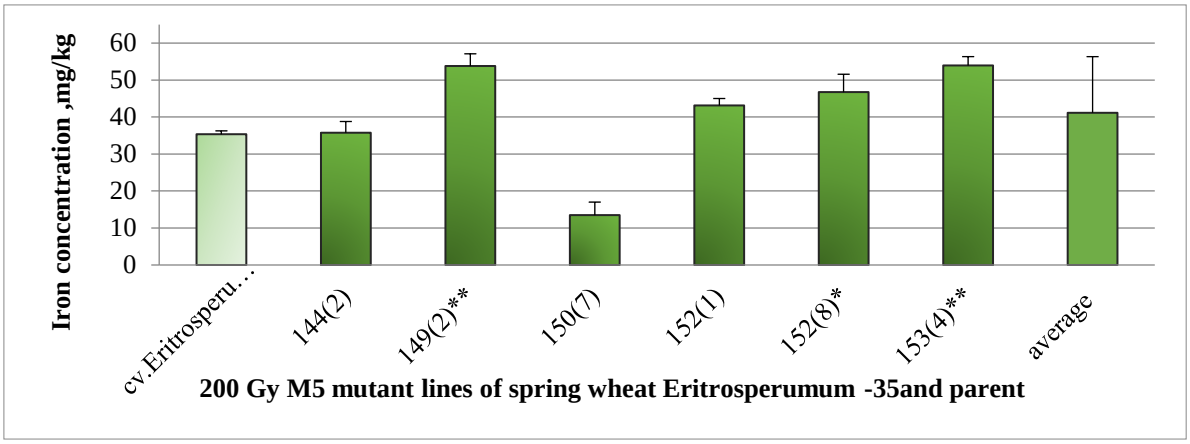

Figure 12. Iron concentration of 200Gy mutant lines of spring wheat Erythrospermum-35

Zinc (Zn) is a vital nutrient to all life forms. Zinc impairment is a global human micronutrient impairment. About 3 billion people in the world affected by micronutrient deficiencies like Zn deficits, particularly in developing countries. A significant reason for a mineral occurrence, especially Zn, human deficiency is the existence of high amounts of phytical acid (PA, myo-inositol hexa phosphate) and fibres, in diets. Around 20.5% of the world's population projected at risk of inadequate food consumption based on national estimates for nutritional supply. As indicator, Zn concentration needed to obtain in wheat grains. In both rays in Fig.13and Fig.14, Zn concentration is high than standard untreated grains, 29.35 mg/kg with no decreasing cases. However, in this case 100γ treatment showed high Zn concentration results of 96.47, 99.30, and 100.35 in 113(5), 118(1), 136 (1) lines respectively.

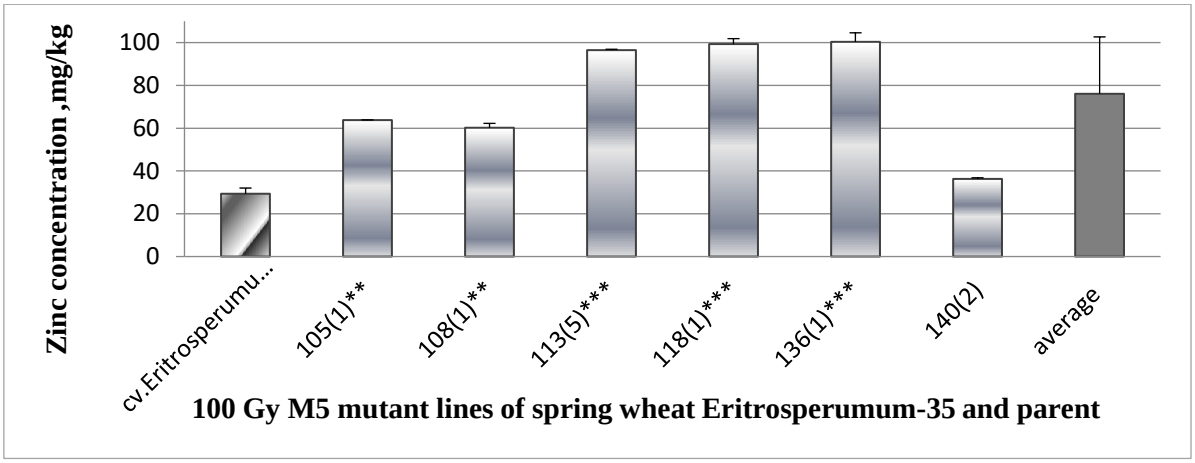

Figure 13. Zinc concentration of 100Gy mutant lines of spring wheat Erythrospermum-35

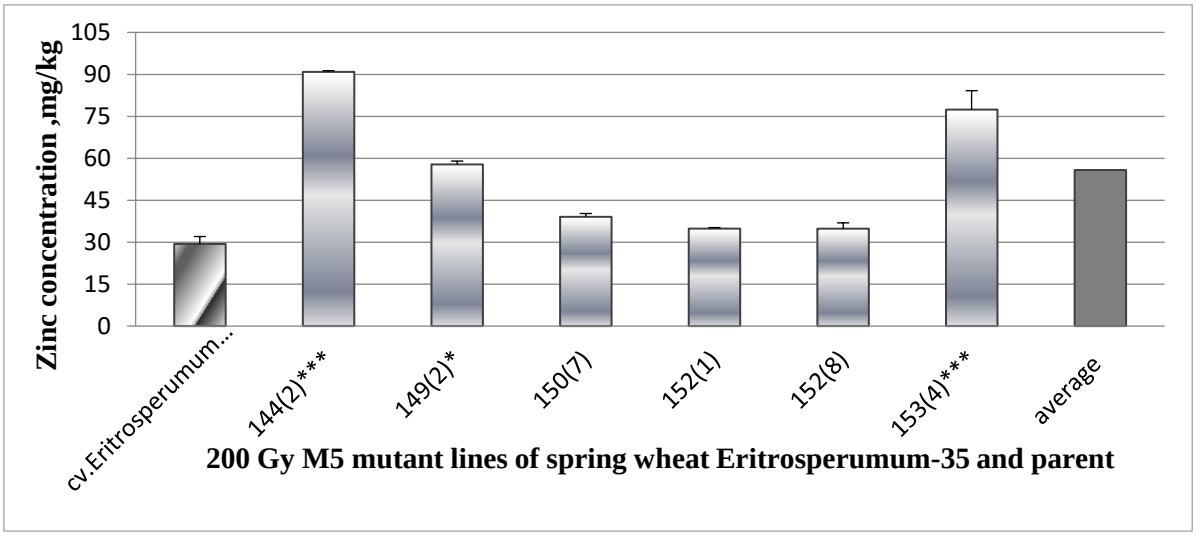

Figure 14. Zinc concentration of 100 Gy mutant lines of spring wheat Erythrospermum-35

Calculations on phytic acid content

Phosphorus (P) processed as PA in cereals, legumes and nuts, one of Zn's key metabolites along with penta phosphorus inositol. Phytic acid is the storage type of P and typically, accounts for 60-80% in wheat, 66-70% in barley, 71-88% in corn 50-70% in soybeans, 27-87% in lentils and 40-95% in chickpeas of total P. In experiments performed by various writers on specific crops, PA content ranged from 0.39-1.35 per cent in wheat, 0.83-2.2 per cent in maize, 0.50-1.89 per cent in triticale, 0.54-1.46 in rye, 0.74-2.10 in beans and 0.28-1.26 in chickpeas. Phytic acid absorbs in cereals, legumes, nuts and oil seeds during production of crops and constitutes 60% to 90% of the overall content of phosphorous.

PA measured by an assay procedure specific for the measurement of phosphorus released as available phosphorus from PA, myo-inositol (phosphate), and monophosphate esters by phytase and alkaline phosphatase using the PA (phytate)/total phosphorus kit from Megazyme (Ireland). Phytic acid level measured by calculating phosphor amount by subtraction phosphor from wheat grains, as represented in the formula below. As it can be seen from Table 2 phytic acid and phosphor measure are presented in g/100g, and their relations directly proportional to each other. In total, mutant lines expresses decreased amount of phosphor and phytic acid, which is effect of mutations in the wheat grain. In comparing with standard number 0.37 and 1.3 g/ 100 g of phosphorous and phytic acid, the average of both gamma groups lowered distinctly. For instance, in 100γ ray sector 108(1), 118(1), 140(2) lines represented low phytic acid synthesis level, in 200γ ray wheat grain 144(2),152(1),

153(4) lines showed lessened output. It described as effect of turning on of lpa mutation features in these lines, and activation low phytic acid genes in these lines.

Table 2 – The phytic acid, g/100g level and phosphorus measurements of mutant lines in relation to control spring wheat of Erythrospermum-35

Compound/ Mutant lines	**Free**	**Total**	**Phosphorus**	**Phytic acid**
	Pi free	Pi total	g\100g	g/100 g
	Sample	Sample	P	PA
ST	0,135	0,461	0,37	1,30
105(1)	0,073	0,364	0,33	1,16
108(1)	0,161	0,343	0,20	0,72
113(5)	0,059	0,428	0,41	1,47
118(1)	0,224	0,396	0,19	0,69
136(1)	0,145	0,406	0,29	1,04
140(2)	0,267	0,422	0,17	0,62
144(2)	0,064	0,271	0,23	0,82
149(2)	0,161	0,438	0,31	1,10
150(7)	0,038	0,347	0,35	1,23
152(1)	0,309	0,421	0,13	0,45
152(8)	0,111	0,500	0,44	1,55
153(4)	0,107	0,284	0,20	0,70

In table 2 concentration of phytic acid is calculated by the free and total phosphorus (P) content of the samples through enzymatic dephosphorylation reaction. In Pi free column in lines 108(1), 118(1), 136 (1), 140(2), 149(2),152(1) showed higher level comparing to standard sample, and less in 105(1),113(50),144(2),150(7), and slight lower in 152(8),153(4) lines. Mutant dosed lines in overall showed decreased phosphorous and phytic acid release in those grains. For example, the less concentration observed in 108(1), 118(1),140(2),144(2), 152(1),153(4), it means 50% of lines shows low P and PA content. In addition, slight low concentration reported in lines 105(1) with 0.33 and 1.16 g\100g, 136(1) with 0.29 and 1.04 g/100g, 150(7) 0.35 and 1.23 g/100g, P and PA level respectively. On the other hand, there observed high concentration in two lines, 113 (5) dosed with 100 Gy and 152(8) dosed with 200Gy. In the 113 (5) line phosphorous level was 0.41, which is 0.04 g/100g higher than standard sample, phytic acid level is 1.47, which is 0.17 g/100g higher. For 152(8)-line, phosphorous level was 0.44, which is 0.07 g/100g higher than standard sample; phytic acid level is 1.55, which is 0.25 g/100g higher.

Phytic acid calculation and effect to nutritional content analysis

PA regarded as a significant mineral absorption inhibiter, generating Fe and Zn complexes in grains, limiting their bioavailability and reducing food nutritional value. During germination seeds, plants mobilize PA phosphorus and PA inositol for development and growth, using specific PA degrading enzyme phytase. In regard to understand the results of the work correlation coefficient of grain components calculated.

The correlation coefficient is a mathematical measure of the correlation of two quantities. In the case when a change in one of the quantities does not lead to a regular change in the other quantity, we can talk about the absence of a correlation between these quantities. Correlation coefficients can be positive and negative. If with an increase in the value of one quantity, a decrease in the values of another quantity occurs, then their correlation coefficient is negative. In the case when an increase in the values of the first object of observation leads to increases in the value of the second object, then we can talk about a positive coefficient. It is an indicator of the relationship between two variables.

The calculations of such two-dimensional criteria for the relationship are based on the formation of pair values that are formed from the considered dependent samples.

Correlation coefficients with values between yield-associated traits (TWG, GNS, GWS and GWP) and micro-elements concentrations, Zn, Fe and phytic acid content in parent (cv. Eritrosperumum-35) and spring wheat M_5 mutant lines calculated by Excel program (Table 3). The Eritrosperumum-35 parent and mutant lines productivity parameters (TWG, GNS, GWS and GWP), as well as, minerals content (Fe, Zn, phytic acid) in grains correlated, and coefficient of correlation showed positive results. In the cv. Eritrosperumum -35 M5 lines TGW significantly correlated with GNS. In the observing dosed mutant lines yield traits of 100 Gy showed significant correlation between GNS and GWS, also GNS to GWP. It shows yield increase in those dosed lines (Table 3). The correlation coefficient between minerals Zn and Fe in mg/kg in these lines reported significant level, which shows that by the decrease of phytic acid level enhancement of minerals occurred. In 200 Gy dosed mutant lines, GNS and GWS number showed high significance, and correlation of minerals slight significance. In both 100Gy and 200 gamma-dosed group of lines, phytic acid not reported correlation significance. It concludes that low phytic acid release in mutant grains, which leaded to significance in grain yield and mineral content.

Table 3 – Correlation coefficients with values between yield-associated traits (TWG, GNS, GWS and GWP) and micro-elements concentrations, Zn, Fe and phytic acid content in parent (cv. Eritrosperumum-35) and spring wheat M_5 mutant lines

	GWS, g	**GWP, g**	**TGW, g**	**GPC, %**	**Fe, mg/kg**	**Zn, mg/kg**	**Phytic acid**
cv .Eritrosperumum-35							
GNS	0.00	0.11	0.11*	0.06	0.00	0.01	0.09
GWS, g		0.03	0.02	0.01	0.00	0.00	0.02
GWP, g			0.17*	0.01	0.00	0.01	0.01
TGW, g				0.01	0.03	0.07	0.03
Fe, mg/kg						0.00	0.23
Zn,mg/k							0.07
100 Gy M_5 mutant lines							
GNS	0.32**	0.17**	0.05	0.09	0.00	0.00	0.09
GWS, g		0.09	0.00	0.04	0.00	0.02	0.01
GWP, g			0.03	0.07	0.06	0.00	0.01
TGW, g				0.05	0.03	0.04	0.17
Fe,mg/kg						0.35***	0.14
Zn, mg/kg							0.01
200 GyM_5 mutant lines							
GNS	0.52***	0.06	0.02	0.05	0.01	0.04	0.01
GWS, g		0.05	0.06	0.01	0.01	0.05	0.01
GWP, g			0.00	0.04	0.07	0.09	0.01
TGW, g				0.06	0.03	0.00	0.02
Fe,mg/k						0.24*	0.03
Zn, mg/kg							0.01
*, ** and ***denote significance at <0.05, <0.01, and <0.001 probability levels							

CONCLUSION

Lack of micronutrients is one of the most common and widespread nutritional problems worldwide. Phytic acid plays a key role among the factors that mitigate the bioavailability of Zn and Fe; therefore, to scrutinize genetic alterations in micronutrient and phytate content, it needed to examine zinc, iron, phytic acid concentrations, and relations to each other. There are two key approaches to

increase the bioavailability of minerals: by growing the amount of phytate in foods or by incorporating extra minerals in the fortification procedure. Bio fortification of crops are among the most effective approaches to address the issue of nutrient malnutrition in the world. The recognizable benefits vary from economically effective, easiness in use to nutrient quality enhancement, absence of harmful effect to crop, which leads to be perspective method to overcome dietary health problems. In this work, mutant lines tested for occurrence of lowering phytic acid concentration, which inhibits minerals, and enhancing minerals to release (Zn, Fe). By treating with gamma ray doses, wheat grains can generate lpa mutant characteristics.

In overall, research work investigations facilitate to wheat crop quality growth and higher yielding for wheat, as one of wildly used crop in the world. Furthermore, it proves to be convenient method of solution for mineral deficiency, and bioavailability.

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Chemical sciences

ANALYSIS OF METHODS FOR UTILIZATION OIL SLUDGE FROM THE ABSHERON PENINSULA

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АНАЛИЗ МЕТОДОВ УТИЛИЗАЦИИ НЕФТЯНЫХ ШЛАМОВ АБШЕРОНСКОГО ПОЛУОСТРОВА

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Abstract

The article is devoted to the analysis of methods for utilization and processing of oil sludge from the Absheron Peninsula. Sludge samples were taken from 4 contaminated sites near oil fields. Physicochemical analyzes were carried out on devices Agilent Technologies GC7820A (gas chromatograph), Agilent Technologies ICP-MS7500 (Inductively coupled plasma), RetortOil and WaterKit RROW-50 (Vacuum distiller). Depending on the characteristics of the sludge, methods for its disposal and processing are proposed.

Аннотация

Статья посвящена анализу методов утилизации и переработки нефтяных шламов Апшеронского полуострова. Пробы шламов изъяты их 4-х загрязненных участков вблизи нефтяных месторождений. Проведены физико-химические анализы на приборах Agilent Technologies GC7820A (газовый хроматограф), Agilent Technologies ICP-MS7500 (Индуктивно-связанная плазма), RetortOil and WaterKit RROW-50 (Вакуумный дистиллятор). В зависимости от характеристик шламов предложены методы для их утилизации и переработки.

Keywords: oil sludge, physical and chemical analyses, thermal methods, chemical methods, biological method.

Ключевые слова: нефтяные шламы, физико-химические анализы, термические методы, химические методы, биологический метод.

Введение

Нефть и нефтепродукты являются неотъемлемой частью химической технологии, пищевой промышленности, растворителей, ядов, бытовой химии. Без этого невозможно представить жизнь современного человека. Однако именно деятельность предприятий нефтегазовой отрасли

наносит огромный ущерб окружающей среде, в том числе за счет образования отходов производства – нефтешламов.

Нефтешламы представляют собой сложную смесь, компонентами которой являются нефтепродукты, а также механические примеси: глины, ил, минералы, продукты коррозии резервуаров, песок, вода. Состав и пропорции компонентов в эмульсии нефтешлама могут варьироваться в зависимости от источника. В основном нефтешламы представляют собой тяжелые нефтяные остатки: твердые примеси 12 – 45%, нефтепродукты 10 – 55% от массы, вода – 30-80% от массы; органическая часть – неокисленные углеводы: алкилбензолы, нафталины, парафины, нафтены и гетероциклические соединения.

Вопросу изучения методов утилизации и переработки нефтешламов посвящено немало научных работ, в которых авторы высказывают свое мнение о возможности работы с отходами нефтедобывающего производства.

Рассмотренные исследования в области обращения с нефтесодержащими отходами выявляют необходимость создания единой системы очистки, утилизации и переработки нефтешламов, а значит, существует необходимость анализа преимуществ и недостатков предлагаемых методов.

Методы и методики исследований

В настоящее время существует пять наиболее эффективных способов утилизации нефтешламов: термический метод , химический метод ,биологический метод ,физический метод , физико-химический метод.

Термические методы:

Термические методы основаны на процессах термического разложения нефтепродуктов. Существует несколько основных подходов: термическое разложение в бескислородной среде, сжигание нефтешламов в печах в псевдоожиженном слое, пиролиз.

Термические методы имеют следующие преимущества: высокоэффективный метод нейтрализации, объем отходов сокращается в 10 раз, возможность рекуперации тепла, возможность получения пористого гранулированного строительного материала, вместо золы - керамзита, который используется в качестве наполнителя;

недостатки: высокие энергозатраты на дополнительное топливо (газ, масло) и оборудование для очистки и нейтрализации дымовых газов, громоздкое оборудование

Эти методы не используются, если в отходах есть такие вещества, как сера, галогены или фосфор, т.к. в результате могут образовываться продукты реакции (диоксины, фураны и др.), токсичность которых во много раз превышает нормативы.

Для сжигания нефтешламов широко применяют печи различных типов и конструкций: камерные, многоступенчатые, вращающиеся печи и печи с кипящим слоем. Термический метод позволяет сжигать загрязненные фильтры, промасленную ветошь и твердые бытовые отходы вместе с нефтешламами [1-4].

Химические методы:

Химические методы основаны на использовании растворителей, к которым могут относиться газовый конденсат, парафины с определенными свойствами и легкие углеводороды. Сначала нефтяные отходы растворяют в специальных веществах, после чего их отделяют от различных твердых и жидких примесей.

Существуют следующие способы использования этой технологии: на специализированном объекте (большие объемы нефтесодержащих отходов рекомендуется размещать на объектах нефтедобычи с системами подачи); в смесительных установках (актуально для небольших объемов нефтесодержащих отходов, размещение которых экономически целесообразно в месте образования); в глиняных карьерах (пастообразные продукты коксования «старых» порывов промысловых нефтепроводов) [5-9].

Преимущество химического метода переработки нефтешламов заключается в получении продукта, который можно использовать повторно (в строительстве, прокладке дорог, засыпке земляных насыпей). С экономической точки зрения считается, что химический метод экономически более эффективен по сравнению с термическим.

Биологический метод:

Биологический метод осуществляется с использованием бактериальных штаммов и биогенных добавок. Преимущества данного метода самый экологически чистый метод, преобразует нефть в простые соединения, при этом полностью сохраняя структуру почвы без дополнительного загрязнения окружающей среды; недостатки: низкая производительность, высокая стоимость, невозможность использования при низких температурах.

Использование биотехнологии перспективно для нейтрализации нефтешламов, образующихся при очистке водоемов, нефтезагрязненных почв и водоемов. В последние годы за рубежом и в Азербайджане разрабатывается ряд биопрепаратов для нейтрализации нефтяных загрязнителей различного состава [10-15].

Физические методы:

Физический метод утилизации отличается низкой эффективностью и образованием непригодных для использования остатков. Этот метод можно разделить на следующие виды: гравитационное осаждение, разделение в центробежном поле, разделение фильтрованием, добыча.

Гравитационного осаждения: Преимущества: не требует больших капитальных и эксплуатационных затрат; может быть частью комбинированного метода. Недостатки: низкая эффективность разделения и длительность процесса; образуется большое количество осадка.

Разделение в центробежном поле: Преимущества: возможность снижения количества отходов и повторного использования части отделенной воды, нефти (нефтепродуктов); возможность интенсификации процесса; Недостатки: требуется специальное оборудование (гидроциклоны, сепараторы, центрифуги); проблема не решена полностью из-за неполного разделения нефтепродуктов одинаковой плотности.

Разделение фильтрованием: Преимущества: относительно невысокая стоимость; высокая степень надежности метода; могут быть составной частью комбинированного физико-химического метода; более высокое качество целевого продукта; менее требовательны к качеству сырья. Недостатки: необходимость замены и регенерации фильтрующих материалов; введение специальных структурирующих наполнителей; проблема экологичности до конца не решена из-за большого количества отходов.

Экстракции. Преимущество: относительно невысокая стоимость; Недостатки: требует специального оборудования, растворителей; необходимость регенерации экстрагента; неполное извлечение нефтепродуктов из отходов.

Широкое распространение получили комбинированные методы, поскольку они позволяют перерабатывать нефтяные отходы с самыми разнообразными физико-химическими характеристиками.

Наиболее часто используемым сочетанием механических и физико-химических методов является использование поверхностно-активных веществ, изменяющих размер и структуру нефтешлама. Достоинства методов: возможность интенсификации процесса, хорошо сочетается с физическими и биологическими методами. Недостатки: требует применения специального дозирующего оборудования, высокие затраты на реагенты, данный метод можно использовать только в составе другого метода.

На основе анализа становится ясно, что для наиболее эффективной утилизации нефтепродуктов необходима универсальная, комплексная технология переработки, заключающаяся в разделении отходов на слои и работе с каждым из них в отдельности. Такие методы должны включать в себя три компонента: обработка слоя масляной эмульсии; обработка водоэмульсионного слоя; нейтрализация осадочного слоя.

Одним из перспективных направлений является вовлечение нефтесодержащих отходов нефтяных и газовых месторождений во вторичную переработку с целью минимизации техногенного воздействия на окружающую среду.

Переработка и утилизация нефтешламов должны быть направлены на применение экономичных и экологически чистых технологий, использование стандартного оборудования и безотходной технологии очистки и утилизации.

Наиболее перспективными технологиями переработки нефтешламов на крупных месторождениях, планируемых к продаже, является использование нефтешламов при производстве топливных брикетов для использования в котельных. Сравнительный анализ состава нефтяного шлама, используемого в настоящее время в промышленности, и асфальто-смоло-парафиновых отложений показал сходство их параметров, что позволяет предположить, что асфальто-смоло-парафиновые отложения обладают коллоидно-химическими свойствами (адгезионными и когезионными свойствами), характерными для нефтешлама. Высокое содержание нефтепродуктов в асфальто-смоло-парафиновых отложениях, низкое содержание воды и механических примесей, наличие адгезионных свойств позволяет предвидеть возможность использования асфальто-смоло-парафиновых отложений в качестве вяжущего для производство шламовых топливных брикетов (евродрова).

Технология получения топливных брикетов из нефтешламов в соответствии с установленными техническими и экологическими критериями состоит из нескольких этапов: подготовка опилок (отсев крупных частиц, сушка); подогрев асфальто-смоло-парафиновых отложений до заданной температуры; дозировка компонентов брикетной шихты; смешивание компонентов шихты и охлаждение до температуры прессования; брикетирование топливно-содержащей шихты при заданном давлении прессования; охлаждение готовых брикетов с целью их максимально быстрого затвердевания; хранение и загрузка готовых брикетов [16-20].

Для реализации предлагаемой технологии соотношение нефтешламов и опилок должно составлять 40% и 60% соответственно. Именно такое сочетание позволяет использовать максимальное количество нефтешламов без ущерба для качества продукта. В результате используется менее половины отходов, что позволяет сделать вывод о низкой технической оценке данного метода, отрицательным мы также считаем использование опилок, производство которых не предусмотрено на местах.

Если содержание в водном растворе более 30% экстракта, растворы оказывают токсическое действие на дафний. Дафнии применяются для выявления токсичности водных растворов, которые используются в исследованиях загрязнений водной среды, поскольку они чувствительны даже к небольшим изменениям структуры воды (например, концентрации солей).

Если содержание в водном растворе более 30% экстракта, растворы оказывают токсическое действие на дафний.

При оценке токсичности растворов, содержащих экстракт из топливных брикетов, установлено, что с увеличением массовой доли экстракта в питательном растворе длина разросшихся корней растения лука уменьшается. Так, в 10% растворе длина корневой системы на 40% меньше по сравнению с контролем, в 50% растворе различия в длине корней составляют 65%, а в 100% экстракте корни вообще не растут в течение всего периода наблюдения.

Обсуждения и анализ результатов

В качестве примеров нефтяных шламов, отобрали проб загрязненных участков Апшеронского полуострова – Balakhani, Ramana, Surakhani, Bibiheybet. Провели физико-химический анализ на приборах Agilent Technologies GC 7820A (газовый хроматограф), Agilent Technologies ICP-MS 7500 (Индуктивно-связанная плазма), Retort Oil and Water Kit RROW-50 (Вакуумный дистиллятор).

Управление и очистка отходов бурения, нефтешламов и сточных вод включают сложные технологии, разработанные для смягчения воздействия на окружающую среду и соблюдения нормативных стандартов. В случае буровых отходов используются такие технологии, как системы контроля твердых частиц и декантерные центрифуги для отделения бурового шлама и облегчения переработки буровых растворов. Повторное закачивание шлама (CRI) также используется после соответствующей обработки в соответствии с правилами утилизации.

Передовые технологии включают электрокоагуляцию, использующую электрокоагуляцию для удаления загрязнений, и озонирование, расщепляющее органические и неорганические загрязнители с помощью озона. Адсорбция активированным углем используется для удаления органических соединений, а мембранные биореакторы (MBR) сочетают биологическую очистку с мембранной фильтрацией для повышения эффективности.

Эти технологии не являются взаимоисключающими, и комплексный подход часто сочетает в себе несколько методов для достижения комплексного и эффективного управления отходами. Непрерывные исследования и разработки способствуют развитию технологий, делая практику нефтегазовой отрасли более устойчивой и эффективной.

Полученные результаты приведены в таблице 1.

Таблица 1.

Parameter	Balakhani	Ramana	Surakhani	Bibiheybet
Composition				
	Oil (20%), water (70%), solids (10%)	Rock cuttings (60%), drilling mud (30%), other materials (10%)	Chemicals (40%), heavy metals (30%), pollutants (30%)	Organic matter (50%), minerals (30%), sediments (20%)
Viscosity	25 cSt (High)	15 cSt (Medium)	20 cSt (Medium)	Low (5 cSt)
Density	900 kg/m³	2.2 g/cm³	1.005 g/cm³	1.1 g/cm³
Water Content	30%	15%	5%	60%
Chemical Composition	Benzene (0.1%), heavy metals (0.05%)	Barite (20%), bentonite (10%), chemicals (5%)	Chlorine (0.2%), arsenic (0.1%), organic pollutants (0.3%)	Nitrogen compounds (25%), phosphorus compounds (15%), dissolved ions (10%)
Temperature	40°C	25°C	30°C	15°C
Cuttings Size	0.1 mm	3 mm	0.5 mm	0.2 mm
Toxicity	Moderate	High	Moderate	Low
Volume	200 cubic meters	5 tons per well	100,000 liters	500,000 cubic meters
Treatment Requirements				
	Centrifugation (80%), chemical treatment (20%)	Screening (50%), sedimentation (30%), Filtration (20%)	Biological treatment (40%), chemical treatment (30%), Filtration (30%)	Settling (70%), natural attenuation (30%)
pH Level	7.2	8.0	6.5	7.8
Turbidity	5 NTU	10 NTU	15 NTU	3 NTU
BOD (Biological Oxygen Demand)	20 mg/L	5 mg/L	30 mg/L	15 mg/L
TDS (Total Dissolved Solids)	300 mg/L	500 mg/L	800 mg/L	150 mg/L

Таблица 1 предлагает теоретическое сравнение четырех различных источников: Балаханы, Рамана, Сураханы и Бибихейбет. Эти источники имеют различный состав и характеристики, связанные с нефтешламами, отходами бурения, сточными водами и земными источниками. Например, Балаханы характеризуются составом, состоящим из 20% нефти, 70% воды и 10% твердых веществ, что свидетельствует о значительном присутствии нефти.

Напротив, Рамана преимущественно состоит из шлама (60%) и бурового раствора (30%), что подчеркивает его связь с буровыми работами.

В разных источниках очевидны различия в вязкости: Балахани демонстрирует высокую вязкость 200 cSt, что предполагает густую консистенцию, а Рамана демонстрирует среднюю вязкость 15 cSt. Различия в плотности также очевидны: плотность Балахани составляет 900 кг/м³, что подчеркивает его относительно меньшую массу на единицу объема по сравнению с 2,2 г/см³ у Раманы.

Разница температур играет свою роль, как видно из более высокой температуры в Балахани (40°C) по сравнению с 25°C в Рамане, что потенциально влияет на свойства флюидов этих источников. Уровни токсичности различаются: Рамана демонстрирует более высокую токсичность по сравнению с Балахани, что указывает на различное воздействие на окружающую среду.

Объемы образующихся отходов отражают существенные различия, как видно из 200 кубических метров скважины Балаханы по сравнению с 5 тоннами скважины Раманы. Требования к лечению подчеркивают различные подходы, необходимые для каждого источника; Балахани требует центрифугирования и химической обработки, тогда как Рамана полагается на просеивание, осаждение и фильтрацию.

Уровни pH в разных источниках указывают на различия в кислотности: в Балахани – 7,2, а Раманы – 8,0. Измерения мутности показывают различия в прозрачности воды, например, в Рамане мутность составляет 10 NTU по сравнению с 5 NTU в Балахани. Значения BOD (биологическая потребность в кислороде) и TDS (общее количество растворенных твердых веществ) дают представление об органическом и неорганическом содержании источников соответственно.

Заключение

Изучив опыт применения методов утилизации и переработки нефтешламов, становится очевидным, что ни один из отдельных методов не способен решить данную задачу самостоятельно.

На основе анализа становится ясно, что для наиболее эффективной утилизации нефтепродуктов необходима универсальная, комплексная технология переработки, заключающаяся в разделении отходов на слои и работе с каждым из них в отдельности. Такие методы должны включать в себя три компонента: обработка слоя масляной эмульсии; обработка водоэмульсионного слоя; нейтрализация осадочного слоя.

Способ производства топливных брикетов для использования в котельных, работающих в полевых условиях, с точки зрения технических и экологических показателей не решает полностью проблему образования нефтесодержащих отходов.

Перспективным направлением в этой области является предложение и реализация схем, предусматривающих снижение объёмов нефтешламов и предотвращение их образования в целом, использование эффективных методов переработки и утилизации. Комплексный подход к этой проблеме позволит минимизировать негативное воздействие на окружающую среду.

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SYNTHESIS AND INVESTIGATION OF (E)-2-AMINO-N'-((2-METHYLNAPHTHALEN-1-YL) METHYLENE) ACETOHYDRAZIDE AND ITS METAL COMPLEXES WITH SM AND PR

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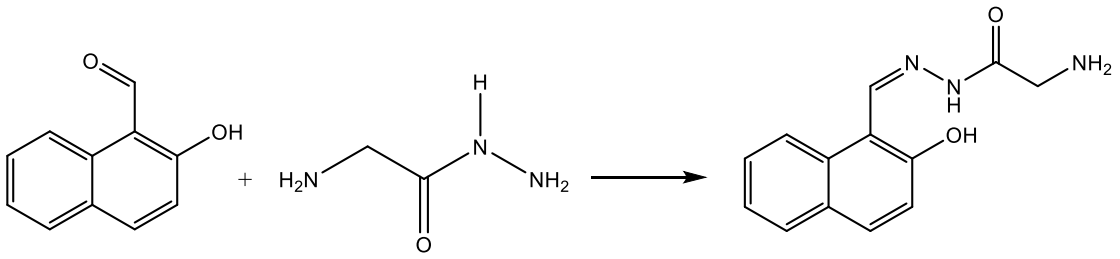
2-hydroxy-1-naphthaldehyde is widely used in the synthesis of chelating ligands containing O, N donor atoms [1, 2]. Due to the donor atoms in this type of ligands, there is the ability to form coordination compounds with metals that have different properties. Also, since it contains azomethine group, these substances are widely used in medicine due to the biological and pharmacological properties of Schiff bases [3, 4]. The review of literature materials of recent years shows that the field of application of azomethine compounds is not limited to their application in medicine and varies in a broad range. Thus, Schiff bases and their complex compounds with metals are widely used in numerous fields of industry, supramolecular chemistry, such as corrosion inhibitors, catalysts, electroluminescent materials and dyes [5].

Although the history of the study of Schiff bases is very old, there is still a great interest in the development of new methods of their synthesis due to the fact that the field of application is multidirectional.

For this purpose, a new hydrazide-type Schiff base based on 2-hydroxy-1-naphthaldehyde and glycine hydrazide - (E)-2-amino-N'-((2-methylnaphthalen-1-yl)methylene)acetohydrazide and its lanthanides complexes were synthesized and identified. The synthesis reaction was carried out according to the following scheme:



a) 2-hydroxy-1-naphthaldehyde; b) glycine hydrazide; c) (E)-2-amino-N'-((2-methylnaphthalen-1-yl)methylene)acetohydrazide

The synthesized ligand was identified by various physico-chemical methods - NMR, IR-, UV-spectroscopic methods. The NMR and IR spectra of the ligand confirm that the keto-tautomeric form of the ligand is involved in complexation with metals. Complexes of the synthesized ligand with Sm, Pr from rare earth elements were obtained, and their structure and properties were studied by elemental analysis, EPR, IR- and UV-spectroscopic methods. It was determined that the metal:ligand ratio in the composition of the complexes is 1:3. The composition of the synthesized ligand was studied by various physicochemical methods. 1H and 13C NMR spectra were recorded on a Bruker (300 MHz) spectrometer in CD4O. M.p.: 195±3°C. Yield was 83%. Anal. Calcd for $C_{13}H_{13}N_3O_2$: C-64.20; H-5.36; N-17.28%. Found: C-63.98, H. 5.54, N. 17.01%. 1H NMR (300 MHz, CD4O): δ 3.32 (2H; CH_2), 6.91-7.99 (6H; naphthoic ring), 8.24 (s, 1H; CH=N), 10.52(s, 1H; OH

Conclusion

A new hydrazone-hydrazide type ligand, based on glycine hydrazide and 2-hydroxy-1-naphthoic aldehyde, was synthesized; its composition and structure were identified using various chemical, physico-chemical methods. Complex compounds of the synthesized ligand with samarium and praseodium were obtained. Structure of complexes was confirmed by elemental analysis, IR- and UV- spectroscopic methods and thermogravimetric analysis.

Keywords: Hydrazides, 2-hydroxy-1-naphthoic aldehyde, glycine hydrazide, Schiff base, NMR.

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Economic sciences

INNOVATIVE DIVERSIFICATION: LEVERAGING TECHNOLOGY FOR ENTERPRISE EXPANSION

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Abstract

"Innovative Diversification: Using Technology to Expand Enterprises" explores the evolving landscape of enterprise diversification in the digital age. As businesses strive for growth and resilience, the integration of technology has emerged as a pivotal enabler of diversification strategies. This article delves into the intersection of technology and enterprise expansion, examining how advancements in artificial intelligence, data analytics, blockchain, and other emerging technologies are reshaping traditional business models.

Drawing on case studies and industry insights, the article showcases how forward-thinking enterprises are harnessing technology to identify new market opportunities, optimize operations, and enhance customer experiences. From leveraging big data analytics to personalize product offerings to utilizing blockchain for supply chain transparency, innovative diversification strategies are driving competitive advantage and fostering sustainable growth.

Moreover, the article explores the challenges and considerations inherent in adopting technology-driven diversification initiatives, including cybersecurity risks, talent acquisition, and organizational adaptability. Through a comprehensive analysis of successful implementations and potential pitfalls, this article provides actionable insights for business leaders navigating the complex landscape of technological diversification.

Ultimately, "Innovative Diversification: Using Technology to Expand Enterprises" underscores the transformative power of technology in shaping the future of enterprise expansion. By embracing innovative approaches and leveraging the latest technological advancements, businesses can effectively diversify their portfolios, capitalize on new opportunities, and thrive in an ever-evolving global marketplace.

Keywords: Diversification, technology, innovation, enterprise expansion, digital transformation, emerging technologies

İntroduction

In today's dynamic business environment, the pursuit of growth and resilience is paramount for enterprises seeking to thrive amidst rapid technological advancements and evolving market landscapes. Traditional approaches to expansion and diversification are being redefined as businesses increasingly turn to innovative strategies fueled by cutting-edge technologies. This paradigm shift underscores the emergence of a new era in enterprise development-one characterized by the strategic integration of technology to drive diversification and expansion initiatives. "Innovative Diversification: Using Technology to Expand Enterprises" explores this transformative trend, shedding light on how businesses are leveraging technology as a catalyst for growth and diversification. From artificial intelligence and data analytics to blockchain and the Internet of Things, advancements in technology offer unprecedented opportunities for enterprises to explore new markets, optimize operations, and enhance customer experiences. In this article, we delve into the multifaceted intersection of technology and enterprise expansion, examining the innovative approaches and best practices employed by forward-thinking organizations. Through a series of case

studies, industry insights, and expert analyses, we uncover the strategic imperatives driving technological diversification initiatives and the tangible benefits they yield. Furthermore, we explore the challenges and considerations inherent in adopting technology-driven diversification strategies, from cybersecurity risks and talent acquisition to organizational adaptability. By addressing these complexities head-on, businesses can effectively navigate the path toward sustainable growth and competitive differentiation in an increasingly digital landscape. As we embark on this exploration of "Innovative Diversification," it becomes evident that technology is not merely a tool for enterprises—it is a fundamental driver of transformation, enabling businesses to expand their horizons, capitalize on emerging opportunities, and chart a course toward long-term success in the 21st century marketplace.

In today's rapidly evolving business landscape, enterprises face the dual challenge of maintaining competitiveness in existing markets while exploring avenues for growth and expansion. Traditional strategies for diversification often relied on geographic expansion, product line extensions, or mergers and acquisitions. However, in the digital era, a new paradigm has emerged—one where technology serves as a powerful enabler of diversification efforts. From artificial intelligence (AI) and big data analytics to blockchain and the Internet of Things (IoT), innovative technologies are transforming how businesses identify opportunities, optimize operations, and deliver value to customers [1].

Unlocking New Opportunities:

Innovative diversification involves leveraging technology to identify and capitalize on new opportunities beyond a company's core business. For example, AI-powered data analytics can reveal hidden patterns and insights in customer behavior, enabling businesses to develop personalized products and services tailored to individual preferences. Similarly, blockchain technology offers opportunities for supply chain transparency and efficiency, allowing enterprises to differentiate themselves through sustainable and ethical practices. Innovative diversification refers to the strategic expansion of a company's portfolio or offerings through the adoption of innovative technologies, approaches, or business models. Unlike traditional diversification strategies, which may involve entering new markets or industries tangentially related to a company's core business, innovative diversification leverages cutting-edge technologies to explore entirely new opportunities or disrupt existing markets. Innovative diversification involves using technology as a catalyst for growth and expansion, often by identifying novel ways to leverage data, automation, artificial intelligence, or other emerging technologies. This approach allows companies to differentiate themselves from competitors, capitalize on emerging trends, and create new revenue streams [2].

Optimizing Operations: Technology also plays a crucial role in optimizing internal operations, driving efficiency and cost savings across the enterprise. Cloud computing, for instance, enables scalable infrastructure and facilitates remote collaboration, empowering businesses to adapt to changing market conditions and customer demands more effectively. Moreover, automation technologies such as robotic process automation (RPA) streamline repetitive tasks, freeing up human resources to focus on higher-value activities and innovation.

Enhancing Customer Experiences: Innovative diversification extends beyond operational improvements to encompass the customer experience. Mobile apps, social media platforms, and augmented reality (AR) applications offer new channels for engaging with customers and delivering personalized experiences. By harnessing the power of technology, enterprises can build deeper relationships with their customers, fostering loyalty and driving long-term growth [3]. Enhancing customer experiences involves improving every interaction and touchpoint that a customer has with a company, ultimately leading to increased satisfaction, loyalty, and advocacy. In today's highly competitive market, providing exceptional customer experiences is essential for retaining existing customers, attracting new ones, and fostering long-term relationships. Here are some key strategies for enhancing customer experiences:

Personalization: Tailoring products, services, and communications to meet the individual needs and preferences of customers. This can involve using data analytics and customer insights to deliver personalized recommendations, offers, and experiences [4].

Omnichannel Engagement: Providing a seamless and consistent experience across multiple channels and touchpoints, including websites, mobile apps, social media, and physical stores. Customers should be able to switch between channels effortlessly while receiving the same level of service and support.

Customer Service Excellence: Offering responsive, knowledgeable, and empathetic customer support through various channels, including phone, email, chat, and social media. Resolving customer issues promptly and effectively can significantly impact overall satisfaction and loyalty.

User-Friendly Interfaces: Designing intuitive and easy-to-use interfaces for digital platforms, such as websites and mobile apps. A user-friendly interface enhances the customer's ability to navigate and interact with the company, leading to a more positive experience [5].

Proactive Communication: Keeping customers informed and engaged throughout their journey with timely and relevant communications. This includes updates on order status, product recommendations, and personalized promotions.

Feedback and Listening: Soliciting feedback from customers through surveys, reviews, and social media channels, and using this input to continuously improve products and services. Actively listening to customer concerns and suggestions demonstrates a commitment to their satisfaction.

Loyalty Programs and Rewards: Implementing loyalty programs and rewards programs to incentivize repeat purchases and encourage customer loyalty. Offering exclusive perks, discounts, and rewards can enhance the overall customer experience and foster a sense of appreciation.

Community Building: Creating opportunities for customers to connect with each other, share experiences, and provide support. Building a sense of community around the brand can deepen customer relationships and strengthen loyalty [6].

By focusing on enhancing customer experiences, companies can differentiate themselves in the market, build stronger relationships with customers, and drive sustainable growth and profitability over the long term.

Challenges and Considerations: While technology holds immense potential for diversification, its adoption presents challenges and considerations for enterprises. Cybersecurity threats loom large in an increasingly interconnected world, requiring robust measures to protect sensitive data and intellectual property. Additionally, talent acquisition and organizational adaptability are critical factors in ensuring successful implementation of technology-driven diversification initiatives. Companies must invest in training and development programs to upskill employees and foster a culture of innovation and agility [7].

Case Studies: Several companies have successfully embraced innovative diversification strategies, leveraging technology to expand their reach and capabilities. Amazon, for example, started as an online bookstore but has since diversified into cloud computing (Amazon Web Services), digital streaming (Amazon Prime Video), and smart home devices (Amazon Echo). Similarly, Tesla began as an electric vehicle manufacturer but has expanded its offerings to include solar energy solutions (Tesla Solar) and energy storage systems (Tesla Powerwall).

Leveraging technology for enterprise expansion involves harnessing digital tools and innovations to drive growth, enter new markets, and create value for stakeholders. In today's rapidly evolving business landscape, technology plays a critical role in enabling companies to expand their reach, increase efficiency, and stay competitive. Here are several ways in which technology can be leveraged for enterprise expansion:

Market Research and Analysis: Utilizing data analytics, artificial intelligence, and machine learning algorithms to conduct market research, identify emerging trends, and assess market opportunities. Technology enables companies to gather and analyze vast amounts of data quickly and accurately, providing valuable insights for strategic decision-making.

Digital Marketing and Branding: Leveraging digital marketing channels such as social media, search engine optimization (SEO), and content marketing to increase brand visibility, attract new customers, and engage with target audiences. Technology enables companies to reach a global audience with targeted, personalized messaging and measure the effectiveness of marketing campaigns in real-time [8].

E-Commerce and Online Sales: Establishing an online presence through e-commerce platforms and digital marketplaces to reach customers beyond traditional geographic boundaries. Technology facilitates online transactions, secure payment processing, and seamless order fulfillment, enabling companies to expand their customer base and generate revenue from new markets.

Cloud Computing and Remote Work: Adopting cloud-based technologies and collaboration tools to enable remote work, virtual teams, and flexible work arrangements. Cloud computing allows companies to scale infrastructure, access business-critical applications, and collaborate effectively across distributed teams, facilitating expansion into new regions and markets.

Supply Chain Optimization: Implementing supply chain management software, IoT sensors, and blockchain technology to optimize supply chain operations, improve visibility, and enhance efficiency. Technology enables companies to track inventory in real-time, streamline logistics, and mitigate risks, supporting expansion into new markets with confidence [9].

Customer Relationship Management (CRM): Deploying CRM systems and customer engagement platforms to manage customer relationships, track interactions, and personalize communications. Technology enables companies to deliver exceptional customer experiences, build loyalty, and drive repeat business, laying the foundation for sustainable growth and expansion.

Internationalization and Localization: Leveraging technology to adapt products, services, and marketing strategies to local markets and cultures. Technology facilitates translation, localization, and cultural customization, enabling companies to overcome language barriers and cultural differences when expanding into new regions [10].

By leveraging technology strategically, companies can unlock new opportunities for growth, expand their reach into new markets, and create value for customers and stakeholders. Technology serves as a catalyst for enterprise expansion, empowering companies to innovate, adapt, and thrive in today's digital economy.

Conclusion:

Innovative diversification, powered by technology, offers enterprises a pathway to sustainable growth and competitive advantage in an increasingly dynamic business landscape. Through the strategic integration of advanced technologies such as artificial intelligence, data analytics, and blockchain, businesses can unlock new opportunities, optimize operations, and enhance customer experiences. By embracing innovation, companies can transcend traditional boundaries and expand into new markets, diversifying their revenue streams and mitigating risks associated with market volatility. However, the journey toward innovative diversification is not without challenges. Enterprises must navigate cybersecurity threats, talent shortages, and organizational barriers to effectively harness the full potential of technology. Moreover, success requires a commitment to continuous learning, adaptability, and a culture of innovation across all levels of the organization. As evidenced by case studies of leading companies like Amazon and Tesla, the rewards of innovative diversification are significant. By leveraging technology to expand their offerings and capabilities, these companies have not only achieved remarkable growth but also transformed entire industries. Their success serves as a testament to the transformative power of technology in driving diversification and unlocking new opportunities for enterprises across sectors. In conclusion, innovative diversification represents a strategic imperative for enterprises seeking to thrive in today's digital economy. By embracing technology as a driver of expansion and differentiation, businesses can position themselves for long-term success and resilience in an ever-evolving marketplace. As we look to the future, those enterprises that boldly embrace innovation and harness the potential of technology will emerge as leaders in their industries, shaping the course of business for years to come.

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INTEGRATION OF DIGITAL TOOLS INTO THE TAX ACCOUNTING OF ENTERPRISES IN KAZAKHSTAN

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ИНТЕГРАЦИЯ ЦИФРОВЫХ ИНСТРУМЕНТОВ В НАЛОГОВЫЙ УЧЕТ ПРЕДПРИЯТИЙ КАЗАХСТАНА

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Abstract

The article «Integration of digital tools into the tax accounting of enterprises in Kazakhstan » provides an overview of key trends in digital integration in the field of tax accounting in Kazakhstan. The authors analyze modern technologies that affect tax accounting processes, such as ERP systems, tax portals, cloud technologies and artificial intelligence. The article highlights the importance of these innovations for optimizing accounting processes, compliance with tax laws and improving the financial efficiency of enterprises. In addition, the advantages and disadvantages of using modern tax technologies are considered. The authors highlight the practical importance of implementing digital solutions to optimize tax liabilities and provide recommendations on the selection and implementation of suitable tools for internal tax accounting at enterprises in the modern economic environment of Kazakhstan.

Аннотация

Статья «Интеграция цифровых инструментов в налоговый учет предприятий Казахстана» представляет обзор ключевых тенденций цифровой интеграции в сфере налогового учета в Казахстане. Автор анализируют современные технологии, влияющие на процессы налогового учета, такие как системы ERP, налоговые порталы, облачные технологии и искусственный интеллект. Статья подчеркивает важность этих инноваций для оптимизации бухгалтерских процессов, соблюдения налогового законодательства и повышения финансовой эффективности предприятий. Кроме того, рассматриваются преимущества и недостатки использования современных налоговых технологий. Авторы выделяют практическую значимость внедрения цифровых решений для оптимизации налоговых обязательств и предоставляют рекомендации по выбору и внедрению подходящих инструментов для внутреннего налогового учета на предприятиях в современной экономической среде Казахстана.

Keywords: accounting, tax accounting, modern technologies, ERP, Internet portals, enterprises.

Ключевые слова: учет, налоговый учет, современные технологии, ERP, интернет порталы, предприятия.

Актуальность. В настоящей эпохе быстрого развития технологий предприятия все чаще обращаются к использованию цифровых инструментов для усовершенствования внутреннего налогового учета. Это открывает новые перспективы для эффективного управления финансовыми обязательствами и обеспечения соблюдения налоговых норм.

Актуальность внедрения цифровых инструментов в налоговый учет предприятий в Казахстане неоспорима в контексте стремительных изменений в мировой экономике и требованиях к более эффективному управлению финансами. Цифровизация процессов

налогового учета открывает новые горизонты для бизнеса, обеспечивая более точные расчеты, минимизацию ошибок и более прозрачную финансовую отчетность.

Цель. Целью данной статьи является анализ эффективности и преимуществ использования современных технологий и программ для внутреннего налогового учета на предприятиях Казахстана. Рассматривая тенденции цифровой интеграции в налоговом учете, мы выявим ключевые аспекты внедрения цифровых инструментов, их преимущества и влияние на эффективность управления налоговыми обязательствами предприятий.

Переходя к рассмотрению технологических тенденций, важно выявить, как инновации в области цифровых инструментов преобразуют налоговый учет на предприятиях Казахстана, и какие практические возможности они открывают для повышения эффективности бухгалтерских операций и улучшения качества финансовой отчетности.

Введение. В налоговую систему Казахстана также активно внедряется применение цифровых технологий. Меняется мышление как сотрудников органов налоговой службы, так и налогоплательщиков. Меняется формат работы: на многих этапах системы налогообложения наблюдается переход от бумажного в цифровой формат. Комитетом государственных доходов Министерства финансов РК активно разработаны информационные системы в налогообложении для более рациональной организации работы налоговых служб и эффективного взаимодействия с налогоплательщиками.

Интеграция цифровых решений в налоговый учет предприятий Казахстана претерпевает быстрое развитие, открывая новые возможности для более эффективного управления финансами. Рассмотрение современных технологий, программных решений и инструментов, используемых для автоматизации процессов налогового учета, позволяет выявить ключевые тренды, формирующие современное лицо налоговой системы предприятий в Казахстане.

Изучение и анализ международного опыта показывают, что ключевыми в технологическом и инновационном развитии ведущих стран в цифровую эпоху являются максимальная либерализация, дебюрократизация и демонополизация рынка ИКТ при параллельном, своевременном, порой опережающем законодательном, нормативном обеспечении и регулировании. Последнее выступает в роли страховки от ошибок рынка.

Основная часть. Технологические тенденции включают в себя широкий спектр программных решений, таких как системы ERP (Enterprise Resource Planning), специализированные налоговые программы, облачные технологии, аналитические инструменты для учета и отчетности, а также искусственный интеллект и машинное обучение, применяемые для автоматизации и оптимизации налоговых процессов.

Казахстан активно внедряет и развивает разнообразные программные решения для автоматизации налогового учета и управления финансами в предприятиях. Среди ключевых технологических решений, используемых в стране, можно выделить:

1. Облачные технологии - многие компании переходят на облачные системы учета, так как они обеспечивают более гибкое использование и управление данными, а также уменьшают затраты на ИТ-инфраструктуру.

2. Аналитические инструменты - программные решения для анализа данных и отчетности, включая бизнес-интеллект и аналитику, помогают предприятиям анализировать информацию для принятия налоговых решений и оптимизации стратегий.

3. Искусственный интеллект и машинное обучение - в некоторых компаниях внедряются инструменты AI/ML для автоматизации повседневных задач, улучшения точности анализа данных и оптимизации налогового учета.

4. Системы ERP - многие предприятия в Казахстане используют системы планирования ресурсов предприятия (ERP) для интеграции различных процессов управления бизнесом, включая учет и налогообложение.

ERP (Enterprise Resource Planning) — это программное обеспечение, предназначенное для интеграции и управления основными бизнес-процессами организации. Эти системы включают в себя широкий спектр функций, включая учет, финансы, управление кадрами,

производство, логистику, продажи и многое другое. ERP — это планирование ресурсов предприятия (enterprise resource planning).

Они объединяют данные и процессы различных подразделений предприятия в единую систему, позволяя эффективно управлять ресурсами компании и обеспечивать информационную согласованность между различными департаментами. ERP обычно имеет централизованную базу данных, к которой имеют доступ разные отделы для совместного использования информации.

Системы ERP позволяют автоматизировать множество операций, оптимизировать рабочие процессы, улучшать планирование ресурсов, повышать эффективность управления и улучшать принятие управленческих решений на основе актуальной информации.

Организации Казахстана чаще используют такие системы ERP как 1С. Предприятие (Рисунок 1. Стартовая страница 1С. Предприятие) и SAP. (Рисунок 2. SAP Easy Access)

SAP — аббревиатура исходного названия компании на немецком языке: Systemanalyse Programmentwicklung, которое переводится на английский как System Analysis Program Development.

Программы «1С» от компании «1С» — одно из самых распространённых решений для автоматизации бизнес-процессов. Чаще всего «1С» ассоциируют с финансами, потому что в Казахстане «1С: Бухгалтерия» — самая популярная бухгалтерская программа.

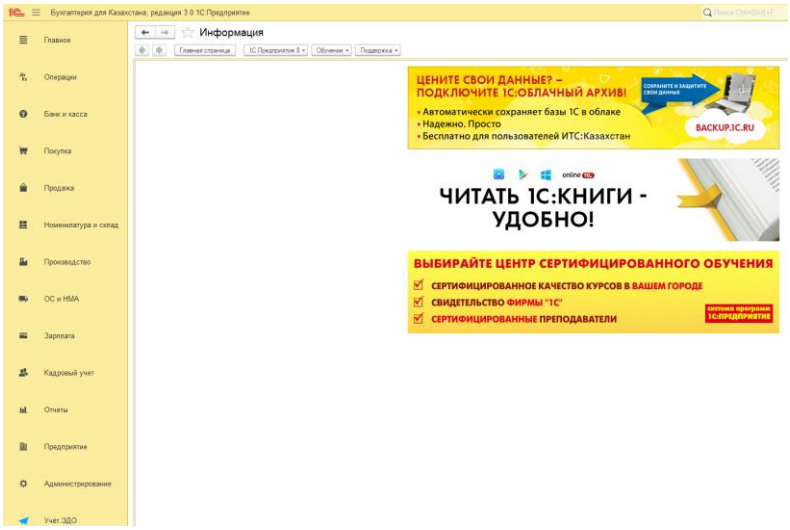

Рисунок 1. Стартовая страница 1С. Предприятие
Pic.1. 1C start page.

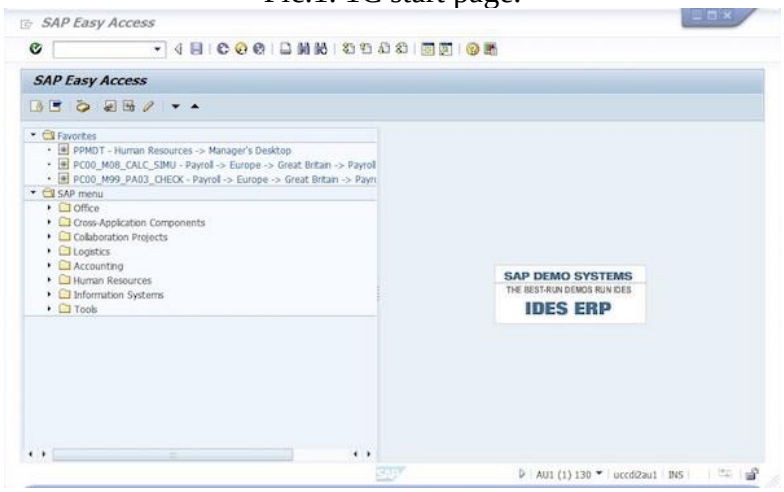

Рисунок 2. SAP Easy Access
Pic.2. SAP Easy Access

5. Специализированные налоговые программы - существуют программные решения, специализирующиеся на налоговом учете, включающие учет налогов, формирование отчетности и автоматизацию налоговых процессов с учетом требований местного законодательства.

В Казахстане имеется множество созданных государством интернет-порталов для регулирования финансовой деятельности предприятий. Именно к налоговому учету по большей степени относятся порталы «Налоговый кабинет» и «ИС ЭСФ».

Портал «Налоговый кабинет» в Республике Казахстан представляет собой веб-ресурс, который предоставляет налогоплательщикам возможность взаимодействия с налоговыми органами онлайн. Через этот портал налогоплательщики могут подавать налоговые декларации, отчеты, получать информацию о своем налоговом статусе, задолженностях, контролировать платежи и многое другое, связанное с налоговыми обязательствами.

Портал обеспечивает удобный и прозрачный способ взаимодействия с налоговыми органами, позволяя экономить время и упрощать процедуры по предоставлению налоговой отчетности и выполнению других налоговых обязательств. Налоговый кабинет помогает налогоплательщикам быть в курсе своей налоговой ситуации и оперативно взаимодействовать с налоговыми органами онлайн. (Рисунок 3. Кабинет Налогоплательщика)

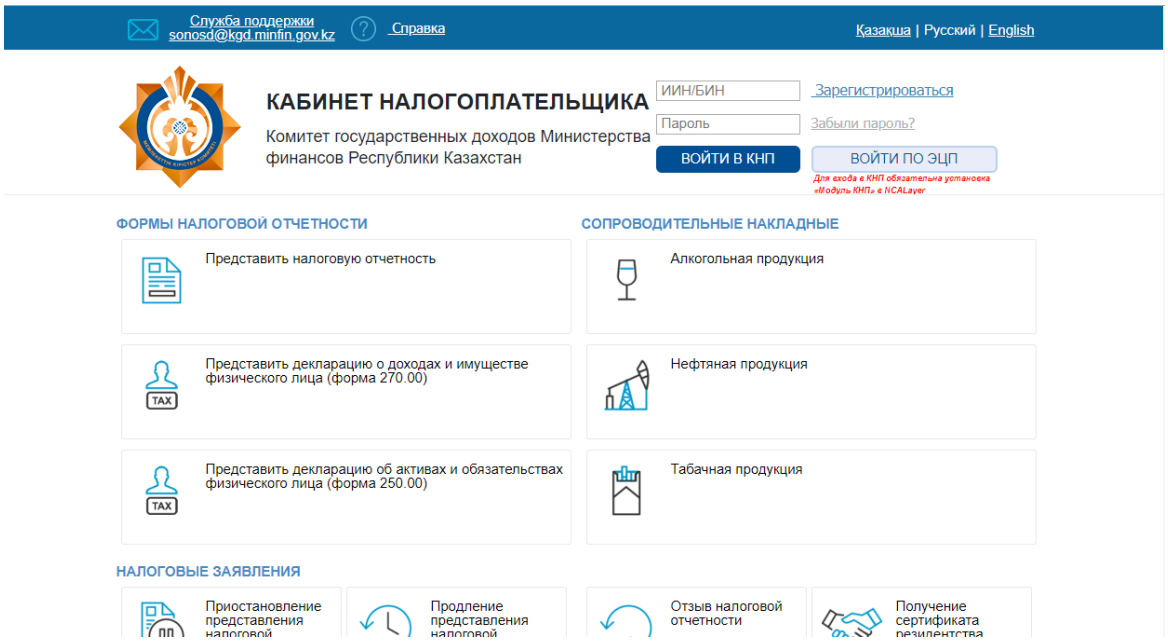

Рисунок 3. Кабинет Налогоплательщика
Pic. 3. Taxpayer's Office

Портал ИС ЭСФ (Информационная система Электронных Счетов-Фактур) используется для передачи и хранения информации о выставленных и полученных счетах-фактурах между организацией и налоговыми органами. Это позволяет вести учет операций по выставлению и получению счетов-фактур в электронной форме, что способствует более эффективному контролю за налоговыми обязательствами и сокращению административной нагрузки для бизнеса. (Рисунок 4. Портал ИС ЭСФ).

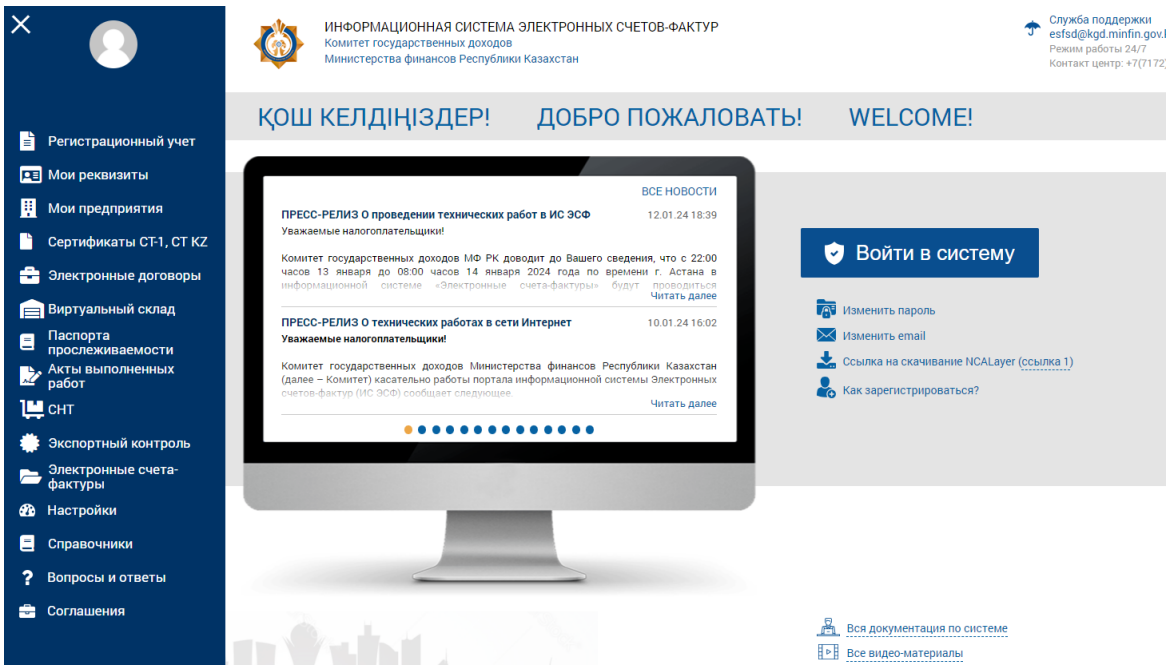

Рисунок 4. Портал ИС ЭСФ
Pic.4. Portal of the Electronic Invoice Information System

У этих порталов имеются как плюсы, так и недостатки. Несомненно, стоит отметить, что преимуществ у них больше, но рассмотрим именно недостатки:

1. Технические проблемы. Особенно относится к порталу «Налоговый кабинет». Недоступность сервиса, медленная работа портала, ошибки в работе функций часто возникают при сдаче налоговой отчетности в период дедлайнов.

2. Сложность использования. Первое время при использовании портала «ИС ЭСФ» у бухгалтеров возникало очень много вопросов. На данный момент имеются специальные платные курсы, что показывает сложность для молодых специалистов.

3. Несмотря на то, что на все порталы можно зайти только через ЭЦП, данный ключ выдается бухгалтерам, юристам и другим сотрудникам по решению руководителя. При текучке кадров не исключена возможность хищения как денежных средств, так и информации о коммерческой деятельности организации.

С первым пунктом ничего не сделаешь, т. к. количество пользователей явно огромно.

По второму пункту можно сказать, что лучшим решением данной проблемы стало бы введение практического занятия в университеты страны по обучению пользования интернет-порталами и программой 1С. Предприятия без необходимости проходить данные курсы после окончания высшего учебного заведения.

Что касается третьего пункта, то стоит чаще менять пароль для входа через ЭЦП ключи или вообще перевыпускать их. Это не решает полностью риск передачи информации сторонним лицам, не преуменьшает его.

В заключении можно сказать, что технологии и программные решения помогают предприятиям в Казахстане не только улучшить свои бухгалтерские процессы, но и поддерживать соблюдение требований налогового законодательства и повышать эффективность работы в целом.

Использование современных технологий и программ для внутреннего налогового учета на предприятиях в Казахстане предоставляет несколько значимых преимуществ:

1. Автоматизация процессов - современные программы облегчают и автоматизируют учет и расчеты, что снижает ручной труд и вероятность ошибок.

2. Улучшенная точность и скорость – эти системы способствуют более точному и быстрому учету налогов, ускоряют процессы и улучшают качество отчетности.

3. Соблюдение требований - с помощью современных программ можно обеспечить соответствие законодательным нормам, уменьшая риски возможных налоговых штрафов за несоблюдение требований.

4. Удобство аналитики и отчетности - программы предоставляют возможность более глубокого анализа данных и генерации отчетов, что помогает принимать более обоснованные решения в управлении налогами и финансами.

5. Снижение затрат и оптимизация ресурсов - использование современных технологий может уменьшить необходимость в ручном труде, что экономит время и ресурсы предприятия.

6. Интеграция с другими системами - такие программы обычно поддерживают интеграцию с другими системами, что упрощает взаимодействие с другими подразделениями предприятия.

7. Безопасность данных - современные программы часто обеспечивают более высокий уровень безопасности данных, что важно для защиты конфиденциальной информации.

Применение таких технологий на предприятии может способствовать повышению эффективности учета и отчетности, улучшению управления налоговыми обязательствами и сокращению возможных рисков для бизнеса.

Заключение. Основной целью цифровой трансформации являются сбор и обработка данных, как из государственных информационных систем, так и систем коммерческих организаций, – цифровой сбор статистической, финансовой, налоговой информации, а также тех, которые на сегодня являются субъектами контроля, мониторинга.

Использование таких инструментов уже позволяет предприятиям сократить временные и финансовые затраты, повысить точность учета и обеспечить соответствие требованиям налогового законодательства. Однако, вместе с возможностями, стоит учитывать и вызовы, связанные с технической поддержкой, безопасностью данных и обучением персонала.

Неоспорима практическая значимость цифровизации налогового учета. Это не только улучшает управление налоговыми обязательствами предприятий, но и открывает путь для более гибкого и конкурентоспособного бизнеса.

Дальнейшее исследование технологических инноваций и их влияния на налоговый учет позволит выявить новые возможности и обеспечить эффективное использование современных инструментов в бизнесе.

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ACCOUNTING AND ANALYTICAL CONCEPT OF INTEGRATED ENTERPRISE INFORMATION SYSTEM

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Abstract

In today's business environment, the implementation of integrated information systems is becoming a strategic priority for enterprises seeking to improve the efficiency of their operations and adapt to rapidly changing market conditions. This article is devoted to determining the system-forming components of the accounting and analytical concept of an integrated information system using the example of the enterprise AKRU LLP in the city of Shymkent.

The article begins with an emphasis on the relevance of implementing integrated information systems in modern business. Identifying these systems as dynamic structures that require a deep understanding of their components becomes the basis for subsequent analysis.

An analysis is carried out of the works of foreign and domestic authors, such as Seisenbaeva, Shakeev, touching on the issues of integration of structures in national companies, as well as the work of Sheshukova and Gulyaeva, concerning the theory and practice of controlling.

A complete analysis of the components of the accounting and analytical concept in an integrated information system is presented. Key components such as financial modules, analytical tools and reporting mechanisms are highlighted.

The article examines the properties inherent in the selected components and their impact on the qualitative characteristics of accounting and analytical information. Particular attention is paid to how these properties contribute to the relevance, reliability and timeliness of information important for making informed management decisions.

The practical application of the selected system-forming components is illustrated using the example of the enterprise AKRU LLP. This segment of the article reveals how the integration of these components into an enterprise information system improves the overall quality and usefulness of accounting and analytical information for management functions.

The work uses analytical research methodology that synthesizes theoretical and practical aspects. The approach includes a careful review of current literature, examination of system components, and case study analysis.

The article concludes by emphasizing the importance of understanding and optimizing the backbone components of an integrated information system. The authors emphasize the need for enterprises, using the example of ACRU LLP, to carefully navigate through these components in order to fully unlock the potential of integrated information systems for informed management decision-making.

Keywords: integration, integrated information systems, accounting and analytical concept, system-forming components, quality of accounting information

Introduction. Relevance. In the modern business environment, the relevance of the article using the example of ACRU LLP in the city of Shymkent becomes more remarkable. This is due not only to the general context of rapid technology development and increased competition, but also to the specifics of the activities of a particular organization.

The introduction of integrated information systems in the accounting and analytical processes of enterprises is becoming a strategically important aspect, especially for companies engaged in technical and engineering tasks, such as ACRU LLP. The identification of system-forming components in this context is crucial for the effective management of information flows and financial risks.

The example of ACRU LLP from the city of Shymkent gives the article a practical orientation, allowing us to consider an integrated information system in the context of the real challenges and needs of the organization. This makes the study more specific and applicable to engineering and technical oriented businesses.

Determining the system-forming components of the accounting and analytical concept allows you to begin creating more effective resource management strategies, optimizing financial processes and ensuring transparency in the activities of the enterprise. In relation to ACRU LLP, this may include the integration of project management processes, cost accounting and analysis of the effectiveness of engineering solutions.

Thus, the article not only emphasizes the general relevance of the topic of implementing integrated information systems in modern business, but also demonstrates its specific application in practice, using ACRU LLP in the city of Shymkent as an illustrative example.

In modern conditions of rapid technological development and dynamic changes in the business environment, issues of effective enterprise management are becoming more relevant and complex. Accounting and information analysis systems play a key role in this context, having a significant impact on strategic decision-making and ensuring the sustainable development of the enterprise.

The purpose of this article is to determine the system-forming components of the accounting and analytical concept of an integrated information system (UAK IIS) using the example of the enterprise ACRU LLP in the city of Shymkent. Accounting and analysis of information are becoming more important in conditions of increasing complexity of business processes, the need to quickly respond to changes in the external environment and increased competition.

Before moving on to a specific analysis of the accounting and analysis system of the enterprise AKRU LLP, it is necessary to determine the key components that form the accounting and analytical concept of the integrated information system. This includes the study of technological components, data analysis techniques, financial management strategies and other factors that together ensure the effective functioning of the system.

An emphasis on the practical experience of ACRU LLP will reveal which specific components are system-forming in their accounting and analytical concept, and how these components interact to achieve the enterprise's goals. This study aims not only to analyze the current system, but also to offer practical recommendations for optimizing and improving the accounting and analytical concept, taking into account modern trends and market requirements.

Thus, this article focuses on introducing the problems of determining the system-forming components of the UAC IIS, and also substantiates the relevance of this study using the example of a specific enterprise, which gives the work a specific practical context.

Literature review. Many scientific materials discuss the key aspects of integration in national companies of Kazakhstan and the features of managing integration exchange associations. Thus, in the article “Seisenbaeva Zh.M., Nurasheva K.K., Baineeva P.T., Mukhamedieva G.M. Kazakhstannyn ulttyk kompaniyalarynda integration-langan kurylymdardy kalyptastyru erekshelikteri” the features of integration in national companies of Kazakhstan are defined. The authors consider the unique features of the structure and form of integration, and also identify management features in the process of forming integrated structures.

The work "Shakeyev S.S., Nevmatulina K.A., Temirbekova L.A. Integration of birlestic-terdin ardurli turlerindegi sharuashylyk zhurgizu zhagdaylarynyn erekshelikteri" examines various types integration associations and analyzes the features of their management. The authors highlight the specifics of specific cases of integration and discuss factors influencing the success of this process.

The book "Sheshukova T.G., Gulyaeva E.L. Theory and Practice of Controlling" provides an extensive overview of the theoretical and practical aspects of controlling. It examines controlling methods and tools designed for effective management of an organization. The book contains useful materials for those interested in modern approaches to business management.

The general trend in the presented literature indicates the importance of research in the field of management of integration processes and controlling to improve the efficiency of business structures and maintain their sustainable development in modern conditions.

Main part.

Components of the accounting and analytical concept of the integrated information system of the enterprise AKRU LLP. The components of the accounting and analytical concept of the integrated information system of the enterprise AKRU LLP, using the example of the city of Shymkent, are a complex system that includes several key elements aimed at the effective management and analysis of business processes.

1. Integrated accounting and analysis system. The main component is the implementation of an integrated accounting and analysis system that combines accounting, financial and operational accounting. This allows the company to quickly receive complete information about the financial condition and efficiency of its activities.

2. Automation of business processes. The automation component includes the introduction of modern technologies to optimize business processes, from supply management to customer interaction. Automation helps speed up operations, reduce the likelihood of errors and improve overall business efficiency.

3. Integration with external stakeholders. The integration component with external stakeholders involves the creation of effective mechanisms for interaction with suppliers, clients and regulatory authorities. This includes information exchange, optimized ordering of raw materials and materials, as well as timely reporting.

4. Analytics and reporting systems. The analytics and reporting component is the creation of a system for collecting, analyzing and visualizing data. This includes the development of key performance indicators, reports for decision making and monitoring of performance results.

5. Security and data protection. An important component is ensuring information security and data protection. This includes developing a security strategy, controlling access to confidential information and regularly updating the security system.

6. Personnel training and development. The component includes training of personnel in the use of new technologies and systems. This allows for a smooth transition to the new integrated system and increases the overall level of employee competence.

7. Constant renewal and development. The final component is the desire for constant updating and development of the system. The enterprise must be ready to introduce new technologies and methods to maintain its competitiveness.

Thus, these components interact in a single system, providing an integrated approach to the accounting and analytical concept of the integrated information system of the enterprise AKRU LLP in the city of Shymkent.

Managerial aspect of integration of the enterprise LLP "AKRU". The managerial aspect of integration in the enterprise LLP "AKRU" (Limited Liability Partnership "AKRU") plays a key role in ensuring the efficiency of business processes and achieving the strategic goals of the organization. Using the example of this enterprise, we will consider the main aspects of integration management:

1. Strategic alignment: In the context of ACRU, the management aspect of integration begins with careful alignment of the integration strategy with the overall enterprise strategy. This includes analyzing market trends, customer needs, and the competitive environment to determine how information systems integration can support key business objectives.

2. Optimization of business processes: Integration management at ACRU includes reengineering and optimization of business processes. This may include reviewing existing supply chain management, manufacturing and finance processes to improve efficiency and reduce costs.

3. Ensuring data integrity: Within ACRU, the management aspect includes developing a data management strategy to ensure the accuracy, reliability and integrity of information within integrated systems. This is important for making informed management decisions.

4. Personnel training and development: Since the implementation of new information technologies requires appropriate skills, the management aspect includes training of ACRU personnel. This ensures that employees can use new systems effectively and maximize their potential.

5. Monitoring and analysis of results: ACRU actively uses monitoring and analytics systems to evaluate the results of integration. The management aspect includes constant analysis of key performance indicators, which allows you to quickly respond to changes and make adjustments to the strategy.

6. Response to changes: ACRU, like any enterprise, faces constant changes in the external environment. The management aspect of integration includes flexibility and the ability to adapt to new demands and opportunities, ensuring resilience to change.

Thus, the management aspect of integration into ACRU is a systematic and targeted process aimed at improving the management of business processes and achieving high efficiency of the enterprise.

The accounting and analytical concept of an integrated information system (AAC IIS) is a complex structure that has a number of properties that significantly affect the quality characteristics of accounting and analytical information and, consequently, the efficiency of management of the ACRU LLP enterprise.

1. Data integration:

UAK IIS provides integration of data from various enterprise sources. This property allows you to create a single information space where data is automatically coordinated and available for use in various aspects of management activities. Data integration contributes to the accuracy and relevance of accounting and analytical information.

2. Unambiguity and uniformity:

The accounting and analytical concept ensures standardization of accounting and analysis processes, which ensures unambiguous terminology and uniformity of methods. This property helps to reduce errors and discrepancies in accounting, and also contributes to the formation of consolidated and reliable information for management decisions.

3. Flexibility and scalability:

UAK IIS provides flexibility in adapting to changes in the internal and external environment of the enterprise. The system must be easily scalable to accommodate new activities or changes in legislation. Flexibility and scalability allow you to adequately respond to market challenges and effectively manage resources.

4. Process automation:

The accounting and analytical concept includes the automation of many routine operations, which helps reduce human intervention and the likelihood of errors. Process automation also provides higher speed of information processing and quick access to up-to-date data.

5. Analytical capabilities:

UAK IIS provides opportunities for conducting a variety of analytical studies and generating multi-level reports. This property contributes to a deep analysis of the financial, operational and strategic aspects of the enterprise's activities, which is important for developing high-quality management decisions.

6. Security and privacy:

The system has data protection tools, ensuring the security and confidentiality of accounting and analytical information. This is important to prevent data leaks, as well as to comply with legal requirements for information protection.

The properties of the accounting and analytical concept of the integrated information system significantly influence the formation of high-quality accounting and analytical information for the management of the enterprise AKRU LLP. Their combination ensures effective resource management, informed decision-making and improvement of the overall productivity of the enterprise.

Consequence. As a result of the research aimed at identifying the system-forming components of the accounting and analytical concept of an integrated information system (AIC IIS), we identified several key aspects that have a significant impact on the efficiency of the functioning of such systems in the modern business environment .

Firstly, it has been determined that the UAC IIS is a complex structure, which is a complex of interconnected components aimed at collecting, storing, analyzing and providing accounting and analytical information for enterprise management purposes. This approach allows organizations to effectively monitor, make management decisions and formulate strategic plans.

Secondly, the main system-forming components that influence the functionality of the UAC IIS are identified. Among them are goal setting and strategic planning, methods of data collection and processing, technological tools, as well as aspects of data security. These components are fundamental to ensuring the efficiency and reliability of the accounting and analytical system.

Thirdly, the importance of adaptability and flexibility of the UAK IIS is emphasized. Today's business environment is characterized by rapid change, and therefore an accounting concept must be able to quickly adapt to new requirements and scenarios, providing relevant information for decision-making.

Finally, a systematization of system-forming components is proposed, which can serve as a guide for organizations in the development and implementation of UAC IIS. This systematization includes a clear definition of goals, strategies, technological tools and data analysis methods, which contributes to a better understanding and practical application of the concept.

In general, the results of the study emphasize the importance of a deep understanding and systematic approach to the construction and management of UAC IIS to ensure the effective operation of enterprises in modern business conditions. Further research and practical applications of the concept of accounting and analytical systems will contribute to their continuous improvement and successful adaptation to changing market requirements.

Improving the system-forming components of the accounting and analytical concept of the integrated information system (UAK IIS) of the enterprise AKRU LLP is an important step in increasing the efficiency and adaptability of the system to modern requirements of the business environment. In this context, the following proposals are offered:

1. Development of technological infrastructure: Expanding the functionality of the UAC IIS involves investing in modern information technologies, including cloud solutions that will provide higher flexibility and scalability of the system.

2. Strengthening data security: Considering the relevance of cybersecurity issues, the enterprise should improve the data protection systems in the UAC IIS. The introduction of modern encryption methods, multi-level authentication and security monitoring systems will contribute to the reliable protection of confidential information.

3. Optimization of data analysis processes: To improve the analytical capabilities of the system, it is advisable to introduce advanced data analysis methods, including machine learning and artificial intelligence. This will allow the enterprise to obtain deeper and more accurate analytical insights.

4. Development of strategic planning models: The introduction of modern strategic planning techniques in UAC IIS will allow the enterprise to more effectively build its long-term development strategy, taking into account the variability of market conditions.

5. Personnel training: For the successful implementation of improved components of the UAC IIS, it is necessary to conduct personnel training. This includes both improving skills in using new technologies and training in analytical methods of work.

6. Establishing feedback mechanisms: Implementing feedback mechanisms will help evaluate the effectiveness of new components and identify potential improvements. The feedback system may include surveys of employees and customers, as well as regular audits of the system.

7. Consistency with business processes: All changes and improvements in the UAC IIS must be closely related to the business processes of the enterprise. This will ensure the harmonious implementation of new components and coordinated work of all structural units.

These proposals are aimed at increasing the efficiency, flexibility and competitiveness of the accounting and analytical concept of the integrated information system of the enterprise AKRU LLP.

Conclusion. At the end of our research to determine the system-forming components of the accounting and analytical concept of an integrated information system (AIC IIS), it seems important to summarize the key conclusions and generalizations obtained in the course of our research.

In the process of work, the results of previous research in the field of accounting and analytical systems were analyzed and considered, which made it possible to determine the relevance of the research topic and its contribution to the development of modern science. The reviewed literature review reflects the variety of approaches to accounting and analytical concepts used in various industries and countries. This analysis became the starting point for identifying the most promising and relevant components of the UAC IIS.

One of the key conclusions of our study is the fact that the system-forming components of the UAC IIS can vary significantly depending on the characteristics of industries and organizational structures. However, we have identified a number of common features that we consider fundamental for the effective functioning of the UAC IIS in the context of modern business.

An important aspect is also the adaptability of the accounting and analytical concept to the changing conditions of the external environment and the internal organization of the enterprise. Data accounting and analysis must be flexible and scalable to match the dynamics of modern business.

We proposed a systematization of the key components of the UAC IIS, which, in our opinion, can serve as a guide for organizations in the development and implementation of such systems. This includes clearly defining goals, strategies, technology tools and data analysis methods.

In conclusion, we emphasize the need for further research in the field of accounting and analytical systems and their integration. Advances in technology, changes in the business environment, and increased demands for managerial transparency highlight the importance of continually improving accounting concepts and practices in modern organizations.

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RETAIL CHAINS AND PRIVATE LABELS IN ALBANIAN MARKET

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Abstract

Nowadays, Albanian consumers have many alternatives in choosing the stores where they want to buy consumer products. Retail chains which operate in Albania are local and foreign companies. Apparently, the number of local supermarket chains is larger, which are mainly Big Market, Ehw, Kmy, Xhangolli, Eco Market, Joena, One Stop, Alb Market, COOP, Diambe, Ne per Ju, AnnA Market, foreign supermarket chains such as Inter Spar Albania and Conad Albania. On the shelves of supermarkets, consumers are faced with local and imported product brands, but also the brands of the manufacturer and distributor. Private label brand (reseller or distributor brand) is a brand, which is developed by retailers and marketers. In grocery stores in Europe and Canada, private brands version is more than 40 percent of items sold. In Britain, supermarket chains Sainsbury's and Tesco's own brands version for roughly half of their product sales. In the United States, one in four products is private label. For many manufacturers, retailers are both collaborators and competitors. As noted above, private brands already occupy a good portion of supermarket shelves.

Keywords: Retail chains, private label, consumers, brands.

Introduction

Retail trade in Albania has evolved rapidly over the years. From a market where the consumer was served by the seller, he now selects the brands of products on the shelves, serving himself. On the shelves of supermarkets there are many local and imported brands where the consumer chooses the ones he has the opportunity and desire to buy. A trend that has emerged is the presence of private brands or private labels. The private label revolution was first observed in Europe and Canada Private brands were first used in Germany by the Aldi supermarket chain in 1948. Nowadays, their use in Europe is very widespread in supermarket chains (Beneke 2010). Consumers see the brand as an important part of the product. The brand adds value to the product and the equity that the brand represents is seen as a value for both the consumer and the company. Over the centuries, the brand has been recognized as a tool that helps to distinguish the goods of manufacturers from each other (Keller 2013). In Albania, supermarkets chain had their beginnings in 2005 and having a wide scope after 2010. Now the competitiveness of local supermarkets chain with each other and with foreign chain is very evident, this is due to the fact that consumers have the opportunity to choose and compare for the conditions of keeping the products, service, communication, promotional policies of these chain. To differentiate these chains, a strategy is offering the products with private labels. Private labels, which are known as retail unit brands, refer to those brands that are owned and sold by a particular retail chain. These products are usually manufactured by a licensed third party (contract manufacturer). In creating a brand, the ability to choose a name, logo, symbol, packaging design or other attributes that identify the product and differentiate it from others is very important (Keller, Hoeffer 2003). According to (Cuneo et al. 2015) distribution structure, types of sales units and logistics are leading in the success of private brands and emphasizing that private brands threaten the existence of other brands in developing countries. These authors also add that it is important for brand manufacturers to understand why private labels are becoming important players in some countries. By studying the information of 46 countries, these authors came to the conclusion that supermarkets become more dominant in the market, with the growth of private labels of products and that supermarket chains offering private labels increase their profits. Their research suggests that private label will become a global phenomenon, entering some markets quickly and others more slowly, and that it is clear that brand manufacturers are being openly competed by private label manufacturers in Europe, where it is estimated that approximately half (48.9%) of the volume of products and 38.7% in value are private labels. However, in different countries of the world, the

introduction of private labels has a lower scope, including Latin America, Southeast Europe and Asia. For example, in Chile private brands represent 5.2% of the market, Brazil 1.9%, Russia 0.8%, Turkey 7.7%, China 0.3%, South Korea 5.5%.

According to (Beneke 2010) the advantages of private labels to retailers are.

- ✓ Private labels increase profits through cost reductions and increased profit margins
- ✓ Private labels increase loyalty over the sales unit and create a distinct identity of their business
- ✓ Private labels create opportunities to venture into new markets
- ✓ Private labels increase the advantages in favor of retailers versus suppliers.

Branding helps consumers in various ways, first with brand names, which help consumers identify products, and then with product quality and consistency. Buyers who always buy the same brand know that they will get the same features, benefits and quality every time they buy. Branding also gives the seller some advantages. The brand name is the basis on which stories can be built, about the special qualities of the product (Kotler, Armstrong 2012). Brands influence consumer choices, as they are more than a logo and elements combined in a brand generate emotional connections with the consumer, describing consumer personality in purchasing brands. The designers develop colors, material forms, as well as attitudes towards function and content for it bring the brand to life (Breakenridge 2001). Personalized labels refer to the manufacture of a product by another company, but that the latter is sold under the name of the company that sends it to the final consumer. This is observed in companies, which have a very important role in distribution and sale of the product to the final consumer. This phenomenon, such as the personalized labeling and branding of products, has become very common (Jain 1999). Supermarket chains in Albania are one of the businesses that are experiencing continuous growth in recent years. In a country where the informal economy is high, key market players are seeing room for expansion. Ranked by annual turnover for the year 2017 in the first place is Big Market Albania 95 million euro, Spar Albania 40 million euro, Conad Albania 19.8 million euro, Eco Market Food 7.6 million euro, Joena 7.2 million euro, Albmarket 6.6 million euro, Xhangolli 4.7 million euro, AnnA Market 3.6 million euro (Monitor 2018).

Local supermarket logos. *Internet source*

Logos of foreign supermarkets in Albania. *Internet source*

Methodology

Marketing research can be classified based on techniques or objectives. Some methods like experiments, surveys, and observational studies are just a few common research ways and means used in marketing research. In this study, is used descriptive research, which describes the characteristics of objects, people, organizations and the environment. Descriptive research tries to give us background on a particular situation. This research is very useful for describing and analyzing brands in retail chains and competitors in Albanian market. The research technique used in this study is the observation method. In marketing research, observation is a systematic process of recording the behavior structure of individuals, physical objects and events as they occur. Researchers who use the observation method collect data, evidence or information by observing events, data recorded from certain sources or from the Internet (Zikmund, Babin 2007). In this study, the retail chains, which are mentioned in the introduction of the paper, were physically visited. The information collected through this technique was recorded in order to be analyzed and processed in the function of the study. According (Proctor 2005) emphasizes that one of the types of observation is the observation of the environment at the points of purchase. This observation includes product distribution, shelf prices, shelf position and placement, promotional displays and the presence of promotional materials at points of purchase. Depending on the user's needs, results can be reported by category, brand, product types and sizes. Results can be reported in total, in individual units and supermarket chains/networks.

Data analysis

The data obtained from the observation of the chains taken in the study, it turned out that the chains of local supermarkets such as Big Market and Eco Market traded private labels registered with their name, while the chains of local markets such as: Ne per Ju, Xhangolli, One Stop, Alb Market, COOP, Diambe, AnnA Market, Joena had no presence of private labels registered under their name. Chains such as: EHW and KMY had their meat offal products branded under their name. Regarding foreign supermarket chains such as InterSpar and Conad, they had the presence of products with private labels in their name, where these products had relevant shelves and promotional tools for identifying private labels under their name.

Private label in the Big Market chain. *Internet source*

Conclusions

Based on the analysis of the information obtained through the observation technique, it was found that only two local supermarket chains, Big Market and Eco Market, offer products registered under their name which are products of daily consumption, the survey resulted in products such as: vegetable oil, flour, rice, sugar. The foreign supermarket chains Conad Albania and Interspar Albania offer a wide presence of products registered under their name which were present on certain shelves. Local supermarket chains offer products from the same manufacturers on their shelves. In terms of the number of Big Market networks, it has a wider reach and some of them are *Franchise* networks which operate through agreements with the Big Market company.

Recommendations

Local supermarket chains should offer private label products under their name to take advantage of their advantages and their successful track record in Europe and beyond. The growing trend of the ratio between private labels and those of manufacturers is constantly increasing in Europe and more widely. This is a clear signal that local networks should operate with private labels, also due to the fact that they offer products offered by the same manufacturer. On the other hand, local producers benefit from the trading of private brands, especially the new producers who encounter difficulties to compete with the older producers who are already consolidated in the market. Existing and new local producers must negotiate to cooperate with local supermarket chains. This collaboration drives profitability between manufacturers, distributors and local supermarket chains. Encouraging private label branding of local products in local supermarkets stimulates increased turnover and increases employment in the country. Local supermarket chains should market private labels under their own name because this increases the image and credibility of local supermarket chains.

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INNOVATION AND CREDIT CHANGE. HOW INNOVATION AFFECTS THE CREDIT RATING CHANGES OF US FIRMS

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Abstract

This study investigates the effect of innovation on credit rating changes of US firms. The dataset encompasses all firms having a Standard and Poor's credit rating, consisting of 8973 observations. The results show that innovation will positively impact the likelihood for downgrade in the short-run, while the relationship will be reversed in the long-run. This impact will be significant in the second year leading the engagement of the firm in innovative activities and onwards. However, too much innovation will positively affect the possibility for the firm to be downgraded, resulting in a reversed U-shaped relationship.

Keywords: innovation, credit rating, research, US firms

Introduction

Since 1909, when they were firstly introduced by John Moody, credit ratings have been one of the most crucial issues and concerns of the corporate management. Almost all the US firms, public and a lot of private ones, have their credit worthiness evaluated by one of the three biggest credit rating agencies (CRAs), being Standard and Poor's, Fitch and Moody's.

The presence of these agencies suggests that they provide important information to investors, borrowers, and creditors (Sufi, 2009). Since financial markets are becoming so big, complex, and interrelated, so has become the need for a risk-measure which is as transparent and objective as it can be. Therefore, credit rating is a very important tool to borrowers since it gives them access to loans and credit cards and easily borrowing money from public debt markets or financial institutions. It is also important at the corporate level since investors' decision on buying a firms' bond or stock is mostly based on the company's debt rating. And lastly, it is also very significant at country level, since foreign investors who intend to purchase a country's debt, heavily base their final judgment on credit rating agencies.

Overall, it can be said that it is of great importance for firms to achieve a good or required rating, which would be achieved by signalling a decent financial outlook. This outlook, to be perceived as a good one from the market, requires for firms to prevent and limit any chance of bankruptcy and also upgrade and strengthen all of their financial and investment decisions. Theoretical models such as Holmstrom and Milgrom (1991) show that agents distort their behaviour when they know they will be evaluated based on specific, easily measurable dimensions. So it is safe to say that if firms know that credit rating agencies put more weight into some specific criteria of a firm rather than other criteria, these firms would then have an incentive of reallocating the resources in their disposal into the dimensions valued more from the credit rating agencies. Further, a lot of studies display clear evidence that credit ratings are a key focus for CFOs and that most managers are willing to forgo positive NPV projects to meet short-term financial objectives (Graham and Harvey, 2001; Graham, Harvey, and Rajgopal, 2005). So, this can lead to the fact that in order for firms to maintain or improve their ratings, they should have strong incentives in smoothing earnings and reducing volatility (Jung, Soderstrom, and Yang, 2013). One of the features that many papers and authors agree to influence firm's value, earnings, and volatility, is innovation.

As innovation is an idiosyncratic investment in intangible assets, attached to unpredictability and considered in the long run, it is in most cases linked to some probability of failure. Therefore, firms which display a higher level of innovation could have a lower rating than those that do not have

such a level of innovation behaviour. On the other hand, in the long-term perspective, innovation seem to be one of the most crucial players of a firm's survival, no matter if the firms are new entrants or incumbents. Innovation activity enables well-established firms to deal with new and emerging or 'disruptive' technologies and continuously improve their existing capabilities (Banbury and Mitchell, 1995, Christensen, 1997). Moreover, most of the results from previous studies suggest that only those firm which engage in successful innovations can firstly establish and then retain a competitive advantage in the market.

Altman and Rijken (2004) show that CRAs place less weight on short indicators of credit quality and more on the long run features such as innovativeness. This is one more reason as why it is of interest investigating more into the relationship between a firm innovation behaviour and its credit rating.

Following this logic line, in this thesis I try to contribute more into the existing literature by adding more evidence and results. To examine the effect of innovation on credit change, two logistic models are used. The first model has a dependent dummy variable defined as credit change, while the second model has a dependent dummy variable defined as credit status. R&D expenses over total assets are used as a proxy for innovation. The downgrade dummy considers one notch differences from a higher level to a lower rating level and the credit status dummy represent all the investment grades a US firm could be assigned to.

Using a sample of 8973 observations for the period 2000-2016, the results show that innovation will positively impact the likelihood of a firm to be downgraded in the short-run, but it will negatively impact this likelihood in the long-run. Leading years of the dependent variable are used to see the differences of signs and coefficient throughout the years. Moreover, too much innovation will increase the possibility of the company to be downgraded and decrease its possibility to be rated at an investment grade. These relationships are significant in the long-run, which in the paper is defined from the third until the fifth leading year. This is because results prove to be insignificant after the fifth leading year.

Theoretical framework

2.1 The role of rating agencies

Assigning credit rating for all the issuers and investors of different types of debt obligations, is the main task of a credit rating agency. So that a CRA to be able to assign such rating, it would have to base its decision on the company's financial statements, management quality, franchise value and its competitive position in the industry, using private and public information and taking a range of macroeconomic and credit conditions in consideration (Gonzalez et al., 2004). In general, the services provided by a credit rating agency can be divided in two groups. The first one is providing information services to derive the default likelihood and even the recovery rates of different securities in order to prevent the duplication effort of financial market. In this way CRAs ensure an independent rating. Even though CRA's independence is doubted by numerous researchers (Becker & Milbourn, 2011; Benmelech & Dlugosz, 2010), in this thesis ratings are assumed to be independent. Meanwhile, they also ensure a rapid spread of important information about companies being rated. In this way, credit rating agencies give their substantial contribution into the market by gathering important information which is otherwise not accessible by investors, leading to a reduction of the information asymmetry between borrowers and lenders. Secondly, in order for issuers to be influenced in taking actions to avoid downgrades via 'watch'-programs, CRAs provide the market with monitoring services (De Haan & Amtenbrink, 2011).

Credit rating agencies' aim stands in ratings delivery which show the potential of timely and complete payments of debt securities. This is done within pre-specified classes displayed through letter scales (Appendix 1). The focus of these agencies is on the relative rather than on the absolute risk of debt securities. Also they concentrate on long-term developments and do not respond to short-term market fluctuations (Dittrich, 2007). On Standard & Poor's 2006 manual, they state that "There is no point in assigning high ratings to a company enjoying peak prosperity if that performance level is expected to be only temporary. Similarly, there is no need to lower ratings to reflect poor performance as long as one can reliably anticipate that better times are just around the corner (page 34)".

This is referred to as 'prudent rating migration policy', which once again proves that CRAs' focus is on future intentions and that their ratings are not only reliable in the short-term. Nevertheless they may be consistent and coherent through a long-term perspective of a firm (no need for a substantial change on the rating each time the market is associated with good or bad news).

2.2 Why innovation is important to CRAs?

Firstly, one of the reasons this thesis focuses on CRA ratings is due to the fact that 21% of U.S.-originated secured syndicated loans were collateralized in part by intangibles over the 1996–2005 period, with intangible asset collateralization increasing significantly over this period (Loumioti, 2014; Mann, 2017). This indicates that the creditworthiness of a firm is increasingly depending on the success of its R&D investments and intangible assets due to the U.S. shift to a knowledge-based economy. However, finding the needed information about R&D and intangible assets, as they are being written off, is a challenge for CRAs since there is not much information in today's financial statements about these items. Consequently, the dilemma as why then should credit rating agencies get involved into such a challenge is raised. As innovation involves a significant risk-taking degree, there is a lot of uncertainty if the innovation activity will ultimately translate into success. On one hand there are the equity holders whose call options value are increased because they value their risk positively. On the other hand, the debt holders, faced with asymmetric payoffs on a firm's assets (Myers and Majluf, 1984), may not value their risk positively. Moreover, debt holders may consider innovation as a transferring of wealth to shareholders. Based on this perspective, Standard and Poor's (2013) points out innovation as an industry risk factor. A high level of innovation may increase the net asset value, but in any case of bankruptcy the value of intangible assets created from R&D would be less than property, plant and equipment forming the value of tangible assets. Based on this logic, initially more innovativeness could probably reduce the firm's credit rating and increase the downside risk. However, firms engaging in such type of behaviors generate both the upside and downside risk. This indicates that as long as there exists the uncertain possibility of gain to protect investors from adverse events and improve their credit ratings, the downside risk will be vanished. What is more, there are direct measures such as increased future cash flows, higher interest coverage and lower leverage that clearly display the positive link between higher innovative activities and improved credit ratings and reduced downgrade probability.

2.3 Rating determinants and their link to innovation

Since credit rating agencies intent to evaluate the ability of a firm in servicing its debt in a timely manner, these agencies affect the cost of debt of a company. This means that they affect their financing structure which further leads to them impacting and determining the probability of survival of the specific firm. Also, rated firms' business and financial strategies can potentially affect the rating and their future cost of capital (Graham and Harvey, 2001). Put differently, CRAs have been trusted with the role of acting as quasi-regulators and not only are being widely used as inputs assessing a firm's internal credit risk, but also for regulatory purposes.

Nevertheless, credit rating agencies have been under the whirlpool of criticism for a long period, and mainly it has all been linked to their failure in predicting worldwide credit crisis events. Therefore, regulatory bodies such as SEC in USA and IOSCO in Europe, have been investigating the methodologies used by CRAs. They have raised such an issue for the rating agencies to be more open, clear and evident into displaying the methods they use for valuating and their determinants. Also, the need for transparent communication with all the regulators and investors in the market is noticeable. It is for this reason that this thesis puts a significant weight into explaining these determinants, linking them to innovation and then shaping the clear picture of this study.

Most of the academic research seem to agree on the fact that credit valuation is based on careful consideration of the unique characteristic of firms and in the same time examination of a wide range of both financial and non-financial determinants.

Many papers (Dunne et al., 1988; Agarwal and Gort, 1996; Damodaran, 2001) show that firm age is inversely related to the probability of default and negatively related to its idiosyncratic risk. Following the logic line, the more established a firm is, the lower is its level of risk (default probability) and the higher is its likelihood of remaining solvent. On the contrary, since young firms face

many existential threats related to managing internal financial and human resources and external relationships with customers, suppliers, investors and competitors (Thornhill and Amit, 2003), they are associated to a high level of risk and probability of default. Czarnitzki and Kraft (2004) and Sufi (2009) maintain that younger firms are more likely to apply for a credit rating, because the certification effect of indicating survival likelihood or even success trajectory is more valuable for younger firms that communicate information to previously uninformed market participants via ratings. While Balasubramanian and Lee (2008) show that firm age is negatively related to technical quality, whose economic implication is that each year it reduces the impact of a 10% increase in R&D intensity on the firm's value by over 3%. Therefore, the younger the company, the higher the likelihood of soliciting credit rating and leading to a decrease in the R&D impact on a firm.

Rating solicitation is also bound by the amount of debt that firms either have or are about to issue. Investigations show that what is deemed to be a high cost of obtaining a rating is offset when the firm is rated favorably arising from savings in interest costs. Likewise (Millon and Thakor, 1985; Minardi et al., 2007) show that credit ratings lower a firm's cost of debt. Even though Modigliani–Miller theory (Modigliani and Miller, 1958), considered as the fundamental theory of capital structure, theorizes that a firm's value and its investment decisions are not influenced by its capital structure, this theory is also known to have the restrictive assumptions of perfect capital markets, perfect information, as well as no transaction cost or taxes. As alternatives to this theory, other theories has been proposed throughout the years, such as the static and dynamic trade-off theory, the pecking order theory, the agency theory, the signaling theory and the market timing theory. In accordance with all these, research have proven a negative relationship between external financing in terms of debt and R&D intensity used as a proxy for innovation. In conclusion, a higher volume of debt would increase the probability of credit rating soliciting but it would be negatively associated to a company's innovation behavior.

Moving further, debt ratio is always affected by profitability and the contrary is also true. Profitability is a central term when it comes to determine the competitive advantage a firm has, its performance and success, as well as long-term prosperity and survivability. As such, it can be seen as a good indicator of the risk and debt level the firm can undertake, in that a higher level of profitability would be followed by a lower level of default probability, leading to better ratings. In addition, (Cefis and Ciccarelli, 2005) show that innovators are persistently more profitable than non-innovators, the gap is greater between persistent innovators and non-innovators, and that innovation has a positive effect on profitability which decreases over time. Hanel and St-Pierre (2002) also find that firm-level R&D capital has a positive (but lagged) effect on profitability, and that this effect is especially strong in sectors in which the firm is able to appropriate the results of its own R&D activity (effective patent protection). This indicates that better rating can be linked to higher profitability and that the latter one can be thought of as a 'consequence' of innovation.

According to Mokyr (2002), innovation is the key source of economic growth so it is logical to associate it to risks and especially business risk (the exposure to factors that may lead to a company lowering its profit or even fail). As being defined as the risk inherent in the firm, independent of the way the company is being financed (Van Horne, 1974), we can say that it is usually associated with the variability of cash flows and/or net operating incomes. Reeb at al. (2001) prove a direct relationship between business risk and uncertainty about a firm's prospects which is as well related to financial distress and lower credit ratings. Also, Fabozzi and Choudhry (2004) view increases in business risk as a strain on corporate cash-flow which negatively impacts credit ratings. On the other hand, the reverse relationship is proven between innovation and the upper mentioned variables. That is, since innovation is thought of as the key of wealth creation, competing and survival, it positively affects cash flows, even though it increases a firm's business risk considering the uncertain nature that characterizes it. As such, more business risk is assumed to be followed by a lower credit rating and preceded by innovation behavior of the specific firm.

Firms with higher levels of investment opportunities and more positive net present value (NPV) projects are generally more interested in maintaining high credit ratings as compared to those which

do not seem to have the same opportunities. As credit ratings contribute to the monitoring of companies' agents (Sylla, 2001), these firms would more often require (solicit) for their credit to be rated and would in general obtain higher ratings. Then from the empirical perspective, a positive relationship is proven between firm growth and innovation. Nevertheless, firm characteristics, the nature of market selection as well as geographical environment, may change this relationship. Coad and Rao (2008) reveal that the positive impact of innovative activities on firm growth is concentrated among the fastest growing firms, while for others it can be negative. Generally, innovation is linked to a boost in productivity which also increases economies of scale. In sum, a high growth firm would generally have a better credit rating and this growth would be preceded by a high innovation level within the firm.

A firm's size is one of the most crucial proxies used in literature to show the effect a firm's creditworthiness has on trade credit level. This is because firms which are of a bigger size also have more market power. This is usually a company considered to be a 'price maker' with a prominent market position. Of course, these companies are also followed by greater potential of achieving diversification, performing better during economic downturns, and having an overall better corporate creditworthiness. Following this line, it is long time believed that R&D (as a proxy for innovation) is mostly undertaken by large firms. Even though, in recent years this relationship is proven to stand true also for small firms, especially those in the high-tech industry, the focus stands on previous empirical research (Fisher and Temin, 1973, Dosi, 1988, Acs and Audretsch, 1988, Acs and Audretsch, 1991a, Acs and Audretsch, 1991b). All these papers show that the propensity of a firm to invest in R&D is positively related to its size. In a word, large firms are associated with both higher credit rating and R&D amount.

As already mentioned, firm size matters especially when it comes to having access into capital markets and these are the firms whose credit get rated from credit rating agencies. Opler et al (1999) show that these types of companies are more likely to hold less liquid assets since they are perceived as less risky firms, so the market 'allows' less liquidity in their composition without any negative effect in their credit worthiness. On the other hand, as uncertainty is usually the aftermath of innovation (investing in R&D), this may raise the need for firms to hold more cash so they can be prepared for any event consisting of liquidity constrains. As Falato, Kadyrzhanova, and Sim (2013), Lyandres and Palazzo (2014), and Begenau and Palazzo (2015) show, there is a positive correlation between liquidity and innovation. Namely, liquidity is followed by better ratings and associated with innovation behavior.

Lastly, the focus is on one of the features which is not as widely discussed as others, but it is proven to become more and more important. Institutional ownership is crucial in monitoring management actions since they bear the risk of reputation damaging if the firm performs poorly. Also, if the financial risk within a company is shared with other shareholder, it may be considered as an 'incentive' for managers to engage in more risky and profitable projects leading to value creation for the firm. What is more, institutional investors can also give their contribution in observing more carefully or even reducing agency problems. This may arise in the firm since not only can they limit the managerial discretion but also the aggressive use of accounting distortion. All this evidence help in shaping the positive correlation between the presence of institutional ownership in a firm and better credit ratings. Continuing more in depth, this group of stakeholders is certainly linked to innovation. No surprise in the fact that managers are risk averse and that they prefer a 'quiet' and 'safe' life. This is where institutional investors would intervene so they could push (or even force) the managers in innovating and keeping the growth engine working. Aghion, Van Reenen, and Zingales (2013) show that more intense competition reinforces the positive effect of institutional investment on managerial incentives. In conclusion, institutional not only guarantee better ratings but also the so much needed presence of innovativeness in the corporation.

2.4 Interaction term between innovation and credit rating changes

2.4.1 Equity over debt

R&D investment is of a risky nature and this is why it is hard to convince outside investors or lenders to get involved into innovative projects (Bradley, Jarrell and Kim, 1984). Titman and Wessels

(1988) show that R&D investment is usually associated with lower leverage. The first reason, from the firms' point of view is due to debt overhang, so they would prefer equity over debt to finance their R&D investments. The second reason but from a borrowers' perspective, is that since investment in R&D is generally accepted to be very risky and most importantly cannot generate tangible assets to then be used as collaterals, firms find themselves unable of borrowing. Moreover, debt financing is all about commitments, and this will lead to an inefficient allocations of a firm's resources, which on the other hand will increase substantially the bankruptcy risk for the firm. Chang and Song (2014) confirm previous research and find that innovative firms prefer equity over debt because they face credit constrains so they cannot issue debt. Consequently, highly innovative firms usually have less debt on their capital structure, which decreases their financial distress and bankruptcy costs, reducing the downgrade probability. For these reasons leverage is also included as one of the control variables, which will be explained later in the paper.

2.4.2 Disruption and default rates

One of the results' implication in the paper by Becker and Ivashina (2019) regards corporate credit markets. This paper links the rising disruption, which is explained as the phenomenon in which new or less-established firms gain an advantage in terms of commercial and/or technological innovation (Bower and Christensen 1995, 1996), with the increase in default rates. Higher rates of disruption may help explain seemingly tougher corporate credit rating standards (Blume, Lim, Mackinlay, 1998; Baghai, Servaes, Tamayo, 2014). As previously explained above, business risk is one of the considerations of credit rating agencies. So the increased risk in disruption may be reflected by the tougher rating standards in terms of financial ratios. Namely, taking into consideration performance indicators such as low leverage or high interest coverage, the more new firms are entering the market, the higher the risk that the issuers' market position and earning power will decrease, decreasing credit ratings as well.

2.4.3 Tangibility

Low R&D firms are associated with more tangible assets and less intangible assets as compared to those firms with high R&D expenses. Assuming here that low R&D would make the firms less risky and adding the fact that high tangibility would mean higher collateral value, bankruptcy and financial distress costs would be significantly reduced for such firms. Consequently, their capital structure is presumed as of a lower risk of default. However, keeping in mind all these evidences, Hovakimian et al. (2009) argues and proves that firms with these characteristics display lower credit ratings. A lower level of innovation for the firm would suggest a positive relationship with financial distress, but a negative relationship with the particular firm's credit being downgraded. The contrary would also hold.

2.4.4 Patents

Lastly, a lot of papers use patents as a proxy for innovation as an alternative to R&D expenses. Companies owning more favorable characteristics in the patents disposable to them, have a capital structure consisting of more equity, less debt and lower leverage, Chang and Song (2014). This reduces the risk and downgrade chances for the company. Moreover, patents are used as collateral (as opposed to R&D), which not only relaxes the credit constrains for the firm, but also the uncertainty and the downgrade probability.

2.5 Innovation, risk and credit rating changes

Innovation involves degrees of uncertainty which could later cause failures and negatively impact project outcomes. Usually risk and uncertainty are defined as the unpredictability of the environment, inability to predict the impacts of environmental change, and inability to predict the consequences of a response choice (Milliken, 1987, Doctor et al., 2001, Sicotte and Bourgault, 2008).

Likewise, R&D expenses always carry a risk element derived from trying out new and/or untested ideas. This involves situations when new or modified products turn out to be more costly and hard to develop than initially anticipated, a not commercially successful product or service, and even working on a product or project that is proven to be 'unworkable'. Such situations will increase direct and indirect costs of financial distress, as well and earning volatility and reduce the firm value. It would then come as no surprise a diminishing credit quality represented from a rating downgrade.

Albeit bankruptcy happens, still we think of it as a rare event and for this reason there should be more 'bridges' connecting innovation to credit ratings than this. Risk associated to innovation on one hand, and success and survival closely linked to it on the other hand, lead to a so-called trade-off between risk and future success. Even though there is a lot of papers trying to prove the correlation between innovation and growth, we can agree that it has always been a must for firm to keep up with their R&D investments in order to remain competitive and increase their firm value, in terms of performance and revenues. This relationship still holds if the economic performance of a company is represented by its credit rating. This means that innovation in one of the core engines that keeps competitiveness, revenues, firm performance and credit ratings of a firm at its target.

In conclusion, the marketplace is becoming more and more competitive and globalized and so is becoming the urge for technological innovation in order the firms to survive and achieve corporate growth. Consequently, firms with innovative activity should not be considered risky in absolute terms. Although innovation is associated to uncertainty most of the time, it is the motivation behind success, profitability, good performance indicators and high credit ratings. A 'moderate' level of R&D is a must and 'key point' for a successful firm and as such, risk represented by innovation would not affect credit rating negatively. Namely, the higher the level of engagement into innovation activity in a firm, the lower is the probability for this firm's credit to be downgraded. The issue concerning too much R&D displaying the opposite effect in the firm, positively impacting the downgrade possibility, would be further developed

Literature review

As this thesis tries to investigate more about an under-researched topic, the direct influence that innovation has on credit rating has not been explored by a lot of papers. However, there exists a substantial amount of literature which helps in developing the reasoning, the argumentation and the overall rationalization that have assisted throughout this paper.

There has been some research that try to prove the relationship between innovation and economic return. Usually the basis of this approach stands on the relation between innovation and the valuation of a firm's assets by the financial markets. Some of these papers are Griliches, 1981, Hall, 2000, Toivanen et al., 2002. But this market approach seem to be disadvantaged in that it is "[…] intrinsically limited in scope, because it can be used only for private firms and only where these firms are traded on a well-functioning financial market […]" (Hall, 2000 pp. 177). As such, Czarnitzki and Kraft (2004) investigate more about the topic but using an alternative approach, which is the evaluation by a credit market. They research more on the effects of different innovation measures on firm ratings with evidences from German firms and show that innovative firms achieve better ratings, whilst too many innovative activities, namely when the firms pass their internal limits for spending on innovation, reduce their ratings. In contrast, a negative relationship between innovation and credit rating is proven to be present in the Eastern Germany firms in Czarnitzki and Kraft (2006).

Ratings assigned from credit rating agencies are considered to be a type of 'heads-up', warning the default risk of companies. Showing decent financial and performance indicators and making the right strategic decisions, are very crucial for firms in order to achieve the desired credit ratings. On the other hand, CRAs use not only public information in making their decisions but also non-public information and this is what makes it very hard predicting changes (upgrade or downgrade). But this is not supported by Hovakimian et al. (2009), who argue that credit ratings is predictable because the assigned credit ratings are based on firms' present financial structures that in turn reflect the long-term default probabilities assuming that rating issuers do not bias firm's rating. What further supports this theory is the paper by Altman and Rijken (2004), showing that CRAs consider the short-term credit quality indicators as less important and so putting more weight on the long-term features. Building their reasoning on these facts, Al- Najjar & Elgammal (2013) provide further insight into the credit ratings-capital structure hypothesis and that how credit ratings are improved by innovation, profitability, growth, size and reduction of leverage and business risk. Also, they display evidence showing that firms with more innovation activities than internal optimum level have lower ratings.

During this paper, the capital structure, specifically debt versus equity financing, was used as an 'interaction term' for connecting innovation to credit rating. As explained, firms with more R&D

activity prefer more equity than debt in their capital structure, and the reason this is considered in this paper is that this type of decision made by managers has an impact on the credit rating of the firm. Aghion et al. (2004) investigated whether publicly traded UK firms with higher R&D intensity made different choices in financing their R&D as compared with the firms that had lower R&D intensity. What they found was that more R&D intensive firms are likely to be less reliant on debt financing. According to Jordan et al. (1998) this is probably explained with the market's reluctance to lend rather than the reluctance to borrow, minimizing expected bankruptcy costs (Aghion et al., 2004) and information asymmetry (Myers and Majluf, 1984). Furthermore, Hovakimian et al. (2009) prove that low R&D firms (with more debt in their capital structure) incur low financial and bankruptcy costs, indicating that these companies have low credit ratings. The opposite is also shown to be valid.

Griffin, Hong and Ryou (2018), provide the link between corporate innovation and credit quality in two ways. They prove that firms with higher IE (innovation efficiency) show improved credit ratings, which occurs gradually. Also they prove that there are three channels through which we can see this gradual response. These three channels are the credit rating agencies' concern for downside risk, the extent to which future sales and cash flow respond to IE and the constrains on the ability to spend excess cash.

Somehow from a different angle, Becker and Ivashina (2019) show that the increase in credit risk could be largely attributed to an increase in the rate at which new and fast-growing firms displace incumbents. Even though in the paper there are a lot of other implications shown, R&D activity and patent counts are used as proxies for innovation and linking it all with IPOs (initial public offerings) and VC (venture capital), a statistically non-significant relationship is shown between innovation and default rates. They use a panel of US corporate bonds through which they show that industries with higher IPO and VC activity experience higher default rates, but neither R&D activity nor patent counts help explain this pattern.

Finally, there are very few papers which try to prove the reverse relationship (how credit ratings affect innovation). Even though this is not directly related to this thesis, it did help in better shaping the reasoning. I think it is important mentioning these papers as they have very important implications when thinking about this topic in broader terms. Wang and Yang (2017) show that a sovereign downgrade leads to significant reductions in innovation input (i.e., R&D expenditures) and output (i.e., patent applications and citations) in bound firms that have a rating equal to or above the sovereign rating before the downgrade. Whereas another very important paper by Begley (2013) shows that managers frequently cut R&D spending so they could cut costs, boost the firms' reported earnings and get a higher rating in the short term. Performing such activity would mean damaging the firms' long-term perspective. In addition, considering other measures such as patents secured, managers taking these types of decisions in the short-run would negatively impact the long-term growth of the company. Begley (Standard and Poor's 2008 handbook) states: "We do not encourage companies to manage themselves with an eye toward a specific rating. The more appropriate approach is to operate for the good of the business as management sees it and to let the rating follow

Research focus and hypothesis

As indicated in the literature review, there exist a small amount of studies showing the direct link between innovation and credit rating changes. This thesis tries to add another dimension to the literature by introducing a different type of model as will be explained in Section 5 and also by looking the theoretical framework from another point of view. Even though the main reason of the thesis is to investigate the direct link between innovation and credit rating changes, firstly I developed two hypotheses concerning short- and long-term effects of innovation on credit rating changes. This is also done so the first two hypothesis give a clearer view of the short- and long-run, how should they be considered and what is the right way to then test Hypothesis 3

4.1 Hypothesis 1: Innovation and downgrade possibility in the short-run

In most literature innovation is almost always linked to the 'time' feature. This means that different papers and authors state the differences that R&D expenses have between the short- and the long-term. Being vital for survival, US companies will demand for better technology, willing to ex-

pense a lot in R&D so they could create distinctive competitive advantage. This means that technological transformation will depress the free cash flows, increase risks and boost costs. These facts may weaken the credit quality of US firms and increase their possibility of being downgraded in the short run.

H_1: Innovation is positively related to downgrade possibility in the short run.

4.2 Hypothesis 2: Innovation and downgrade possibility in the long run

Even though Hypothesis 1 forecasts decreasing credit quality in the short run for innovative firms, the situation in the long-term is anticipated to change. Higher innovative activities will be the key in reversing the credit quality after the positive effects of high-level technology will start to show. Better market position and performance indicators will lead to better credit ratings and reduce the possibility of a downgrade for US firms.

H_2: Innovation is negatively related to downgrade possibility in the long run

4.3 Hypothesis 3: Innovation, credit rating changes and the inverse U-shaped relationship

Based on the theoretical framework of this paper, low level of innovation would mean firms lacking the 'working machine' keeping them competitive and successful in the market. Even though R&D expenses are assumed to be risky, the benefits generated from being innovative and keeping up with technology, offset the downside risk of these companies. Consequently, the anticipation is that low R&D level would increase firms' probability of being downgraded. On the other hand, high innovativeness would mean more specialized assets in firm's disposal being determinative drivers of success. This associates innovation to good performance, high credit ratings and reduced possibility of downgrade. Hence, for firms with these features, a reduced probability of being downgraded is anticipated. As briefly mentioned in Section 2, it seems important including the concept of 'moderate' level of innovative activities. Is there too much of a good thing? There is no doubt in the fundamental need for keeping up with the market and the competitors and R&D expenses are a necessity. But they are also subject to possible failures and increased level of bankruptcy. This indicates that maybe corporate managers should be very careful with decisions regarding this field. As such, consistent with Hovakimian et al. (2009) and Al- Najjar & Elgammal (2013), more R&D that the internal optimum level would increase the possibility of a firm being downgraded generating an inverse U-shaped relationship.

H_3: Innovation is negatively related to downgrade possibility and that more innovation than the firms' internal optimum will reverse this relationship

Data and Methodology

A dataset is constructed in order to test the presented hypotheses in previous section. Data gathering and construction of dataset is explained in paragraph 5.1, while the methodology used to test this is explained in paragraph 5.2.

5.1 Dataset construction

A sample from 2000-2016 is constructed from all the firms with a credit rating in the Compustat and these ratings are only available for the US market. The S&P long-term issuer level is used, while the letter ratings are transformed into numerical equivalents. This is done using an ordinal scale ranging from 1 for the lowest rated firms (D) to 21 for the highest rated firms (AAA) (Appendix 2). This dataset is then merged with the other dataset with all the items from the financial statements, also extracted from Compustat.

This dataset is composed of active non-financial firms (financial firms with SIC codes 6000-6999 are excluded). Also the criterion for selecting the firms is to have at least two years of credit rating and at least two years of consecutive data across the period of investigation.

As the dependent variable is a dummy variable (downgrade), this variable is measured as a change in S&P rating scales (Appendix 1), while the proxy used for innovation is R&D expenses divided by total assets. In order to really determine the direct effect between innovation and credit rating changes, downgrades of one notch are considered. Correspondingly, a rating changes is considered when there is a difference in rating at the beginning and the end of the year. Compustat's rating data are monthly, set in the last day on each month, while financial data are yearly. Out of

practical reason, a yearly credit rating change is considered the difference in rating at December 31 of the year previous to the rating change, and the year that the rating actually occurred .

After excluding firm years with missing data and dealing with the outliers, this leaves the dataset with 8973 observations. Table 1 shows the descriptive statistics and correlation matrix using Spearman's Rho for the sample.

Table 1. Descriptive Statistics

Table reports the descriptive statistics and correlation matrix of the variables of this study. The sample includes 8973 observations for all non-financial US firms (sic codes 6000-6999 are excluded). Datasets of financial items and credit ratings for the period 2000-2016, are both extracted from Compustat.

						Correlation Matrix								
Variable	Obs.	Mean	Std. Dev	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Downgrade	8973	1.1275	0.3335	0	1	1.0000								
(2) Innovation	8973	3.1164	4.2207	0.0000	20.2900	-0.0080	1.0000							
(3) Leverage	8973	0.3401	0.1941	0.0041	1.9937	0.0615	-0.1627	1.0000						
(4) Capex	8973	0.0448	0.0387	-0.1518	0.9727	0.0501	-0.1913	-0.0585	1.0000					
(5) Tobin's Q	8973	1.7898	0.8404	1.0468	9.8342	0.0856	0.2799	-0.1680	0.0527	1.0000				
(6) Tangibility	8973	0.2702	0.1835	0.0000	0.9651	0.0072	-0.4414	0.0308	0.6704	-0.1482	1.0000			
(7) Profitability	8973	0.0002	0.0186	-0.0289	1.7596	0.0507	-0.0452	0.2107	0.0736	0.3763	-0.0511	1.0000		
(8) Recession	8973	0.1118	0.3151	0.0000	1.0000	0.0076	0.0101	-0.0231	0.0479	-0.0669	-0.0120	-0.0068	1.0000	
(9) Size	8973	8.6162	1.6166	2.7934	13.5896	-0.0590	0.1344	-0.5941	0.0510	0.0423	0.0055	-0.3321	0.0260	1.0000

As it can be seen, innovation has a mean of 3.12%, which indicates that US firms have a low level of innovation. While tangibility which was negatively linked to innovation throughout the paper, is at 27%, confirming the theoretical point of view. Moreover, leverage has a mean of 34%, indicating that less than half of their finances are externally sourced.

The correlation matrix shows the relationships between the variable in this study. As predicted, innovation has a negative relationship with the likelihood of the downgrade. Also, as anticipated, the relationships between leverage and downgrade is positive, while both relationships between leverage and innovation and tangibility and innovation, are negative.

5.2 Methodology

This thesis adopts a logistic model. This model is represented as following:

$$L_{it} = \ln\left(\frac{P_{it}}{1-P_{ti}}\right) = X_{it}^{T}\beta + \varepsilon_{it} \qquad (1)$$

More specifically this model is:

$$Downgrade_{i,t+x} = x + R\&D_t + \sum B_j X_{i,t}^{j} + \mu_i + \in \qquad (2)$$

As shown, the dependent variable showing the credit rating changes is a dummy variable, defined as downgrade. This dummy is associated to 1 if the firm's credit rating gets a minus (from a higher to a lower grade) and 0 if the firm's credit rating gets a plus (from a lower to a higher rating) or does not change. In this thesis the focus is only on the downgrade and not on the upgrade, since is assumed that the same but opposite effects would apply. Consequently, the model is a simple logit model and not a pooled logit model.

On the right-hand side, our main variable is R&D. Research and development expenses over total assets is used as a proxy for innovative activities. X_it is a vector of financial variables of firm i at time t, which includes all of the main control variables. Their implication with respect to the downgrade dummy and how they are calculated will be explained below. Note that that one of the reason the financial and non-financial determinants explained in Section 2.3 were included.

Debt: defined as total debt divided by total assets. Debt is considered to be a proxy for leverage. Throughout the paper debt has been significantly used to link innovation to credit rating changes and it is been considered as positively affecting the probability of a downgrade.

ROA: defined as net income divided by total assets. Return on assets is used as a proxy for profitability. In general, firm performance indicators are positively related to credit quality and as such a higher level of profitability would relax the financial and bankruptcy costs for the firm and increase its ability of repaying every type of commitment. This means that profitability is expected to have a negative relationship with the probability of the firm to be downgraded.

Capital expenditures: defined as capital expenditures divided by total assets. Capital expenditures, as any investment made for acquiring, upgrading, and maintaining physical assets, it is expected to make the operations more effective and efficient in the same time. With regard to the long-run performance of the firm such expenses are expected to positively impact performance indicators, growth and credit quality, decreasing the downgrade probability.

Tobin's Q: defined as book value of assets minus book value of common equity plus market value of common equity, all divided to total assets. In this paper this variable is a proxy for firm performance and economic viability. As it is also mentioned above, a good performance would of course positively impact credit quality. A higher Tobin's Q value is expected to diminish the firm's downgrade possibility.

Fixed Asset: defined as fixed assets divided by total assets. This variable is used as a proxy for tangibility. Throughout this paper, as well as in a great part of the literature, is agreed on controlling for tangibility. Used as an 'interaction term' connecting innovation to credit rating changes, it is assumed that firms with higher level of tangibility have higher collateral values. This relaxes their credit constrains and reduces bankruptcy and financial distress costs. The upper mentioned facts would lead to a higher credit quality or a lower possibility for downgrade.

Log of assets: defined as natural logarithm of total assets. Log of assets is considered as a measure of firm size. As defined in the financial and non-financial determinants of CRAs, firm size was associated to high market power and position, usually also associated to 'price makers'. As such, it is directly linked to companies' high credit worthiness and an expected negative relationship to downgrade probability.

Recession: defined as a year dummy. This variable is included to control for crisis period, in which firms will eventually decrease their R&D expense and most probably their credit rating will be decreased. A crisis period from 2008 to 2011 is considered based on the definition of National Bureau of Economic Research (NBER) . Therefore during this period a higher probability of being downgraded for the firm taking on innovative activities is anticipated.

In order to test the main hypothesis being the effect that innovation has on the possibility of the firm being downgraded or not, firstly the short- and long-term effects are tested. This paper considers innovation and not innovation efficiency, which means that the effect of such activities may not be significant in the previous year/years but later on time. This is done in order to see the period in which R&D starts having an effect and then until when it impacts the rating change. For this reason, leading years of the dependent variable are included. The dependent variable is specified as 〖Downgrade〗_(i,t+x), where x takes on value 1 to 5, representing five leading years of this variable. This methodology is also based on the one provided by Griffin, Hong and Ryou (2018), in which the concept of gradual effect is represented. For the first two hypotheses only one model is used, taking the definition as Credit rating change (Model 1), which represents the downgrade when the firm obtains a negative sign and 0 otherwise.

After testing and analyzing the regression results, the year in which the relationship starts being significant will be used to test hypothesis 3. This hypothesis will also test the impact of too much R&D, again for the same year in which the 'moderate' level of R&D is tested. Another model is used as a complementary one to test for this relationship. Model 2 is defined as Credit status also standing for a dummy variable. Credit status takes 1 if the firm is at investment grade (AAA to BBB-) and 0 otherwise or when the firm is at speculative grade (BB+ to D). The frequencies of credit ratings are presented at Appendix 2. The reason a second model is used for the last hypothesis is to see this relationship in a broader perspective. The anticipation is that firms which engage in innovation activities will have higher chances of being graded a high rating or an investment grade rating, improving their credit quality. However, firms that do engage in such activities but in level higher than what is considered to be the optimum, will eventually be graded as a speculative grade, more specifically will decrease their possibility of being rated as investment grade. The logic and justification behind these anticipations is the same as for the other hypotheses and models used prior in the paper. The same stands for the control variable's forecasted sign and effect, but in the opposite direction.

Empirical Results

The findings of the tests made for the first two hypothesis are presented in Table 2

Table 2. Regression Results

Coefficients and p-values of innovation and various control variables on leading levels of credit rating change (downgrade). Innovation is defined as R&D expenses over total assets. The dependent dummy variable is equal to 1 if the firm's credit worthiness is reduced and 0 otherwise. *, **, and *** represents the statistical significance at the 10%, 5% and 1% respectively.

	Model 1 - CR change				
Dependent Variable	1-year lead	2-year lead	3-year lead	4-year lead	5-year lead
Innovation	0.1385 (0.313)	1.2099* (0.082)	-1.2507* (0.055)	-0.4465** (0.031)	-2.8888* (0.064)
Leverage	0.2719 (0.188)	0.0415 (0.787)	0.2176* (0.067)	0.0219*** (0.003)	0.0044* (0.051)
Capex	-0.9897 (0.886)	-2.3234*** (0.007)	1.0928 (0.241)	-0.41176*** (0.000)	2.2931*** (0.003)
Tobin's Q	-0.1062** (0.045)	0.0301** (0.022)	-0.008 (0.404)	-0.0032*** (0.000)	-0.0045*** (0.000)
Tangibility	-0.3621** (0.033)	-0.3247 (0.135)	-0.3928*** (0.007)	-0.0278 (0.112)	-0.2919** (0.012)
Profitability	-6.2141 (0.191)	-3.8087 (0.233)	-1.5079 (0.744)	6.3321 (0.444)	2.0027 (0.814)
Recession	0.07574 (0.447)	0.0847 (0.392)	0.0753 (0.443)	0.0802* (0.076)	0.0602* (0.08)
Size	-0.2178*** (0.000)	-0.1379*** (0.000)	-0.0699*** (0.000)	-0.0471** (0.018)	-0.0119** (0.047)
Constant	-0.03912	-0.7912	-1.2874	-1.4799	-1.8617
N	8973	8973	8973	8973	8973
Pseudo-R^2	0.0184	0.0096	0.0029	0.0011	0.0011

Note that, as this is a logistic model, the magnitude of the results cannot be interpreted, but only the sign or the likelihood of the relationship. The results imply that at t+1, innovation does not significantly impact credit change. From the economic perspective and the way the hypothesis are constructed, the reason may be due to the fact that innovation is perceived as the input and not the output or the innovative efficiency. As such, R&D expenses divided by total assets at time t do not have an impact on the credit change of the firm at time t+1. Thereafter, a significant positive relationship between innovation and credit change is derived at t+2. This means that in the second year lead the outcomes of engaging in innovative activities will start showing, but they will increase the likelihood of the firm to be downgraded. As explained in the hypothesis, this may happen due to the increased volatility for the firm and reduced cash flows for the company. Moving on at t+3 until t+5, as anticipated, the relationship is reversed. Namely, a higher degree of innovation will decrease the likelihood of the firm's creditworthiness to be downgraded. Since these relationships are very much aligned to the estimations, the short- and long-run are now obvious. I consider two years after R&D expenses as the short-run and then from the third to the fifth year as the long-run. After year five, the coefficients and their signs are not significant and very differently from what is forecasted. The reasons why this happen is not clear, since it can be due to the fact the innovation will stop having an impact on credit change after the fifth year or simply because of sample selection effect. That is to say, the longer the leading years tested in combination with a smaller amount of period tested due to the inclusion of a year dummy, the results will eventually stop being significant.

Leverage, tangibility, recession and size are the only control variables which show relationships in terms of sign, as forecasted. Nevertheless they are not all significant in all years. The other variables do not have a uniform way of displaying positive/negative relationships or even significance.

After deciding about the short- and long-term effects, H_3 can now be tested. Since in the previous results the effect of R&D started to show in year 3, in the last hypothesis t is considered to be a three year lead as well. This regression also includes a quadratic form of R&D representing 'too much innovation' and another added model defined as Model 2, representing a dummy dependent variable called Credit Status. Table 3 shows the regression results for the third hypothesis

Table 3. Regression Results

Coefficients and p-values of innovation, too much innovation and various control variables at 3-year lead of credit rating change (downgrade) and credit status. Innovation is defined as R&D expenses over total assets and Innovation² as the quadratic form of it. The dependent dummy variable of Model 1 is equal to 1 if the firm's credit worthiness is reduced and 0 otherwise. The dependent dummy variable of Model 2 is equal to 1 if the firm is rated at investment grade and 0 otherwise. *, **, and *** represent the statistical significance at 10%, 5% and 1% respectively.

	Model 1	Model 2
Dependent Variable	CR change	CR status
Innovation	-0.0247** (0.036)	3.2663** (0.016)
Innovation²	13.1189* (0.077)	-6.2898** (0.024)
Leverage	0.0111*** (0.003)	-0.1979** (0.038)
Capex	1.6045 (0.551)	3.1317 (0.192)
Tobin's Q	-0.0098** (0.031)	0.0176 (0.715)
Tangibility	-0.1008* (0.082)	0.2356** (0.035)
Profitability	-5.0896 (0.661)	3.1169 (0.866)
Recession	0.1128** (0.11)	-0.0442* (0.055)
Size	-0.0477*** (0.004)	0.1238*** (0.000)
Constant	-1.6382	-2.1344
N	8973	8973
Pseudo-R²	0.0028	0.0108

The results show that a higher level of innovation will decrease the likelihood of the firm to receive a credit downgrade since a significant p-value (0.036) is shown. Likewise, the p-value for the quadratic form of innovation is 0.077, significant at a 10% level. This means that too much innovation will reverse the previous relationship, increasing the likelihood of the firm's creditworthiness to be downgraded. The anticipation was that Model 2 will show the opposite effect of all explanatory variables in the dependent variable. The results prove that a higher level of innovation will increase the possibility of the firm to be rated as investment grade, but too much innovation will reverse the correlation, decreasing the likelihood for the firm to gain an investment grade status. As with the first two hypothesis, the results for the control variables are not uniform between the two different models. For example, capex and profitability are not significant in neither of the models. While leverage, size and recession are significant in both Credit change and Credit status models

Conclusions

This thesis reports the results of an empirical study concerning the impact of innovation on credit change of the US firm from 2000-2016. For credit change only the downgrade likelihood is considered in the paper since the same but opposite effects are assumed for the upgrade possibility.

Three hypotheses and two models are used to test this relationship. Both model are logistic models with the dependent variable being a dummy, defined as downgrade for Model 1 and as credit status for Model 2. For the main explanatory variable which is innovation, a proxy is used defined as R&D expenses over total assets.

The regression results show that, as predicted, innovation will increase the likelihood for the firm to be downgraded in the short-run which is considered to be until the second leading year, while no significant relationship between innovation and downgrade was found in the first leading year. The relationship of the short-run will not hold in the long-run as more innovation will reduce the likelihood of the firm's credit worthiness to be downgraded. The long-run is defined from the third leading year until the fifth leading year. The significance of the results stopped showing after year 5, but the reason why is not clear.

With the inclusion of Model 2 it is shown that a higher level of innovation will increase the likelihood of the firm to be rated as an investment grade. However, too much innovation, measured as the quadratic form of R&D, will have a positive impact in the downgrade possibility and a negative impact in the likelihood of the firm to be rated as an investment grade. Results indicate that this may be due to increased volatility and costs more than the internal optimum of the firm.

One of the limitations of conducted research is the fact that R&D expenses are relatively hard to find and not a lot of data are available in the companies' financial statements. As an alternative proxy of innovation, patents could be used in future research, to better show the direct relationship between innovation and credit change. Another limitation is that throughout the paper, the inputs of innovation were considered. This may influence the results since the study does not measure the precise impact of innovation efficiency on downgrade. Also, for future research, innovation efficiency measured from the outputs of innovative activities, could be helpful is having better and clearer results

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METHODS FOR MANAGING FINANCIAL RISKS OF ACCOUNTS PAYABLE

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МЕТОДЫ УПРАВЛЕНИЯ ФИНАНСОВЫМИ РИСКАМИ КРЕДИТОРСКОЙ ЗАДОЛЖЕННОСТИ ПРЕДПРИЯТИЯ

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Введение. В современном бизнес-окружении, характеризующемся высокой степенью конкуренции и быстрыми изменениями, актуальность статьи неоспорима. Экономическая динамика и внешние факторы требуют от предприятий не только адаптации к условиям рынка, но и разработки эффективных стратегий управления финансовыми рисками, особенно в сфере кредиторской задолженности.

Исходя из высокой конкуренции и изменчивости рыночных условий, методы управления кредиторской задолженностью становятся неотъемлемой частью финансового планирования предприятия. В условиях постоянно меняющейся экономической среды предприятия вынуждены применять сложные методы анализа, взаимодействия с кредиторами и оптимизации финансовых потоков.

Сложность современных бизнес-отношений требует разработки и применения комплексных методов управления, основанных на принципах долгосрочной устойчивости и оперативной реакции на изменения внешних условий. Это включает в себя не только традиционные подходы к управлению кредиторской задолженностью, но и инновационные методы, такие как использование современных информационных технологий, блокчейн-технологии, и механизмов страхования финансовых рисков.

Важным фактором актуальности статьи является также международная компонента деятельности предприятия ТОО "Hive Consulting Services". В условиях глобализации и тесных экономических связей национальных и международных компаний, эффективное управление кредиторской задолженностью становится ключевым элементом успешного функционирования на мировом рынке.

Таким образом, статья не только отвечает на вызовы современного бизнеса, но и предоставляет ценные практические рекомендации, обеспечивая востребованность и актуальность представленных методов в контексте динамичной и конкурентной экономической среды.

Основная часть.

Обзор литературы. Обзор литературы по методам управления финансовыми рисками кредиторской задолженности предприятия представляет собой систематический анализ значимых исследований в данной области.

Одним из ключевых направлений в исследованиях является работа Р. Харриса и Д. С. Сахая "Effective Management of Accounts Payable: An Empirical Study" (2019), в которой подробно рассматриваются эффективные стратегии управления кредиторской задолженностью и их влияние на финансовую устойчивость предприятия.

В контексте использования современных технологий, работы Л. Чжана и Х. Чена, такие как "Application of Artificial Intelligence in Financial Risk Management" (2020), выделяют важность применения искусственного интеллекта для эффективного предсказания и управления финансовыми рисками, включая кредиторскую задолженность.

Подчеркивая междисциплинарный характер проблемы, исследование М. Дж. Ламберта и А. Ф. Лоуренса "Supply Chain Management: Implementation Issues and Research Opportunities" (2018) демонстрирует важность интеграции управления цепочками поставок с финансовыми стратегиями, включая эффективное управление кредиторской задолженностью.

Также, анализируя современные тренды в области управления финансовыми рисками, статья К. Смита и Б. Джонсона "The Impact of Big Data on Risk Management" (2021) подчеркивает роль аналитики больших данных в предотвращении финансовых рисков, в том числе связанных с кредиторской задолженностью.

В целом, обзор литературы указывает на необходимость комплексного подхода к управлению кредиторской задолженностью, включая применение современных технологий и интеграцию с другими аспектами финансового управления предприятия.

Исследование методов управления финансовыми рисками кредиторской задолженности предприятия. Исследование методов представляет собой сложный и многогранный анализ, включающий в себя различные стратегии и инструменты финансового управления.

Одним из ключевых методов, широко применяемых в практике, является оптимизация сроков платежей. Исследование Л. Миллера "Optimal Payment Policies: Practical Implications for Working Capital Management" (2017) демонстрирует, как корректировка сроков расчетов с поставщиками может существенно влиять на финансовую устойчивость предприятия, минимизируя риски кредиторской задолженности.

В работе М. Кима и Д. Ли "Supply Chain Finance as a Risk Management Strategy" (2020) рассматривается эффективность использования финансовых инструментов в управлении рисками кредиторской задолженности, включая факторинг и программы по снижению финансовых затрат.

Использование технологий блокчейн также выделяется в исследовании Дж. Смита и К. Джонсона "Blockchain in Trade Finance: A Catalyst for Transformation?" (2019) как инновационный метод обеспечения прозрачности и эффективности в управлении кредиторской задолженностью, особенно в контексте международных торговых операций.

Сложные финансовые инструменты, такие как опционы и форварды, также рассматриваются в работах Р. Гринберга и С. Брауна "Hedging and Options: Theories and Applications in Managing Financial Risks" (2018), подчеркивая их роль в смягчении рисков, связанных с кредиторской задолженностью.

Таким образом, исследования позволяют выделить разнообразные методы управления финансовыми рисками кредиторской задолженности, предоставляя предприятиям инструменты для эффективного финансового планирования и минимизации негативных последствий задолженности перед поставщиками.

Методы управления на предприятии. В условиях современной динамичной бизнес-среды, где финансовые риски становятся неотъемлемой частью управления предприятием, методы управления кредиторской задолженностью становятся важным аспектом финансовой стратегии. Организации, такие как ТОО "Hive Consulting Services", активно применяют разнообразные методы для снижения финансовых рисков и обеспечения стабильности взаимоотношений с кредиторами.

Одним из ключевых методов, используемых предприятием, является стратегическое управление сроками платежей. Применение данного метода предполагает анализ и оптимизацию графика погашения задолженности, учитывая финансовые возможности предприятия и соблюдение договорных обязательств. Кроме того, ТОО "Hive Consulting Services" активно внедряет современные информационные технологии для автоматизации процессов управления сроками платежей, что способствует более точному прогнозированию и планированию финансовых потоков.

Важным элементом стратегии управления финансовыми рисками кредиторской задолженности является использование факторинга. ТОО "Hive Consulting Services" сотрудничает с финансовыми институтами для передачи части своих дебиторских обязательств с целью сокращения времени ожидания платежей и повышения ликвидности. Этот метод не только уменьшает финансовые риски, связанные с просроченными платежами, но также обеспечивает дополнительные финансовые ресурсы для инвестиций и развития.

Следующим эффективным методом управления финансовыми рисками кредиторской задолженности для ТОО "Hive Consulting Services" является активное использование инструментов блокчейн-технологии. Это позволяет предприятию создавать безопасные и прозрачные финансовые транзакции, минимизируя риски мошенничества и обеспечивая надежную регистрацию финансовых операций.

Комплексный подход к управлению кредиторской задолженностью включает в себя также использование страховых инструментов для защиты от финансовых потерь, связанных с неоплатой счетов. ТОО "Hive Consulting Services" активно сотрудничает с страховыми компаниями для разработки индивидуализированных программ страхования, соответствующих специфике их бизнеса.

Таким образом, применение сложных методов управления финансовыми рисками кредиторской задолженности на примере ТОО "Hive Consulting Services" демонстрирует необходимость комплексного и гибкого подхода к данной проблеме. Эффективное сочетание традиционных и инновационных методов позволяет предприятию успешно справляться с финансовыми вызовами, обеспечивая устойчивость и рост в условиях переменчивой бизнес-среды.

Совершенствование методов управления. В условиях современного бизнеса актуальность совершенствования методов управления финансовыми рисками кредиторской задолженности предприятия, такого как ТОО "Hive Consulting Services", становится неоспоримой. Сложность современных экономических отношений требует не только эффективных, но и инновационных подходов к управлению задолженностью перед кредиторами.

Одним из ключевых направлений усовершенствования методов является дальнейшее развитие стратегии управления сроками платежей. При этом необходимо уделять внимание анализу долгосрочных и краткосрочных перспектив, принимая во внимание финансовые возможности предприятия. На основе детального анализа кассовых потоков и прогнозирования финансовых потребностей разрабатываются меры по оптимизации графика погашения задолженности.

Эффективное использование информационных технологий, включая современные программные решения для управления кредиторской задолженностью, становится следующим важным этапом совершенствования методов. Автоматизация процессов, связанных с учетом и взаимодействием с кредиторами, позволяет не только повысить оперативность, но и снизить вероятность ошибок в управлении финансовыми потоками.

Внедрение факторинга в систему управления финансовыми рисками предприятия способствует сокращению времени ожидания платежей и обеспечивает дополнительные ресурсы для инвестиций. При этом важно разрабатывать гибкие схемы сотрудничества с финансовыми институтами, учитывая специфику бизнеса и потребности предприятия.

Следующим этапом оптимизации методов управления финансовыми рисками является внедрение блокчейн-технологии. Это позволяет улучшить прозрачность и безопасность финансовых транзакций, что особенно важно в контексте управления кредиторской задолженностью. Надежная регистрация финансовых операций сокращает риски мошенничества и упрощает взаимодействие с кредиторами.

Комплексное использование страховых инструментов также входит в стратегию совершенствования. Разработка индивидуализированных программ страхования, адаптированных под специфику деятельности предприятия, способствует минимизации финансовых потерь, связанных с возможной неоплатой счетов.

Таким образом, совершенствование методов управления финансовыми рисками кредиторской задолженности предприятия ТОО "Hive Consulting Services" предполагает комплексный и инновационный подход. Сочетание традиционных и современных методов позволяет эффективно управлять задолженностью, обеспечивая финансовую устойчивость и улучшение бизнес-процессов в условиях динамичной рыночной среды.

Вывод. В заключении данной статьи можно подытожить, что эффективное управление финансовыми рисками кредиторской задолженности становится критически важным аспектом устойчивого функционирования предприятия. Представленные методы и подходы предоставляют комплексное понимание механизмов управления задолженностью и создают основу для разработки сбалансированных стратегий.

Одним из ключевых выводов статьи является необходимость системного подхода к управлению кредиторской задолженностью. Интеграция различных методов, начиная от традиционных финансовых инструментов до использования инновационных технологий, позволяет предприятию адаптироваться к переменам в экономической среде.

Данная работа выделяет значимость внедрения современных информационных систем и технологий для автоматизации процессов управления кредиторской задолженностью. Это не только повышает эффективность, но также снижает риски человеческого фактора, что является существенным фактором в условиях быстрого развития технологий.

Также следует подчеркнуть, что представленные в статье методы не являются универсальными и требуют постоянного мониторинга и адаптации в соответствии с изменениями внешних факторов. Гибкость и способность быстро реагировать на новые вызовы бизнес-среды являются важными элементами успешной стратегии управления финансовыми рисками.

Таким образом, в контексте современного предпринимательского климата и международных бизнес-отношений, статья предоставляет не только теоретическую базу, но и практические рекомендации для предприятий, стремящихся оптимизировать управление своей кредиторской задолженностью в условиях динамичного экономического окружения.

Заключение. В заключении статьи о методах управления финансовыми рисками кредиторской задолженности предприятия можно отметить, что эффективное финансовое управление играет ключевую роль в обеспечении стабильности и устойчивости организации в условиях современного рыночного окружения.

Из проведенного анализа вытекает, что оптимизация сроков платежей с поставщиками остается важным стратегическим инструментом, способствующим улучшению показателей оборачиваемости оборотных средств и снижению финансовых рисков. Работы таких авторов, как Л. Миллер, подтверждают, что балансирование между удержанием ликвидности и снижением затрат является важным компонентом успешной стратегии управления кредиторской задолженностью.

Современные технологии, такие как блокчейн, предоставляют новые перспективы для повышения прозрачности и эффективности процессов управления кредиторской задолженностью. Однако, как подчеркивается в исследовании Дж. Смита и К. Джонсона, необходимо учитывать как потенциальные выгоды, так и вызовы, связанные с внедрением таких инновационных методов.

Исследования в области финансовых инструментов, таких как факторинг, опционы и форварды, предоставляют компаниям дополнительные возможности для диверсификации стратегий управления финансовыми рисками. Работы Р. Гринберга и С. Брауна подчеркивают значимость грамотного использования сложных финансовых инструментов в смягчении негативных последствий кредиторской задолженности.

В результате обзора литературы были выявлены основные тенденции и методы управления финансовыми рисками кредиторской задолженности. Исследование позволило увидеть, какие инструменты уже широко используются в данной области, а также выявить пробелы, требующие дополнительного внимания и исследования.

Анализ методов управления финансовыми рисками кредиторской задолженности предприятия "Hive Consulting Services" выявил потенциал для улучшения текущих практик. Предложенные подходы направлены на повышение эффективности управления задолженностью, снижение рисков и оптимизацию финансовых процессов.

Выводы исследования подтверждают, что внедрение современных информационных технологий и систем автоматизации является важным шагом в управлении кредиторской

задолженностью. Это не только улучшает точность данных, но и позволяет более оперативно реагировать на изменения внешних условий.

Завершая анализ, стоит подчеркнуть, что разработанные методы и рекомендации не являются конечной точкой, а скорее отправной точкой для дальнейших исследований и практической реализации. Динамичность современного бизнес-мира требует постоянного совершенствования подходов к управлению финансовыми рисками, и данная статья предоставляет базу для таких инноваций.

Таким образом, комплексный подход к управлению финансовыми рисками кредиторской задолженности, основанный на анализе множества методов и инструментов, позволяет предприятиям эффективно преодолевать вызовы современного рынка и обеспечивать устойчивое развитие в долгосрочной перспективе.

Introduction. In today's business environment, characterized by a high degree of competition and rapid change, the relevance of the article is undeniable. Economic dynamics and external factors require enterprises not only to adapt to market conditions, but also to develop effective strategies for managing financial risks, especially in the area of accounts payable.

Based on high competition and variability of market conditions, methods of managing accounts payable become an integral part of the financial planning of an enterprise. In a constantly changing economic environment, enterprises are forced to use complex methods of analysis, interaction with creditors and optimization of financial flows.

The complexity of modern business relations requires the development and application of integrated management methods based on the principles of long-term sustainability and prompt response to changes in external conditions. This includes not only traditional approaches to accounts payable management, but also innovative methods, such as the use of modern information technologies, blockchain technology, and financial risk insurance mechanisms.

An important factor in the relevance of the article is also the international component of the activities of the company "Hive Consulting Services" LLP. In the context of globalization and close economic ties between national and international companies, effective management of accounts payable becomes a key element of successful functioning in the global market.

Thus, the article not only responds to the challenges of modern business, but also provides valuable practical recommendations, ensuring the relevance and relevance of the presented methods in the context of a dynamic and competitive economic environment.

Main part. Literature review. A review of the literature on methods for managing financial risks of an enterprise's accounts payable is a systematic analysis of significant research in this area.

One of the key areas of research is the work of R. Harris and D.S. Sahai “Effective Management of Accounts Payable: An Empirical Study” (2019), which examines in detail effective strategies for managing accounts payable and their impact on the financial stability of the enterprise .

In the context of the use of modern technologies, the works of L. Zhang and H. Chen, such as “Application of Artificial Intelligence in Financial Risk Management” (2020), highlight the importance of using artificial intelligence for the effective prediction and management of financial risks, including creditor debt.

Highlighting the interdisciplinary nature of the issue, M. J. Lambert and A. F. Lawrence's study, Supply Chain Management: Implementation Issues and Research Opportunities (2018), demonstrates the importance of integrating supply chain management with financial strategies, including effective accounts payable management.

Also, analyzing modern trends in the field of financial risk management, the article by K. Smith and B. Johnson “The Impact of Big Data on Risk Management” (2021) emphasizes the role of big data analytics in preventing financial risks, including those associated with creditor debt.

Overall, the literature review indicates the need for an integrated approach to accounts payable management, including the use of modern technologies and integration with other aspects of enterprise financial management.

Study of methods for managing financial risks of an enterprise's accounts payable. The study of methods is a complex and multifaceted analysis that includes various strategies and financial management tools.

One of the key methods widely used in practice is the optimization of payment terms. L. Miller's study "Optimal Payment Policies: Practical Implications for Working Capital Management" (2017) demonstrates how adjusting the timing of payments to suppliers can significantly affect the financial stability of an enterprise, minimizing the risks of accounts payable.

The work of M. Kim and D. Lee “Supply Chain Finance as a Risk Management Strategy” (2020) examines the effectiveness of using financial instruments in managing accounts payable risks, including factoring and programs to reduce financial costs.

The use of blockchain technologies is also highlighted in J. Smith and K. Johnson's study "Blockchain in Trade Finance: A Catalyst for Transformation?" (2019) as an innovative method to ensure transparency and efficiency in accounts payable management, especially in the context of international trade transactions.

Complex financial instruments such as options and forwards are also discussed in R. Greenberg and S. Brown's Hedging and Options: Theories and Applications in Managing Financial Risks (2018), emphasizing their role in mitigating risks associated with financial - accounts payable.

Thus, the research allows us to identify a variety of methods for managing the financial risks of accounts payable, providing enterprises with tools for effective financial planning and minimizing the negative consequences of debt to suppliers.

Description of methods for managing financial risks of an enterprise's accounts payable.

Implementing effective strategies to manage the financial risks associated with an enterprise's accounts payable involves a multifaceted approach, incorporating various methods. This intricate process aims to mitigate potential adverse consequences related to outstanding financial obligations. Here are several key methods, delineated through compound and complex sentences:

1. Comprehensive Creditworthiness Analysis: Conducting a thorough analysis of the creditworthiness of suppliers entails scrutinizing financial statements, statistical data, and macroeconomic indicators. This multifaceted examination allows the enterprise to identify potential risks and proactively prevent issues related to overdue payments.

2. Development of Optimal Payment Schemes: Devising flexible and advantageous payment schemes, considering both the financial capabilities of the enterprise and its suppliers, contributes to risk reduction concerning overdue payments. This involves offering discounts for prompt payments and establishing adaptable terms and conditions for financial transactions.

3. Effective Integration of Digital Technologies: Leveraging modern information systems to automate accounting processes and monitor accounts payable proves instrumental in enhancing management efficiency. The application of big data analytics for risk forecasting and anticipation becomes a crucial element in contemporary risk management strategies.

4. Diversification of Suppliers: Actively diversifying the pool of suppliers helps the enterprise distribute risks and minimize the impact of issues with any single supplier. This encompasses market research, attracting new suppliers, and fostering reliable partnerships to create a resilient supplier network.

5. Debt Insurance Strategies: Engaging in debt insurance contracts specific to accounts payable provides the enterprise with additional guarantees and protection against unfavorable circumstances. This type of insurance can cover risks related to non-payment as well as fluctuations in currency exchange rates.

In essence, these methods, when implemented collectively, establish a more robust and sustainable framework for managing the financial risks associated with an enterprise's accounts payable. Such an approach enhances the financial stability of the enterprise, reinforcing its competitiveness within the market.

Comparison of methods for managing financial risks of an enterprise's accounts payable in Kazakhstan and abroad. Comparing the methods employed for managing financial risks of an

enterprise's accounts payable between Kazakhstan and international practices unveils distinct approaches shaped by unique economic environments, regulatory frameworks, and cultural factors. This analysis, articulated through compound and complex sentences, sheds light on the divergent strategies employed in these contexts.

Regulatory Landscape and Compliance Standards:

In Kazakhstan, financial risk management strategies are often influenced by local regulatory nuances. The adherence to compliance standards set by the National Bank of Kazakhstan becomes paramount. Conversely, in many international settings, enterprises navigate a more intricate web of regulatory frameworks, often involving compliance with multiple jurisdictions, necessitating a meticulous approach to risk mitigation.

Cultural Dynamics Impacting Payment Practices:

Cultural aspects significantly impact payment practices in both Kazakhstan and international contexts. While some countries prioritize early payments as a sign of goodwill and relationship-building, others may view them as a financial burden. Navigating these cultural intricacies is crucial for enterprises to establish and maintain fruitful relationships with suppliers.

Technological Integration and Automation:

Internationally, there is a pronounced emphasis on technological integration for automating accounts payable processes. Advanced digital solutions, including artificial intelligence and blockchain, are commonly adopted to streamline financial operations. In Kazakhstan, the pace of technological adoption may vary, influencing the efficiency of risk management practices.

Access to Financial Instruments and Insurance Products:

Abroad, enterprises often have access to a broader array of financial instruments and insurance products tailored for managing accounts payable risks. This includes trade credit insurance and derivatives for hedging against currency fluctuations. In Kazakhstan, the availability and utilization of such instruments may be influenced by the sophistication of the financial market.

Global Supply Chain Dynamics:

Enterprises operating internationally contend with complex global supply chains, introducing additional layers of risk. Managing geopolitical uncertainties, currency exchange rate fluctuations, and logistical challenges become integral components of risk mitigation. In Kazakhstan, while international trade is vital, the scale and intricacy of supply chain dynamics may differ.

In conclusion, the comparison underscores the need for enterprises to tailor their financial risk management strategies to the specific conditions of the regions in which they operate. While some practices may be universally applicable, a nuanced understanding of local dynamics remains imperative for effective risk mitigation.

Enterprise management methods. In today's dynamic business environment, where financial risks are becoming an integral part of enterprise management, methods of managing accounts payable are becoming an important aspect of financial strategy. Organizations such as Hive Consulting Services LLP actively use a variety of methods to reduce financial risks and ensure stability in relationships with creditors.

One of the key methods used by the enterprise is the strategic management of payment terms. The use of this method involves analysis and optimization of the debt repayment schedule, taking into account the financial capabilities of the enterprise and compliance with contractual obligations. In addition, Hive Consulting Services LLP is actively implementing modern information technologies to automate the processes of managing payment terms, which contributes to more accurate forecasting and planning of financial flows.

An important element of the strategy for managing financial risks of accounts payable is the use of factoring. Hive Consulting Services LLP partners with financial institutions to transfer a portion of their receivables in order to reduce payment waiting times and increase liquidity. This method not only reduces the financial risks associated with late payments, but also provides additional financial resources for investment and development.

The next effective method of managing the financial risks of accounts payable for Hive Consulting Services LLP is the active use of blockchain technology tools. This allows an enterprise to

create secure and transparent financial transactions, minimizing the risk of fraud and ensuring reliable recording of financial transactions.

An integrated approach to accounts payable management also includes the use of insurance instruments to protect against financial losses associated with non-payment of bills. Hive Consulting Services LLP actively cooperates with insurance companies to develop individualized insurance programs that meet the specifics of their business.

Thus, the use of complex methods for managing the financial risks of accounts payable using the example of Hive Consulting Services LLP demonstrates the need for an integrated and flexible approach to this problem. An effective combination of traditional and innovative methods allows an enterprise to successfully cope with financial challenges, ensuring sustainability and growth in a changing business environment.

Improving management methods. In modern business conditions, the relevance of improving methods for managing financial risks of accounts payable of an enterprise, such as Hive Consulting Services LLP, becomes undeniable. The complexity of modern economic relations requires not only effective, but also innovative approaches to managing debt to creditors.

One of the key areas for improving methods is the further development of the strategy for managing payment terms. In this case, it is necessary to pay attention to the analysis of long-term and short-term prospects, taking into account the financial capabilities of the enterprise. Based on a detailed analysis of cash flows and forecasting financial needs, measures are developed to optimize the debt repayment schedule.

The effective use of information technology, including modern software solutions for managing accounts payable, is becoming the next important stage in improving methods. Automation of processes related to accounting and interaction with creditors allows not only to increase efficiency, but also to reduce the likelihood of errors in managing financial flows.

The introduction of factoring into the financial risk management system of an enterprise helps reduce the waiting time for payments and provides additional resources for investment. At the same time, it is important to develop flexible cooperation schemes with financial institutions, taking into account the specifics of the business and the needs of the enterprise.

The next stage in optimizing financial risk management methods is the introduction of blockchain technology. This improves the transparency and security of financial transactions, which is especially important in the context of accounts payable management. Reliable recording of financial transactions reduces the risk of fraud and simplifies interactions with creditors.

The integrated use of insurance instruments is also included in the improvement strategy. The development of individualized insurance programs, adapted to the specifics of the enterprise's activities, helps to minimize financial losses associated with possible non-payment of bills.

Thus, improving the methods of managing financial risks of accounts payable at the Hive Consulting Services LLP enterprise requires an integrated and innovative approach. The combination of traditional and modern methods allows you to effectively manage debt, ensuring financial stability and improving business processes in a dynamic market environment.

Inference. The conclusion of this article, it can be summarized that effective management of financial risks of accounts payable is becoming a critical aspect of the sustainable functioning of an enterprise. The presented methods and approaches provide a comprehensive understanding of debt management mechanisms and create a basis for the development of balanced strategies.

One of the key conclusions of the article is the need for a systematic approach to accounts payable management. The integration of various methods, ranging from traditional financial instruments to the use of innovative technologies, allows the enterprise to adapt to changes in the economic environment.

This work highlights the importance of introducing modern information systems and technologies to automate accounts payable management processes. This not only improves efficiency, but also reduces human error risks, which is essential in an environment where technology is rapidly evolving.

It should also be emphasized that the methods presented in the article are not universal and require constant monitoring and adaptation in accordance with changes in external factors. Flexibility

and the ability to quickly respond to new challenges in the business environment are important elements of a successful financial risk management strategy.

Thus, in the context of the modern business climate and international business relations, the article provides not only a theoretical basis, but also practical recommendations for enterprises seeking to optimize the management of their accounts payable in a dynamic economic environment.

Conclusion. In conclusion of the article on methods for managing the financial risks of an enterprise's accounts payable, it can be noted that effective financial management plays a key role in ensuring the stability and sustainability of the organization in the modern market environment.

It follows from the analysis that optimizing the timing of payments with suppliers remains an important strategic tool that helps improve working capital turnover indicators and reduce financial risks. The work of such authors as L. Miller confirms that balancing between retaining liquidity and reducing costs is an important component of a successful accounts payable management strategy.

Modern technologies such as blockchain provide new prospects for increasing the transparency and efficiency of accounts payable management processes. However, as highlighted in the study by J. Smith and K. Johnson, it is necessary to consider both the potential benefits and challenges associated with the implementation of such innovative methods.

Research into financial instruments such as factoring, options and forwards provides companies with additional opportunities to diversify their financial risk management strategies. The works of R. Greenberg and S. Brown emphasize the importance of the competent use of complex financial instruments in mitigating the negative consequences of accounts payable.

As a result of the literature review, the main trends and methods of managing the financial risks of accounts payable were identified. The study allowed us to see which tools are already widely used in this area, as well as to identify gaps that require additional attention and research.

An analysis of methods for managing the financial risks of accounts payable at the Hive Consulting Services enterprise revealed potential for improving current practices. The proposed approaches are aimed at increasing the efficiency of debt management, reducing risks and optimizing financial processes.

The findings of the study confirm that the introduction of modern information technologies and automation systems is an important step in managing accounts payable. This not only improves the accuracy of the data, but also allows you to respond more quickly to changes in external conditions.

Concluding the analysis, it is worth emphasizing that the developed methods and recommendations are not an end point, but rather a starting point for further research and practical implementation. The dynamism of the modern business world requires constant improvement in approaches to financial risk management, and this article provides the basis for such innovation.

Thus, an integrated approach to managing the financial risks of accounts payable, based on the analysis of many methods and tools, allows enterprises to effectively overcome the challenges of the modern market and ensure sustainable development in the long term.

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THE WILLINGNESS OF CUSTOMERS TO USE GREEN BANKING PRODUCTS. THE INFLUENCING FACTORS

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Abstract

The banking industry worldwide is facing the challenge of creating a sustainable banking system as a result of climate change and increased environmental awareness. Banks have begun to focus on protecting the environment in their operations, but also by offering green banking products to their customers. The purpose of this work is to determine the level of knowledge of customers about green banking products and their willingness to use them in Albania. We will also analyse the factors that may influence their willingness. The factors included in the analysis are environmental concern, environmental behaviour and environmental knowledge. In order to measure these indicators, a questionnaire was distributed to bank customers. A total of 217 questionnaires were returned. Customers were asked about their knowledge of green banking products and their willingness to pay a higher monthly account maintenance fee for banks to develop and increase the range of green banking products. The results show that about 60% of customers in Albania have no information about green banking products. Lack of information may be the main reason why a relatively high proportion of customers, 61%, are unwilling to pay for environmental protection. We conclude that knowledge about the green product plays an important role in the willingness of customers to pay. Customers need to be informed about green counter products. Banks should conduct information campaigns to present these products, the importance and necessity of using them to protect society from climate change. On the other hand, there is a high level of environmental concern, environmental behavior and environmental knowledge in general. This shows that there is a gap between environmental concern and environmental action. Future studies will explore the mechanisms of this behavior.

Keywords: Green banking, Environmental concern, Environmental Behavior, Environmental Knowledge

INTRODUCTION

Climate change is a phenomenon that has affected all countries of the world. Some are very endangered and others less so, however, it is a problem from which all countries suffer. On December 11, 2019 the European Green Agreement was created. This agreement aims to transform the EU into a fair, modern society, an economy with efficient and competitive resources where economic growth is disconnected from the use of resources (European Commission, 2019). According to Saar, Damberg, Frombling, & Ringle (2021) following the focus of the Climate Action Plan and the Green Deal for the European Union, the promotion of sustainable consumption and the identification of influencing factors will significantly help policymakers. Therefore, the main focus should be on

environmental knowledge and risk perception. Green banks are a necessary practice to react to climate change

During their activity, green banks promote the protection of the environment. Green banks offer a range of banking products that aim to protect the environment and discourage all activities that can damage the environment. The willingness of bank clients to use these products depends on several factors. The authors (Joshi & Rahman, 2015)analyzed 53 studies over 14 years to identify factors influencing consumers' willingness to purchase green products. They conclude that there are two influencing factors: individual factors and situational factors. Individual factors include emotions, habits, perceived consumer effectiveness, perceived behavioral control, values and personal norms, knowledge, and trust. Situational factors include price, product availability, product attributes and quality, brand image, eco-labeling and certification, etc. In our analysis, we will focus on the individual factors and respectively environmental concern, environmental behavior, and environmental knowledge. According to Maichum, Parichatnon, & Peng (2016), concern for the environment is one of the factors that most influence the decision to buy green products. Therefore, it is very important that all actors make citizens aware that the use of green products helps to reduce negative impacts on the environment. According to Dessai & Sims (2010), which compared two regions, it was observed that in that region where residents experience water restrictions and drought, it creates a high-risk perception of the seriousness of the water situation and encourages a change in behavior to save water during the drought period. We can all contribute to the protection of the environment by changing our lifestyle, choosing to use green products, saving energy, etc. Only in this way can we build sustainable development, and a green and better world (Yang, Fang, & Zhu, 2022). There is a lack of consumer awareness and education in the implementation of green banking. Green practices will be successful if customers and bank employees are properly educated and trained(Mahale & Hebbar, 2023).The main objective of this paper is to determine the level of knowledge bank customers have about green banking products and their willingness to pay a higher monthly account maintenance fee in order to develop and expand the range of green banking products. We will also analyze the potential factors that influence their willingness. In our analysis, we will focus on the individual factors of environmental concern, environmental behavior, and environmental knowledge. Based on the objectives of the paper, the research questions that arise are:

RQ 1: Are bank customers in Albania aware of green banking products?

RQ 2: Are bank customers in Albania willing to pay a higher monthly account maintenance fee in order to develop and increase the range of green banking products?

RQ 3: Do environmental concern, environmental behavior and environmental knowledge influence the willingness to pay of bank customers in Albania?

To answer the research questions, descriptive analysis was used based on the results of the questionnaire. The results of this paper are initial and in future works, more in-depth analyses will be used to measure the age and factors that affect the longevity of the customers of the counters, including other factors in the analysis.

LITERATURE

2.1. Environmental Awareness and Willingness to Pay

Su, Song, Shang, Wang, & Xue (2021) evidenced a positive relationship between residents with a high level of environmental awareness and environmental protection behavior. The factor that affects this relationship is the high level of perception of risk to the environment. According to Karaoğlan & Durukan (2016) in their study measures the willingness to pay for electricity from renewable energy sources. The analysis shows that environmental awareness affects willingness to pay. In cases where individuals have a high level of environmental awareness, their focus remains on environmental protection even when they have to choose between the economic situation and the impact on the environment. They will also choose green products in any product group. The same result was observed in the study by (Tavárez et al., 2024), where the willingness to volunteer in forest management was closely related to the level of environmental awareness. The results of this study show that policy makers can use education as a way to increase environmental awareness. The study

of Shah et al., (2023) concluded that people are aware of green banking, but banks play an important role in making people aware of innovative ideas. The whole society will benefit from this practice.

Green banking is one of the best ways to make individuals and businesses aware of climate change. This practice creates positive effects by improving the quality of banks' assets (Thomas & Linson, 2016).

2.2 Environmental Behavior and Willingness to Pay

According to Mahmoud et al., (2022) awareness of green packaging positively influenced individuals' decisions to buy. The study conducted by Zaidi et al., (2021) found an important relationship between environmental concern and willingness to pay for green products. Individuals have begun to understand the importance of the environment and this has made them more inclined towards green products. A study conducted in Indonesia by Pratiwi & Pratomo (2018) and Trivedi et al., (2015) showed that pro-environmental behavior has a positive effect on consumers' willingness to pay for green products.

According to Vicente et al., (2021) individuals who engage in pro-environmental behaviors such as waste management, energy and water conservation, and purchasing and using green products do not mean that they are willing to pay additional costs to protect the environment. However, from their analysis, it was found that individuals with high perceived behavioral control and environmental awareness are more willing to pay higher prices to protect the environment.

2.3 **Environmental Knowledge and Willingness to Pay**

According to Zobeidi, Yazdanpanah, & Bakhsh (2020), the perception of the risk of climate change is essential in the climate change literature and policies. The more knowledge individuals have about climate change, the more the perceived risk of individuals will improve and as a result, they will take mitigation actions against climate change and more pro-environmental behavior. According to O'Connor, Bard, & Fishel (1999) high perceptions and knowledge about the risk of climate change increase the willingness of individuals to participate in solving environmental problems and to care more for the environment. Environmentally literate people help them create green knowledge by pushing them toward green products and creating a green culture (Afridi et al., 2023).

In the study conducted by Myung (2017) was analyzed the relationship between knowledge about the environment and willingness to pay higher prices for environmental protection purpose. From the analysis, it was found that knowledge about the environment did not affect the willingness to pay more for the purpose of environmental protection. However, when the marginal effects were measured, it was evident that as knowledge and attitudes towards the environment increase, the probability of having a higher willingness to pay increases.

3. METHODOLOGY

3.1 Survey instrument

In order to analyze the knowledge and satisfaction of bank customers and the factors that influence bank customers, an online questionnaire was distributed. The questionnaire is divided into three parts, the first part includes questions related to demographic factors, the second part includes questions that aim to measure customers' knowledge of green banking products and their willingness to use them, and the third part are questions related to the factors that influence their behavior.3.2 Sampling and Data Collection

Table 1:Demographics

Demographics	Value	Frequency	Frequency percentage
Gender	Male	153	70.5%
	Female	64	29.5%
Age	18-24	121	55.8%
	25-34	59	27.2%
	35-44	22	10.1%
	45-54	11	5.1%
	55-64	4	1.8%
Educational Level	High School	32	14.75%
	Bachelor	102 175	47.00%
	Master	83 79	38.25%
Income	10.000 - 30.000 lek	12	5.5%
	30.000 - 60.000 lek	55 100	25.3%
	60.000 - 90.000 lek	45 66	20.7%
	90.000 - 120.000 lek	38 55	17.5%
	120.000- 150.000 lek	24 33	11.1%
	150.000- 180.000 lek	32 46	14.7%
	Over 180 000 lek	11 10	5.1%

Source: Authors elaboration

As can be seen from Table 1 most of the respondents are women, respectively 70% and 30% are men. The age group that dominates the clients of the banks who filled in the questionnaire is 18-24, which is almost half, 27% belong to the 25-34 age group, 10% belong to the 35-44 age group and the rest belong to the 45-64 age group, which is very small.

In terms of education, about half of the clients have a bachelor's degree, 15% have a high school diploma, and 38% have a master's degree. Regarding income, there is a distribution: 5.5% have a minimum monthly income of 10,000-30,000 ALL, 25% have an income of 30,000-60,000, 17.5% have an income of 90,000-120,000, while individuals with a monthly income that can be considered high are 11% with an income of 120,000-150,000. 150,000-180,000 is the income of 14 5 of the clients interviewed and 5.1% have a monthly income of over 180,000 ALL.

4. RESULTS

From the results of the questionnaire, which are summarized in Table 2, we will find out whether the customers of the banks in Albania know the green banking products offered by the banks, their willingness to pay a higher monthly fee for the maintenance of the account in order to develop and increase the range of green banking products. Also, from the table below, we will find out whether they are aware of the importance of environmental protection, whether they have knowledge about the environment and whether they have pro-environmental behavior. What can be seen from the results is that 58% of clients have no information, they have never heard about green banking products, while 41% of clients have heard about green banking products. The next question, *how much do you know about green banking products?* reveals a very low level of information that customers have about green products offered by banks. Only 3% have a lot of information, while the rest have little or no information.

Regarding the willingness to pay a higher monthly account maintenance fee for banks to develop and increase the range of green banking products, we can say that we have an almost even

distribution. 54% are willing, while 46% are not. Only 40% of customers are willing and very willing, while the rest are neutral, 34% and slightly not willing, 28%.

6 questions were used to measure customers' environmental concern. The results of the questionnaire show a high level of environmental concern among bank customers. About 60% of them are extremely concerned about the state of the environment in the world and the impact it will have on the future. Also, most of the clients interviewed, 58% of them think that in general, human economic activities are damaging nature on our planet, 80% think that people must live in harmony with nature to survive. In terms of pro-environmental behavior, 73% of them have made some changes in their daily behavior in recent years because of concern for the environment. A little more than half of the customers have tried to keep the environment clean, they have avoided buying products from a company that causes environmental pollution during production, they have avoided buying products from a company that causes environmental pollution during production, when they go shopping in a store or supermarket, they take the bag with them to put the products they buy, while 65% have bought products made of recycled material.

In order to demonstrate the level of knowledge about the environment among bank customers, we asked them 6 questions. The analysis shows a high level of environmental knowledge. About 85% of them are aware of the dangers of air pollution, the dangers of vehicle emissions, the dangers of insufficient green spaces. In addition, 95% of them are aware of the damage caused by the deterioration of the quality of cultivated land. About 85% of them are aware of the dangers of air pollution, the dangers of vehicle emissions, the dangers of insufficient green spaces. In addition, 95% of them are aware of the damage caused by the deterioration of the quality of cultivated land.

Table 2: WTP, knowledge, awareness and behavior

The main constructs	**Indicators**	**Yes**	**No**			
Knowledge about green products	Have you heard about green banking products before?	41.9%	58.1%			
		Strongly Disagree	**Disagree**	**NA/D**	**Agree**	**Strongly Agree**
	How much do you know about green banking products?	49.3%	24.9%	22.6%	2.8%	0.5%
		Yes	**No**			
Willingness to pay	Would you be willing to pay a higher monthly account maintenance fee for banks to develop and increase the range of green banking products?	**54%**	**46%**			
		Strongly Disagree	**Disagree**	**NA/D**	**Agree**	**Strongly Agree**
	Would you be willing to pay a higher monthly account maintenance fee for banks to develop and increase the range of green banking products?	6%	21%	34%	29%	10%
		Strongly	**Disagree**	**NA/D**	**Agree**	**Strongly Agree**

		Disagree				
Environmental concern	People are extremely concerned about the state of the environment in the world and the impact it will have on the future.	6.0%	13.4%	24.0%	30.9%	25.8%
	Mankind is severely abusing the environment	5.1%	5.1%	18.9%	33.6%	37.3%
	In general, human economic activities are damaging nature on our planet.	5.1%	5.5%	21.7%	35.0%	32.7%
	You are very concerned about the environment	4.1%	4.1%	26.3%	36.4%	29.0%
	The balance of nature is very delicate and easily upset.	2.8%	8.3%	20.7%	42.4%	25.8%
	People must live in harmony with nature to survive.	3.7%	3.2%	15.7%	32.7%	44.7%
Environmental Behavior		**Yes**	**No**			
	Over the past few years, have you made any changes in your daily behavior because of your concerns for the environment?	73.3%	26.7%			
		Strongly Disagree	**Disagree**	**NA/D**	**Agree**	**Strongly Agree**
	Have you tried to keep the environment clean?	0.5%	0.9%	7.4%	35.9%	55.3%
	Have you talked with friends about environmental protection?	2.8%	7.4%	24.9%	43.8%	21.2%
	Have you avoided buying products from a company that causes environmental pollution during production?	14.3%	18.9%	23.5%	24.4%	18.9%
	Have you bought products made from recycled material when is possible?	6.5%	10.6%	17.5%	34.6%	30.9%
	When you go shopping in the store or supermarket do you take with you the bag to place the products you are going to buy?	10.6%	10.6%	22.1%	29.0%	27.6%
	Have you reduced the energy you use at home for environmental reasons?	6.5%	15.7%	20.7%	38.2%	18.9%
		Strongly Disagree	**Disagree**	**NA/D**	**Agree**	**Strongly Agree**
Environmental Knowledge	Are you aware of the risk of emissions from vehicles is harmful to human health?	6.0%	1.8%	7.4%	16.6%	68.2%

	Are you aware that the use of chemical fertilizers and pesticides will cause environmental damage?	4.1%	2.8%	6.9%	26.3%	59.9%
	Are you aware of the risks of air pollution?	4.1%	2.8%	6.0%	30.0%	57.1%
	Are you informed about the risks of water pollution?	4.6%	3.2%	4.6%	29.0%	58.5%
	Are you aware of the dangers of insufficient green space?	4.1%	4.1%	6.5%	29.5%	55.8%
	Are you aware of the damage to the degradation of the quality of cultivated land?	0.5%	1.4%	2.8%	31.3%	64.1%

Source: Authors elaboration

5. CONCLUSIONS

The purpose of this paper is to show whether bank customers in Albania are aware of green banking products and would they be willing to pay a higher monthly account maintenance fee to develop and increase the range of green banking products. In the study, we took some personal factors such as environmental concern, environmental behavior, environmental knowledge as potential factors that influence the attitudes of customers. The results of the descriptive analysis showed that almost 40% of bank customers have heard about green banking products. However, we can say that only 3% of them have a lot of knowledge about the products. This shows a very low level of information that customers have about these products. This may be the reason why a relatively small proportion, only 39%, of customers are willing to pay a higher monthly maintenance fee to develop and expand the range of green banking products. On the other hand, the results of the analysis show a high level of environmental concern, environmental behavior and environmental knowledge. In recent years, customers have adopted pro-environmental behavior, which is related to a high level of concern for the environment and a high level of knowledge about the damage caused by the environment.

Based on the results of the questionnaire, we can say that knowledge and concern for the environment play an important role in customers' willingness to pay. Therefore, it is very important for banks to conduct information campaigns about the green banking products they offer and their importance for the whole society. According to (Putri et al., 2017) if customers are informed about the banks' environmental protection programs, they will contribute to their implementation, for example, by using e-banking services. The lack of customers' knowledge about green banking may be the main factor that they do not use these products. Therefore, banks should be more aggressive in their information campaigns and encourage the use of these products. For environmental policy to be effective, there must be an understanding of the factors that translate knowledge about climate change into concrete action(Kokthi et al., 2023).

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MODERN TRENDS IN THE DEVELOPMENT OF GREEN MARKETING

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Abstract

The article shows that green marketing has emerged as a critical facet of contemporary business strategies, reflecting a paradigm shift towards sustainability and environmental consciousness. As society becomes increasingly aware of the ecological challenges posed by traditional business practices, companies are compelled to adopt more responsible and environmentally friendly approaches. This research delves into the realms of green marketing, exploring its definition, conceptual underpinnings, and its pivotal role in fostering sustainability within the business landscape.

Keywords: Green marketing, Government Policies, Green Consumer Behavior.

1. INTRODUCTION

Green marketing can be defined as a strategic approach that emphasizes the promotion and sale of products and services based on their environmental attributes. It goes beyond mere advertising and seeks to integrate environmental considerations into every stage of a product's life cycle – from design and production to distribution and disposal. The core concept revolves around fostering a harmonious relationship between business activities and the natural environment [1].

In the contemporary business landscape, the importance of sustainability cannot be overstated. The escalating concerns about climate change, resource depletion, and environmental degradation have prompted a paradigm shift in consumer attitudes and expectations. As consumers become more conscientious about their ecological footprint, businesses are compelled to align their strategies with sustainable practices. This shift is not just driven by ethical considerations but also by the recognition that sustainable practices can lead to long-term profitability and resilience [2].

The purpose of this essay is to unravel the multifaceted dimensions of green marketing, shedding light on its significance and implications for businesses. It aims to explore how green marketing strategies can contribute to mitigating environmental impact, meeting consumer expectations, and fostering a positive corporate image. The scope extends beyond theoretical discussions to practical insights, examining successful green marketing campaigns, challenges faced by businesses in implementing sustainable practices, and potential future trends [3].

In essence, the essay navigates through the intricate landscape of green marketing, unraveling its layers to provide a comprehensive understanding of how businesses can navigate the delicate balance between profitability and environmental responsibility. By examining the purpose and scope of green marketing, we can gain valuable insights into its transformative potential in shaping a more sustainable and resilient business environment [4].

2. THEORETICAL FRAMEWORKS IN GREEN MARKETING

Environmental Marketing Myopia:Levitt's concept of Environmental Marketing Myopia highlights the tendency of businesses to focus narrowly on short-term profit goals without adequately considering the long-term environmental implications of their actions [5]. This myopic perspective often leads to unsustainable practices and a disregard for environmental stewardship. The framework encourages businesses to adopt a broader outlook, understanding that environmental sustainability is not just a trend but a fundamental aspect that should be integrated into the core of their operations. By recognizing the interconnectedness of business and the environment, companies can avoid myopic thinking and embrace strategies that align with long-term ecological viability.The Green Marketing

Mix:Peattie's Green Marketing Mix expands the traditional marketing mix (product, price, place, and promotion) to include three additional Ps: people, processes, and physical evidence, forming the 7Ps of green marketing [6]. This framework emphasizes the need for businesses to consider the social and environmental aspects of their operations, beyond the conventional focus on product attributes and promotional strategies. By incorporating sustainability into organizational processes and ensuring transparency in communication, companies can build a holistic and environmentally responsible brand image. The Green Marketing Mix thus provides a comprehensive toolkit for businesses aiming to integrate sustainability into their overall marketing strategy. Consumer Attitudes and Perceptions: Polonsky's framework delves into the psychological aspects of consumer behavior in the context of green marketing. It emphasizes the significance of consumer attitudes and perceptions in influencing purchasing decisions related to environmentally friendly products. Understanding the factors that shape consumer perceptions, such as trust in eco-labels, environmental awareness, and perceived personal efficacy, is crucial for businesses seeking to effectively market green products. By aligning marketing efforts with the values and concerns of environmentally conscious consumers, companies can create targeted campaigns that resonate with their target audience, thereby enhancing the success of their green marketing initiatives [7].

The Triple Bottom Line: Elkington's Triple Bottom Line (TBL) framework introduces a broader perspective on business performance, incorporating three dimensions: economic, social, and environmental. It encourages businesses to assess their success not only in terms of financial profit (economic), but also in terms of social responsibility and environmental impact. For green marketing, this framework suggests that companies should strive for a balance between profitability, social equity, and environmental sustainability. By adopting the TBL approach, businesses can measure and communicate their overall impact, demonstrating a commitment to a more holistic and responsible approach to corporate success [8].

The historical evolution of green marketing traces the development of environmentally conscious business practices and marketing strategies over several decades. The roots of green marketing can be traced back to the mid-20th century, gaining momentum in response to growing environmental concerns [9].

In conclusion, these theoretical frameworks in green marketing provide valuable insights for businesses seeking to navigate the complexities of sustainable practices. By embracing a broader perspective, integrating environmental considerations into marketing strategies, understanding consumer behavior, and adopting a triple-bottom-line approach, businesses can not only meet the growing demand for eco-friendly products but also contribute to a more sustainable and resilient future [10].

3. GOVERNMENT POLICIES AND REGULATIONS

The Role of Government in Promoting Sustainable Business Practices: Governments worldwide play a pivotal role in promoting sustainable business practices through the formulation and implementation of policies and regulations. Recognizing the critical need to address environmental challenges, governments act as catalysts for change by creating frameworks that encourage businesses to adopt sustainable strategies. This involves setting standards for resource use, emissions, and waste management, as well as providing incentives for eco-friendly initiatives. Government initiatives may include tax benefits for sustainable practices, grants for research and development in green technologies, and partnerships with businesses to achieve collective environmental goals. By establishing a regulatory environment that prioritizes sustainability, governments contribute to shaping a business landscape that is both socially responsible and environmentally conscious [11].

The Impact of Environmental Regulations on Marketing Strategies: Environmental regulations directly influence the marketing strategies of businesses. Compliance with these regulations not only ensures legal adherence but also serves as a cornerstone for building a positive brand image. Companies often incorporate their commitment to environmental responsibility into their marketing messages, highlighting compliance with regulations and showcasing eco-friendly initiatives. On the flip side, failure to adhere to environmental regulations can result in reputational damage, legal

consequences, and financial penalties. The regulatory landscape shapes the narrative of green marketing, steering businesses towards authenticity and accountability in their sustainability claims. As environmental consciousness grows among consumers, marketing strategies that emphasize adherence to regulations and genuine sustainable practices become increasingly significant in gaining consumer trust [12].

Comparative Analysis of Policies Across Different Regions: Government policies and regulations related to sustainability vary significantly across different regions. Some countries prioritize stringent environmental standards and offer substantial support for green initiatives, while others may have more relaxed regulations. A comparative analysis reveals a spectrum of approaches, influenced by factors such as political ideology, economic considerations, and cultural values. For instance, European countries are known for their robust environmental policies, emphasizing renewable energy, waste reduction, and emissions control. In contrast, developing regions may face challenges in implementing and enforcing comprehensive environmental regulations due to economic constraints. Understanding these regional variations is essential for businesses operating in global markets, as it influences the formulation of effective and region-specific green marketing strategies [13].

In conclusion, government policies and regulations play a crucial role in shaping sustainable business practices and influencing the marketing strategies of companies. The alignment of business practices with environmental regulations is not only a legal requirement but also a strategic imperative for building trust with environmentally conscious consumers. A comparative analysis of policies across regions highlights the need for businesses to navigate diverse regulatory landscapes, emphasizing adaptability and region-specific approaches in their pursuit of sustainability [14].

4. GREEN CONSUMER BEHAVIOR

Understanding green consumer behavior is crucial for businesses aiming to succeed in the evolving landscape of sustainability. Several factors influence the choices consumers make when it comes to eco-friendly products, and examining these aspects can provide valuable insights for businesses seeking to align their offerings with consumer preferences [15].

Factors Influencing Green Consumer Behavior: Numerous factors shape green consumer behavior. Environmental awareness and concern for ecological issues play a pivotal role. Consumers increasingly consider the environmental impact of their purchases, looking for products that have minimal harm to the planet. The availability of information and transparency in business practices also influence consumer choices. Eco-labels, certifications, and clear communication about sustainable practices can enhance a product's appeal to environmentally conscious consumers. Additionally, personal values, beliefs, and lifestyle choices contribute to the decision-making process, reflecting a broader shift towards sustainable living [16].

The Role of Demographics in Green Purchasing Decisions: Demographic factors, such as age, education, and income, play a significant role in shaping green consumer behavior. Research suggests that younger generations, particularly millennials and Generation Z, are more inclined towards sustainable choices. Higher education levels often correlate with increased environmental awareness, while income can impact the willingness to pay a premium for eco-friendly products. Understanding these demographic nuances allows businesses to tailor their marketing strategies to specific target audiences, ensuring a more effective approach to green consumer engagement [17].

Consumer Attitudes Towards Eco-Friendly Products: Consumer attitudes towards eco-friendly products are diverse and can be influenced by various factors. Positive attitudes may arise from a genuine concern for the environment, a desire to make ethical choices or a belief in the health benefits of eco-friendly products. On the other hand, skepticism may stem from doubts about the authenticity of green claims, perceived inconvenience, or the perception that green products are more expensive. Successful green marketing strategies should not only highlight the environmental benefits but also address and alleviate potential concerns to foster positive consumer attitudes [18-19].

Case Studies Illustrating Shifts in Consumer Behavior: Several case studies exemplify the shifts in consumer behavior towards more sustainable choices. For instance, the rise of electric vehicles, the popularity of plant-based diets, and the increased demand for sustainable fashion showcase how

consumer preferences are evolving. Companies that have successfully navigated these shifts often prioritize transparency, educate consumers about the environmental impact of their products, and align their values with those of eco-conscious consumers. These cases highlight the importance of adapting to changing consumer sentiments and proactively integrating sustainability into business practices [20-21].

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Thus, understanding green consumer behavior involves considering a myriad of factors, from individual values to demographic trends. As consumers increasingly prioritize sustainability, businesses can capitalize on this shift by aligning their products and marketing strategies with the values and preferences of eco-conscious individuals, ultimately contributing to a more sustainable and responsible marketplace.

5. GREEN MARKETING AND CORPORATE SOCIAL RESPONSIBILITY (CSR)

Integration of Green Initiatives into CSR: The integration of green initiatives into Corporate Social Responsibility (CSR) has become increasingly prevalent as businesses recognize the interconnectedness of environmental sustainability and social responsibility. CSR encompasses a company's commitment to operate ethically, contribute to social well-being, and minimize its environmental impact. Green marketing plays a pivotal role in this integration by focusing on environmentally friendly practices and communicating a commitment to sustainability. When companies align their green initiatives with broader CSR goals, it creates a holistic approach to

responsible business conduct. This integration goes beyond marketing strategies and involves adopting sustainable practices in production, supply chain management, and community engagement [22].

Positive and Negative Impacts of Green Marketing on Corporate Reputation: Green marketing has both positive and negative impacts on corporate reputation. When executed authentically and backed by tangible sustainable practices, green marketing initiatives can enhance a company's reputation. Consumers increasingly value environmentally responsible behavior, and companies that actively communicate and implement green initiatives are viewed favorably. However, the greenwashing phenomenon, where companies exaggerate or falsely claim their environmental efforts, can lead to negative consequences. This can result in a loss of consumer trust, damage to the company's reputation, and potential legal ramifications. Therefore, the sincerity and transparency of green marketing efforts are crucial in shaping positive perceptions of a company's CSR commitments [23].

Case Studies Illustrating the Intersection of CSR and Green Marketing: Several case studies exemplify the successful intersection of CSR and green marketing. Unilever's Sustainable Living Plan is a prominent example, demonstrating a commitment to environmental and social sustainability. Unilever not only implemented eco-friendly practices in its supply chain but also communicated these efforts through various marketing channels, enhancing its CSR image. Another case is IKEA's People & Planet Positive strategy, emphasizing sustainable sourcing, energy efficiency, and waste reduction. By aligning its green initiatives with broader CSR goals, IKEA has positioned itself as a socially and environmentally responsible brand. These cases highlight the synergy between CSR and green marketing, where companies leverage their commitment to sustainability to positively impact both the planet and their reputation [24-25].

Based on the above, we can say that, the integration of green initiatives into CSR represents a strategic alignment that goes beyond marketing rhetoric. When businesses authentically incorporate sustainability into their operations, communicate these efforts transparently, and align them with broader CSR objectives, they can foster a positive corporate reputation. However, the success of this integration requires a genuine commitment to sustainable practices and a careful avoidance of greenwashing, ensuring that green marketing efforts contribute authentically to both environmental and social responsibility.

6. FUTURE TRENDS IN GREEN MARKETING

Emerging Technologies Influencing Green Marketing: The future of green marketing is poised to be significantly influenced by emerging technologies. Advancements in Artificial Intelligence (AI), Internet of Things (IoT), and blockchain are likely to play pivotal roles. AI can be leveraged for data analytics to track and optimize the environmental impact of products throughout their life cycles. IoT devices can provide real-time information about sustainable practices, enabling consumers to make informed choices [26-27]. Blockchain technology, with its transparent and decentralized nature, has the potential to enhance traceability in supply chains, ensuring the authenticity of eco-friendly claims. The integration of these technologies will not only enhance the efficiency of green marketing campaigns but also provide consumers with more reliable information about the sustainability of products [28-30].

Shifts in Consumer Expectations and Preferences: As environmental awareness continues to grow, consumers are expected to place even greater emphasis on sustainability in their purchasing decisions. Future trends suggest that consumers will demand more than just eco-friendly products; they will seek transparency, ethical sourcing, and a genuine commitment to environmental and social responsibility from brands. Companies that align with these evolving consumer expectations and communicate their sustainable practices effectively are likely to thrive. Additionally, the rise of conscious consumerism may lead to increased demand for circular economy models, where products are designed for durability, recyclability, and minimal environmental impact [31].

Anticipated Challenges and Opportunities for Future Research: While green marketing presents numerous opportunities, it also faces challenges that warrant further research. One challenge is the potential for greenwashing, where companies make false or exaggerated environmental claims.

Future research can explore ways to enhance the credibility of green marketing efforts, such as the development of standardized eco-labels or certification processes. Another area for research is understanding the psychological factors influencing consumer behavior in the context of green marketing [32-33]. Exploring the drivers of sustainable choices, barriers to adoption, and effective communication strategies will be crucial for businesses aiming to navigate the complex landscape of environmentally conscious consumerism. Additionally, researchers may explore the impact of policy changes and global initiatives on green marketing trends, providing insights into the evolving regulatory landscape [34].

The above allows us to say that, the future of green marketing is dynamic and shaped by emerging technologies, shifting consumer expectations, and ongoing research efforts. Businesses that proactively embrace these trends, aligning their strategies with evolving consumer values and leveraging innovative technologies, are likely to stand out in an increasingly competitive and environmentally conscious marketplace.

7. CONCLUSION

In conclusion, our exploration of green marketing has unveiled key insights into the evolving landscape of sustainable business practices and consumer behaviors. The article began by defining green marketing and highlighting its significance in the contemporary business environment. Theoretical frameworks such as Environmental Marketing Myopia, the Green Marketing Mix, Consumer Attitudes and Perceptions, and the Triple Bottom Line provided a theoretical foundation for understanding the complexities of green marketing strategies.

Examining green consumer behavior revealed that factors such as environmental awareness, demographics, and consumer attitudes significantly influence purchasing decisions. The essay delved into the success factors of green marketing campaigns, emphasizing the importance of authenticity, effective communication, and building and maintaining consumer trust. We explored how green marketing intersects with Corporate Social Responsibility (CSR), emphasizing the integration of green initiatives into broader CSR goals, as well as the positive and negative impacts on corporate reputation.

Looking towards the future, emerging technologies, shifts in consumer expectations, and potential challenges and opportunities for research were identified as crucial aspects shaping the trajectory of green marketing. The integration of technologies like AI, IoT, and blockchain is anticipated to revolutionize the way businesses approach sustainability, providing more transparent and efficient solutions. For businesses and marketers, the implications are clear. Embracing sustainability is not merely a trend but a strategic imperative. Aligning green marketing strategies with authentic sustainable practices, incorporating emerging technologies, and understanding evolving consumer expectations are essential for long-term success. Building and maintaining trust through transparent communication and avoiding greenwashing are critical considerations in navigating the delicate balance between profitability and environmental responsibility.

Recommendations for fostering sustainable practices in marketing include ongoing research into consumer behavior, exploring the impact of policy changes, and enhancing the credibility of green marketing efforts through standardized certifications. Businesses should proactively engage in sustainable initiatives, not just for compliance but as a genuine commitment to social and environmental responsibility.

In conclusion, the journey through green marketing underscores the transformative potential it holds for businesses willing to embrace sustainable practices. As we move forward, the integration of green principles into marketing strategies will not only contribute to a more environmentally conscious marketplace but also position businesses as leaders in a world where sustainability is not just a choice but a necessity.

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INTERNAL AND EXTERNAL SOCIAL AUDIT: MAIN ADVANTAGES AND DISADVANTAGES

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Social audit is a set of measures aimed at improving the provision of specific services and the implementation of public policy. The main importance in social audit is given to participation, since the emphasis is not only on the research itself (although its planning is important), but also on the involvement of responsible parties in active cooperation, such as service users, policy beneficiaries, government structures, opinion leaders, etc.

A company may initiate a social audit to enhance internal cohesion or enhance its public image. Positive results from the audit can be shared publicly. For instance, if a factory is perceived to have a negative impact, conducting a social audit can help identify actions that genuinely contribute to society. In Ukraine, large companies involved in foreign economic activities often take the lead in developing social audits to attract investors [1-6]. The use of social audits as a tool for operational management is increasingly prevalent. Foreign company administrations aim to proactively address social conflicts to avoid disruptions in working hours and profit loss. This approach offers numerous advantages, such as cost savings on social contributions for wages, sick leaves, holiday pays, penalties for refusing to employ individuals with disabilities, and more. The tools employed to implement such a personnel policy at the enterprise are commonly categorized as follows:

– outstaffing: involves removing employees from the official staff of the enterprise while allowing them to remain in their positions and carry out their assigned duties.

– freelancing: encompasses engaging specific specialists (freelancers) to perform work without being physically present on the enterprise's premises.

– outsourcing: entails the delegation of specific tasks or business processes of the enterprise to a third-party organization, known as an outsourcer [5].

– crowdsourcing: involves the completion of required work either for free or by volunteers, often for a small remuneration.

To perform social audit, a determining factor will be to compare the economic efficiency of these options, to analyze their advantages and disadvantages. Table 1 shows the characteristic features, advantages and disadvantages of the audit procedures to external and internal auditors [11].

Table 1. Advantages and disadvantages of internal and external social audit

Characteristic features	Internal social audit		External social audit	
	Advantages	Disadvantages	Advantages	Disadvantages
Degree of informativeness	The complete information aboutthe organization; ability to start working without preliminary familiarizing with the organization	Requires constant training and advanced training	Work experience gained at some enterprises; initial professional development	Need for extra time and resources to receive information about the organization

Degree ofinterest		Dependence on management and other groups and employees	Objectivity, independence, lackof personal interest	
Degree of trust	Confidential information is entrusted			Unwillingnessto provide the necessary information
Communicative connections	Communicative connections		Available image expert on social issues	
The level of public coverage		Results are usedonly for management needs	The results are published in the media	
Degree of responsibility	A high degree of responsibility		A high degree of responsibility for the result, since his professional image depends on it. In addition, the contract may outline its financial responsibility	

It should be noted that external social audit has a number of advantages: for example, limitation of the enterprise's personnel for the enterprise to preserve the status of a small one; cost savings for wages including the cost of paying the involved works or services can be much lower than the cost of building of your own personnel structure [16-17].

Social audit as a mechanism of the regulation and ensuring social justice is becoming more and more widespread in the world as a tool of public control and as a tool that promotes business responsibility. Global challenges make social audit indispensable for conflict prevention. Social audit provides an opportunity for the public to influence on the world economy and politics sustainability and to adhere to ethics in solving national problems. The importance of social audit is found in ensuring the openness and transparency of governments and corporations the activities, as well as the availability ofinformation [19].

Differences in national models of social audit limit opportunities for sharing experience and using best practices for countries that are beginning to form own social audit models. We consider that social audit can be an effective tool only when it identifies the risks and challenges inherent in local communities and mentality.

The classifications of goals, levels and subjects of social audit carried out in this case will contribute to further scientific investigations and the development of its most effective models [20].

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ATTITUDE TOWARDS DIGITAL DELIVERY OF PUBLIC SERVICES IN ALBANIA

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Abstract

Every aspect of our lives has already been impacted by the digitalization process, which has also become a significant challenge for the governments of numerous countries trying to establish public services. Government public service delivery is changing as a result of this ongoing process, becoming more open, effective, and customer-oriented.

Herein, the objective of this research study is to estimate the attitude toward the digitalization of public service delivery based on the public's perception in Albania. Through an online survey, a dataset with information on 286 respondents was obtained. The data analysis was made through Descriptive and Correlation Analyses.

The findings among other things, showed that even though there are inequalities in internet accessibility and those particularly disadvantaged are people living in rural areas and those with low levels of income, overall, the respondents are more satisfied with receiving Public Services delivery digitally than in the traditional way, but at the same time it creates difficulties due to the lack of a contact person, which can be considered as an issue to facilitate.

Regarding the research findings, the authors recommended that public organizations in Albania should develop policies and procedures for a wider use of digital public services making them more inclusive and effortlessly accessible.

Keywords: Digital Transformation; Digital Government, Public Attitude; Digital Public Services.

1. Introduction

Due to the many opportunities digitization has provided, it is currently the subject of much interest from both the public and private sectors. Generally speaking, the current discussion about this process which "knocked on the door" of every country, government, institution, and business" is not related to the fact whether it should be embraced or not, but what methods and models should be used to ensure that it is accepted by all participants in the market as effectively as possible.

The provision of public services has moved from a traditional role to a digital one, becoming a challenge for many governments around the world, to fulfill good governance. This implies that digital governance is no longer simply perceived as a way to provide public services through ICT, but also includes the interaction of governance through public institutions with citizens. Furthermore, this process should be understood not simply as being able to access the Internet, but to be able to receive the services offered through it. Therefore, it is crucial to analyze this approach from the perspective of citizens in different countries as they are considered significant stakeholders in every e-government system.

Considering the literature in this area, *the level of internet usage*, *internet access in households*, and *overall digital skills* can provide a useful general picture of how digitally prepared a country or region may be (*Regional Cooperation Council*).

Referring to the official data on these indicators, Albania seems to have made progress recently, not only because of the strategy followed by the Albanian government but also because of the COVID-19 pandemic, which pushed the need for Internet usage. According to the Eurostat data, for 2022 Albania has improved in terms of internet usage, with 85.82% of individuals having used the internet at least once in 12 months. Additionally, Albania ranks first in the region for internet access in households (98.44%). However, it's concerning to see that Albania ranks last in the region for overall digital skills, with only 23.8% of the population having the necessary skills. This shows that

there is still a lot of work to be done in this direction. Also, based on the official INSTAT data (2023), the number of citizens who use E-government services has increased with a considerable year-on-year improvement.

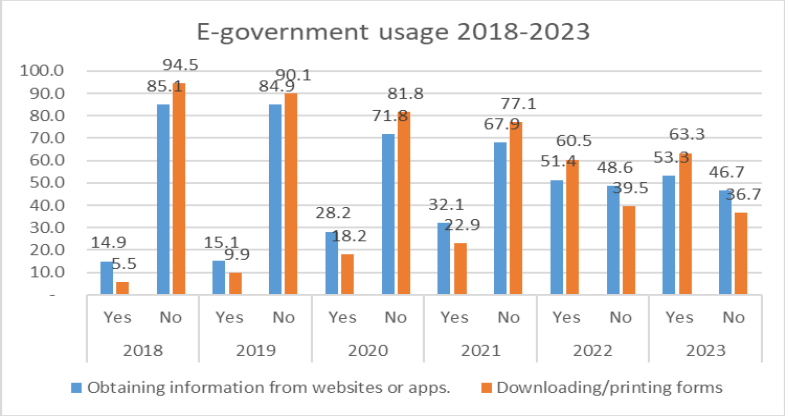

Chart 1: E-government usage 2018-2023

Source: INSTAT

The UN E-Government Index ranks Albania 63rd (2022) out of 193 countries but with a decrease from 2020 when Albania ranked 59th (2022) out of 193 countries. E-Government INDEX takes into account takes into consideration the development of three indicators as it is shown in *Table 1*:

Table 1: Albanian's E-Government Rankings 2003-2022

	2022	2020	2018	2016	2014	2012	2010	2008	2005	2004	2003
Online service index (OSI)	0.818	0.841	0.736	0.5942	0.4488	0.4248	0.3111	0.3913	0.1615	0.1622	0.083
Infrastructure Index (TII)	0.604	0.579	0.432	0.35296	0.3548	0.337	0.1629	0.1251	0.068	0.0578	0.0494
Human Capital Index (HCI)	0.802	0.8	0.788	0.65199	0.71	0.7863	0.886	0.8869	0.89	0.8	0.8
E-Government Development Index	0.741	0.74	0.652	0.53305	0.5046	0.5161	0.4519	0.467	0.3732	0.34	0.3108
Albania Rank	63	59	74	82	84	86	85	86	102	110	114

Source: UN-Government Knowledgebase

The data clearly show that Albania has achieved significant improvement over the years both in the *Online Service Index* and the *Infrastructure Index*, while the *Human Capital Index* has mostly stayed the same. It shows that the country has been investing in its technological and physical infrastructure to make services more accessible and efficient.

The main objective of this research study is to assess the attitude of Albanian citizens toward the digital delivery of public services. This study will also examine the opportunities and challenges related to the digital delivery of public services based on the perception of the respondents, believing that their approach toward this process could play a key role in determining its success.

The lack of studies evaluating the effects of digitalization on public service performance from the perspective of citizens in Albania as a developing country highlights the significance of this research paper. Furthermore, this paper could contribute to enhancing comprehension and resolving concerns regarding the impact of digitalization on public service delivery.

2. Literature Review

Digitalization has indeed brought about significant changes in the way governments provide public services. Digital platforms and technologies in public service delivery have been a topic of much debate and scrutiny among citizens. From online portals for government transactions to the incorporation of cutting-edge technologies such as artificial intelligence and blockchain in developed countries, the digital delivery of public services covers a wide range of activities.

There is a large body of empirical literature that evaluates the positive effects of digitization of public service (Raiu & Melenciuc 2022; Terlizzi, 2021; Aker, 2017; Accenture, 2014; Zumofen et al., 2022; Upadhyay et al., 2022). As technology continues to evolve and improve, it becomes easier

and more cost-effective for people, corporations, and governments to connect regardless of time and location. This has led to significant advancements in globalization and innovation, as noted by Vuori, Helander, and Okkonen (2019) study.

At the same time, some studies focus on the citizens' benefits considering that they are an important part of this process. According to Lindgren et al. (2019), the connection between the public sector and citizens is altered by the digitalization of public service delivery. In the past ten years, the public sector and government have undergone a digital transformation aimed at reevaluating current procedures and offerings to improve citizen and business experiences (Mergel et al., 2018). In this way, the digital revolution has had a significant impact on how governments provide services to their citizens, as mentioned in the study by Birner et al. in 2021. With the advancement of technology, it's now possible for citizens to access government services and information online, which has made the process more convenient and efficient. According to Taylor's study (2016), even though domestic policies may aim to promote innovation, they could hinder it due to pushback from stakeholders. As a result, governmental intervention may be required to maintain the progress of innovation. This means that the development of a digital public service can achieve its goal only if it is properly understood and accepted by the citizens, but above all if they trust in this process. Since citizens are major players in every e-government system, they must be able to access and be ready to use it, (Rahman , 2015). This has led to a growing interest in the evaluation of citizens' expectations and their attitudes towards the digitization of public services.

Alzahrani et al. (2018) focus on how differences in online experience, age, and gender affect citizens' trust in the use of e-government and conclude that internet usage is positively correlated with citizens' trust. Additionally, the survey revealed that women are more confident and think better of online services than men do. Meanwhile, Welch et al. (2004), focus on the relationship between Internet use, citizen satisfaction, and trust in electronic governance. The study concludes that important components of e-government initiatives—transparency, engagement, and transaction—are important components that affect confidence both directly and indirectly.

However, a different study by Al-Hujran et al. (2015) discovered that a citizen's attitude is the most significant element influencing whether or not they would accept and subsequently use e-government services. Perceived value and usability interact to shape public opinion.

Tremblay-Cantin et al.'s research report from 2023 offers a general overview of the critical factors affecting people's adoption of e-government services. They determined 46 variables that affected citizens' adoption of e-government services, and after classifying them into four categories based on their objectives, they separated them into the following categories: *1) individual factors, 2) individual beliefs, 3) government factors*, and *4) user adoption.*

Overall, the research studies have shown that citizens' attitudes toward digital public services play a crucial role in their acceptance and success. Governments and service providers need to take into account the needs and preferences of citizens while designing these services to ensure their effective implementation and usage. This can ultimately lead to better outcomes for everyone involved.

3. The Data and Methodology

Since understanding the attitudes of the citizens was the primary objective of the study, simple random selection was used. To guarantee that respondents could provide accurate and insightful answers to the issues discussed, a survey was created based on prior research and included appropriate questions. Of the 25 questions in the survey, 15 were multiple choice and used a 5-point Likert scale, with 1 denoting "strongly disagree" and 7 denoting "strongly agree." Additionally, the survey contained questions revealing the participants' socio-demographic characteristics, access to the Internet, and reasons for utilizing e-government. 286 respondents gave their anonymous responses through an online survey.

The relevant data gathered through the survey were processed and analyzed accordingly and a summary of the adequate findings regarding respondents' perceptions and attitudes will be presented. This study attempts to contribute to the ongoing discussion over people's perceptions of the digital transformation of public services, specifically in Albania, by utilizing a combination of descriptive and correlation analyses.

4. Data analysis and research findings

The study results showed that 95.1% of respondents are using digital public services, even though 100% of the respondents answered that they have access to the Internet. This is a positive indication of the questionnaire since it demonstrates that nearly all of the respondents are informed about the delivery of public services via digital means. But even if a sizable portion of them use digital public services and have access to the Internet, only 68% of them are content with the services they receive in this way.

4.1. Profile of surveyed sample

Based on the sample's demographic information, 51.4% of the 286 respondents were women and 48.6% were men, indicating about equal representation of both genders in the research.

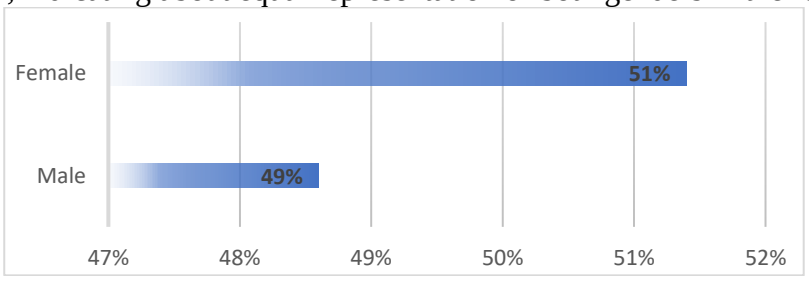

Chart 1. Gender of Respondents

The majority of respondents (40.9%) belonged to the 20-29 age group, with the remaining age group (31.5%) being the 30-39 age group. This indicates that the sample was concentrated in the age group that most likely finds it easier to use digital technology. Additionally, 47.6% of them hold a bachelor's degree or more, demonstrating their proficiency with technology.

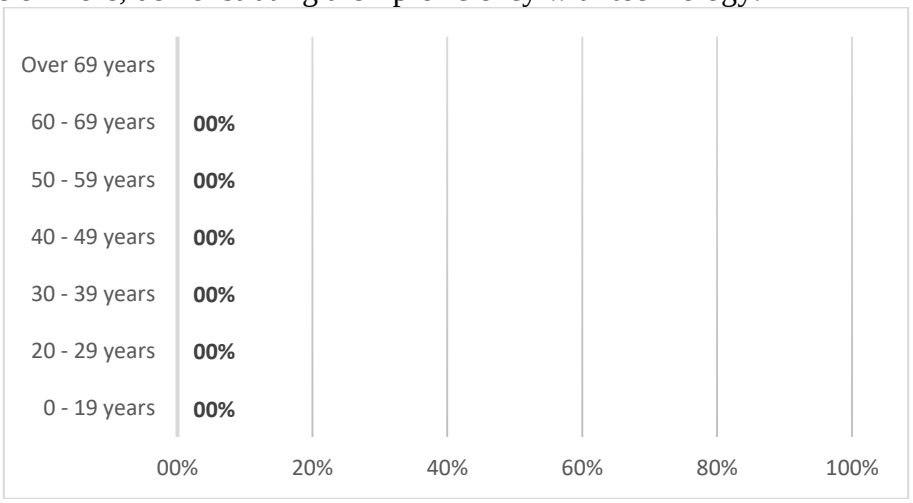

Chart 2. Age of Respondents

According to the data provided, it seems that there are probably inequalities in internet accessibility across different types of areas. Out of the 286 respondents, a large majority of the respondents (84.6%) live in urban areas, while only 10.5% live in suburban areas, and a mere 4.9% live in rural areas. This suggests that people living in rural areas may have limited access to the Internet compared to those living in urban and suburban areas.

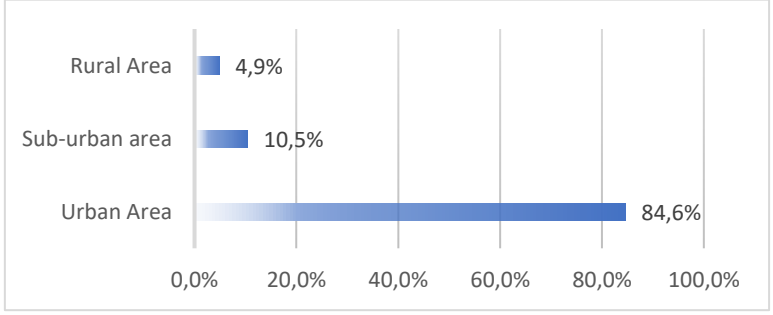

Chart 3. Location of Respondents

In terms of income, almost 45% of respondents had more than ALL 150,000, indicating that the sample was concentrated among the upper class of earners, who are probably accessing digital public services at a higher rate than other income groups.

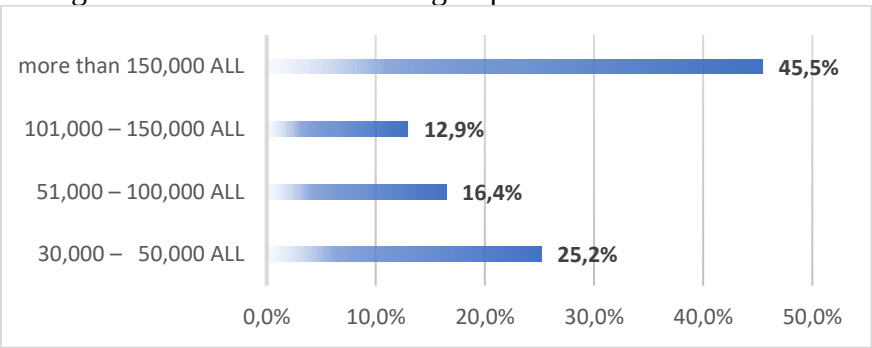

Chart 4. Income level of Respondents

4.2. Aspects influencing digital public service delivery

According to the respondents' perception of this study, it seems that digitalizing public services can have several benefits. People generally believe that it makes public services more accessible and easier to use, while also saving time. Respondents in the study rated the "Digitization of Public Services enables the saving of public time" at (6.11) and "Digitalization of Public Services enables easier access to public services" at (5.4), which suggests that they have a positive perception of the impact of digitization. The results are presented in *Chart 5*.

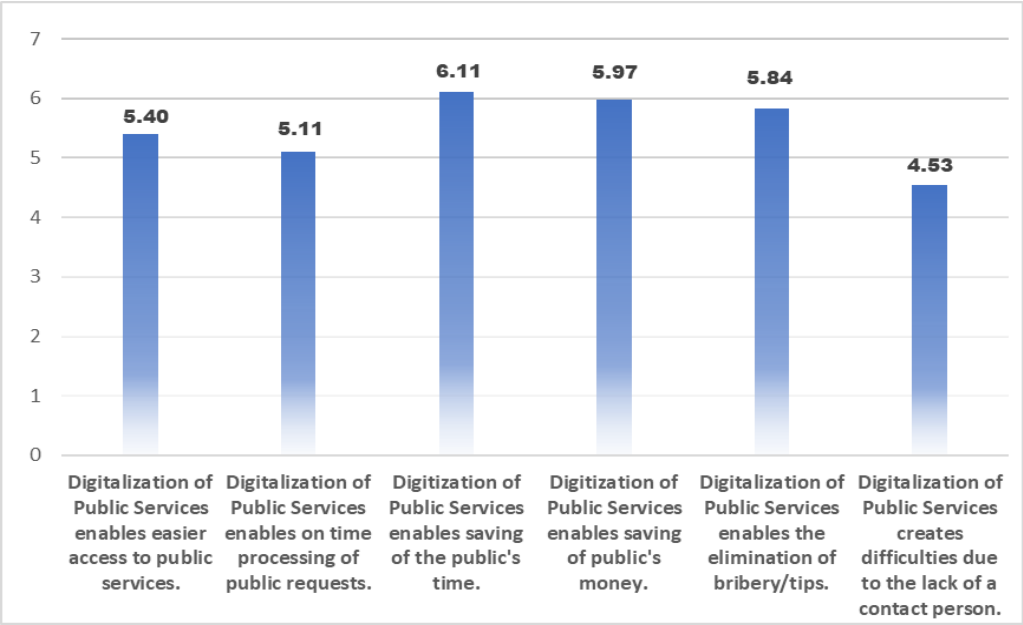

Chart 5. Perception of factors influencing digitalization of public service

Furthermore, digitizing public services can reduce costs for the public, and help to eliminate bribery/tips. The rating for "Digitalization of Public Services enables the elimination of bribery/tips" at (5.84). However, it's important to keep in mind that some challenges come with this process. For instance, the lack of a defined point of contact can make it difficult for citizens to receive public service digitally, which is something worth considering.

Regardless of the respondents' positive approach to the opportunities brought by the digitization of public services, considering the results in *Chart 6*, the respondents rank on average the satisfaction they have from receiving services in this form and the progress of digitization.

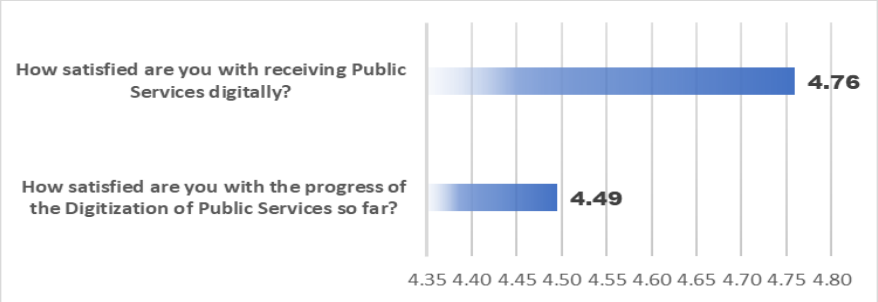

Chart 6. Perception of the level of satisfaction among citizens with digital public service delivery and the progress of digitalization

Based on the mean perception rating (*from 1 = strongly disagree, through 5 = neutral to 7 = strongly agree*) they rank "How satisfied are you with receiving Public Services digitally?" at 4.76 and "How satisfied are you with the progress of the Digitization of Public Services so far? " at 4.49. This demonstrates that more should be done in this direction by governments and public institutions to reach the aim of digitalization, to become more effective and efficient.

4.3. Demographics and opportunities/challenges of public service digitalization

Next, it is analyzed if respondents' perceptions of the opportunities and problems associated with the digitization of public services are influenced by variables like age, income level, or location as perceived by them.

As we can see from the results in *Chart 7*, the oldest group age (40-49) is more aware of the positive impact of digitalization in public service compared to other age groups. This might have to do with the fact that people in this age range utilize public services more frequently than people in younger age groups. But on the other hand, they are less adept at using digital public services than young people. This derives from the fact that this age group perceives that the provision of public digital services creates difficulties due to the lack of a contact person. So, they are conscious that the biggest opportunities are connected with even more challenges.

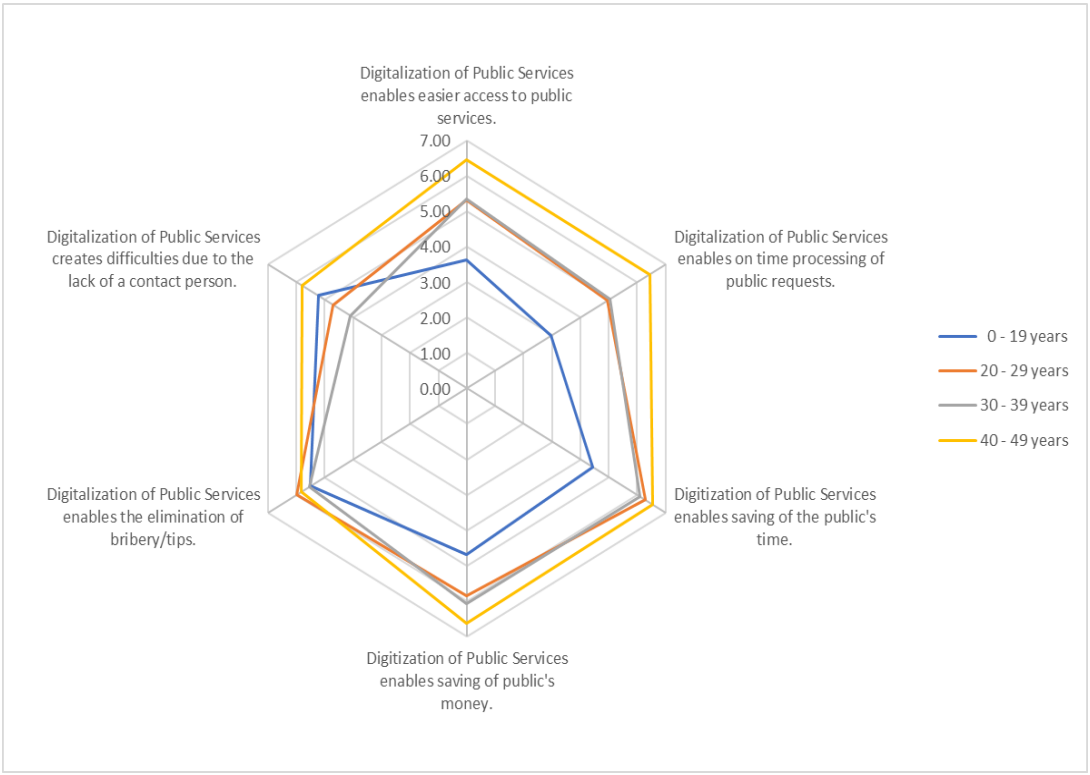

Chart 7: Age group & Opportunities/challenges related to the digital delivery of public services in Albania

The findings presented in *Chart 8* regarding the correlation between the income level and opportunities/challenges related to the digital delivery of public services show, that all groups believe that the digitization of public services allows for savings in public time and money as well as the elimination of bribery/tips. According to income level, there appears to be variation in respondents' perceptions regarding the promptness and ease of access for public requests. At an average rating of more than *6* the highest income groups (101,000–150,000 and over 150,000) rank more than the lowest income groups (30,000–50,000 and 51,000–100,000), which score at an average of 5, considering mean perception rating (*from 1 = strongly disagree, to 7 = strongly agree*). Moreover, it can also be noted that the groups with the lowest income perceive the lack of contact with a person in receiving digital services as more challenging than the groups with the highest income.

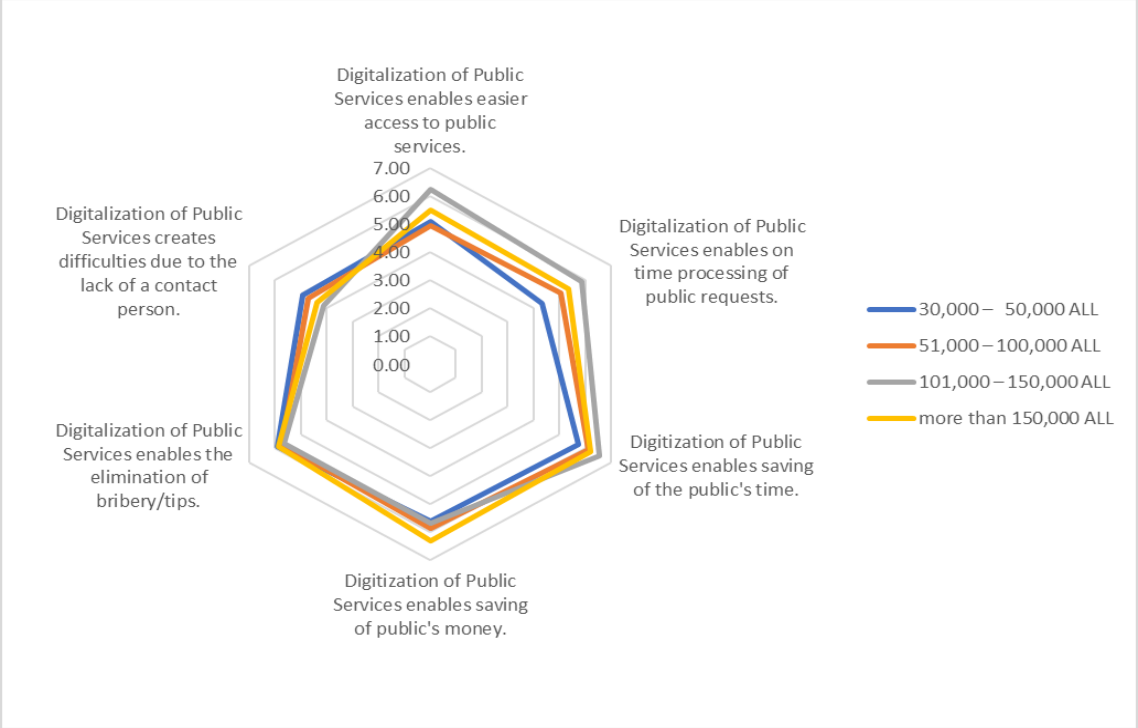

Chart 8: Income level & Opportunities/challenges related to digital delivery of public services in Albania

There are variations in respondents' perceptions when it comes to the relationship between location and opportunities/challenges associated with the digitalization of public services in Albania, as demonstrated by the results presented in *Chart 9*.

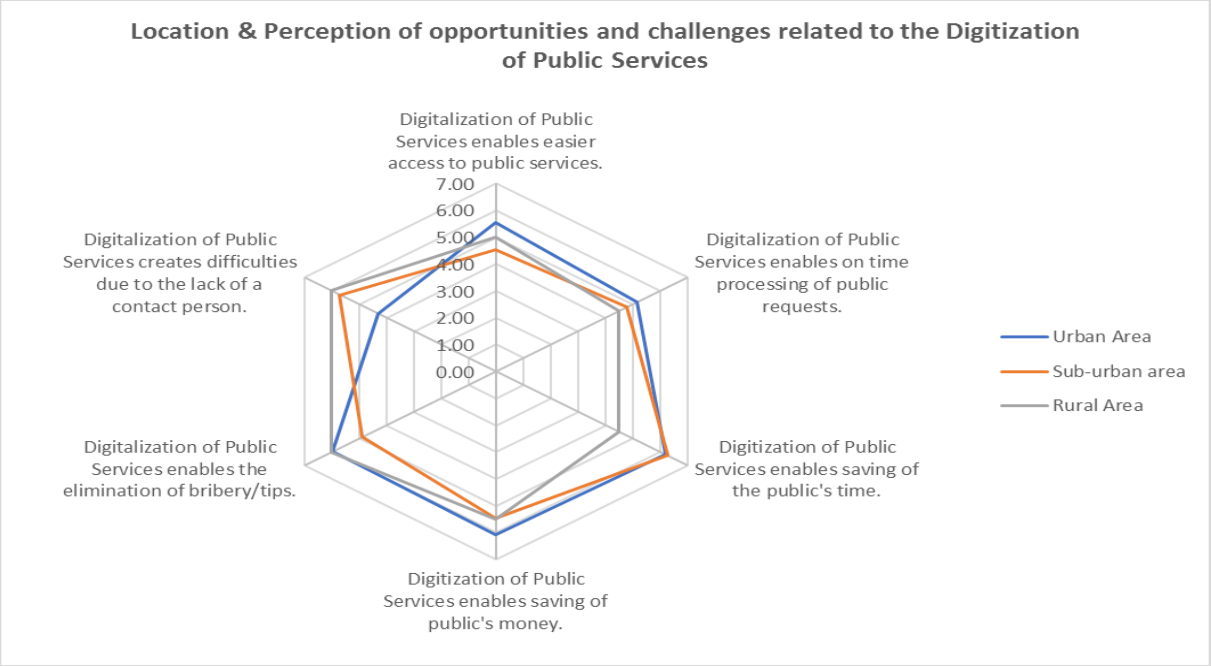

Chart 9: Location & Opportunities/challenges related to the digitalization of public services in Albania

Compared to people who reside in suburban or rural areas, those who live in urban areas embrace the opportunities provided by digitizing public services.

Accordingly, they believe that offering services in this manner facilitates quicker processing of citizen requests and simpler access to public services, saving both time and money.

When it comes to the challenges that the digitization of public services can bring, the group living in rural areas perceives that the provision of services in this way can create difficulties due to the lack of contact with a person more than those who live in the suburban or urban areas. Based on these results we can conclude that location so governments must do more to provide access to digital public services.

5. Conclusion

Albania's growth and development depend heavily on digitization. It can potentially improve society as a whole, raise digital literacy, and quickly extend broadband connectivity.

Aiming to increase trust in digital services and increase the level of digitization, every government initiative aimed at "going digital" should be interpreted as an effort to involve as many stakeholders as possible. This will help close the digital divide and make it easier for all citizens and businesses to access services. Governments and policymakers need to consider these various attitudes and challenges when implementing digital public services. Efforts should be made to address concerns, bridge the digital divide, and ensure that the benefits of digitalization are accessible to all citizens.

Overall, the research findings of our study show that Albanian citizens evaluate the opportunities that digitalization of public service has brought. The citizens can save time, have easier access to public services, and have their requests processed promptly thanks to the digitization of public services. Additionally, digitizing governmental services allows for the elimination of bribery and tips while also saving money for the public. However, it also presents challenges because there is no designated point of contact, which could be a barrier to facilitating. This last one is particularly crucial for the less income groups, those who reside in rural areas, or those who are older. Based on the research findings, the authors suggested that Albanian public organizations should create policies and practices to encourage broader usage of digital public services, making them more easily accessible and inclusive.

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Historical sciences

STATE SECURITY (SIGURIMI) UNDER THE OPTICS OF THE ALBANIAN PUBLIC

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Abstract

The purpose of this article is to provide information on how the Albanian people saw State Security (Sigurimi) during the early years 1944–1946.

Documentary sources and a poll I conducted from July 11 – August 12, 2023, titled "Albanian public perception on State Security (Sigurimi) during the years 1944-1946," are the primary sources utilized.

The article demonstrates how Albanians view and deal with their communist history as well as their level of awareness of the severity of state violence carried out by the Sigurimi. In conclusion, the Albanian public's perception of State Security (Sigurimi) is presented, with particular attention paid to the Directorate of People's Protection, internments, penalties, persecution of political opponents, post-war justice and trial procedures, the disclosure of crimes, etc.

Keywords: Directorate of People's Protection, State Security (Sigurimi), Communist regime, Albanian public.

Introduction

The embryonic structure of the State Security (Sigurimi) of Albania, in its beginnings, was known as the People's Protection Directorate, but after March 1946, its official name was changed and it was called the Directorate of State Security (Drejtorija e Sigurimit te Shtetit) or the Sigurimi (secret police). In the first years of the communist regime, Sigurimi functioned more as a "secret police".

In Albanian documentary sources it is mentioned that, - the bodies of the Sigurimi or as they were called in the beginning the Directorate of People's Protection were created on December 10, 1944.[1] Koçi Xoxe was appointed as the head of the directorate and Nesti Kerenxhi as his deputy and was followed by the third leading figure, Vaskë Koleci. The Directorate would function as a "political police" and was subordinate to the Ministry of War and National Defense (later renamed the Ministry of National Defense) headed by Enver Hoxha.

From the use of many documents in the Central Archive of the Albanian State and in the Archive of the Ministry of Interior, it turns out that, - for the establishment of the Directorate of People's Protection, the model of the Yugoslav Security of OZNA was taken, and their representatives who were attached to Albania helped in the organization of the DMP. At the end of January 1945, the Directorate of People's Protection began to be organized and functioned according to the Yugoslav model of the OZNA (*Odelenje Zaštite Naroda*).[2]

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[1] *AMB,* F. 4, V. 1948, D. 23, fl. 14; *AQSH*, F. 411/AP, V. 1949, D. 6, fl. 71. Promemorie mbi punën trockiste të organeve të Sigurimit të Shtetit.
Shënim: Në një tekst të vitit 1974, jepet data 14 dhjetor 1944, si datë e themelimit të organeve të Sigurimit të Shtetit, ndërsa në vitin 1962, Sekretariati i KQ dhe Presidiumi i Kuvendit Popullor vendosi si datë e themelimit të Sigurimit të Shtetit të jetë data, 20 mars 1943. Shih më gjerësisht: *AMB,* F. 4, (Kutia 259-260), Historikët e Sigurimit të Shtetit: *Historia e Armës së Sigurimit të Shtetit*, pjesa e dytë (nëntor 1944-1948), përgatitur nga Themi Bare (Tiranë: 1974), 10; *AQSH,* F. 490, V. 1962, D. 366, fl. 1-2; *Fjalori enciklopedik shqiptar* (Tiranë: Akademia e shkencave e RPSSH, 1985), 42. Për mendimin tim, data më e saktë dhe më pranë të vërtetës historike mbi themelimin e Sigurimit të Shtetit është data 10 dhjetor 1944 që e përmend vetë drejtuesi i parë i Sigurimit të Shtetit, Koçi Xoxe.

[2] Në shqip (Organizata ose Drejtoria e Mbrojtjes së Popullit). OZNA udhëhiqej nga Aleksandër Leka Ranković që e drejtoi OZN-ën nga (13 maj 1944 - mars 1946), i cili ishte vartës i drejtpërdrejtë i Komandantit suprem të Ushtrisë Popullore Jugosllave, Marshallit Josip Broz Tito. OZNA u krijua si një entitet autonom., një organizatë ushtarake me një strukturë unitare për të siguruar një vijë të ashpër politike në shërbimet e inteligjencës dhe kundër-zbulimit. Në këtë kohë, ishin ngritur disa seksione për realizimin e disa objektivave të caktuara. Qëllimi i OZNA-s dhe KNOJ (*Korpus Narodne Odbrane Jugoslavije*) ishte, - të pastronte të ashtuquajturit "armiq të popullit". Më gjerësisht mund të konsultohuni me këto burime: Bojan Dimitrijević, *"Intelligence and Security Services in Tito's Yugoslavia 1944-1966", Istorija 20. veka*, god. XXXVII, 2 (Beograd: Institut za savremenu istoriju, 2019), 9-11. Dimitrijević është studiues në Institutin për Historinë Bashkëkohore, Beograd; *OZNA 1944 -1964 Yugoslav Secret Police - State Security Service.*

The Directorate of People's Protection (Sigurimi) was assigned with carrying out several tasks:

➲ Search, detection, and disposal of war criminals and old agents. It was also intended to discover the bases of their accommodation, to capture and expose them in public.

➲ Surveillance and detection of agencies in the direction of foreigners and their missions, as well as suspicious persons who were connected with them.

➲ Protection of important economic objects from damage, sabotage diversions, etc.

➲ Discovery of possible activity organized by anti-government organizations, clergy, political opponents, etc. The main goal was to find out in time and expose people who raised slogans against the Communist Party and its government.

➲ Protection of the Party and the government from foreign agencies and opposing groups.

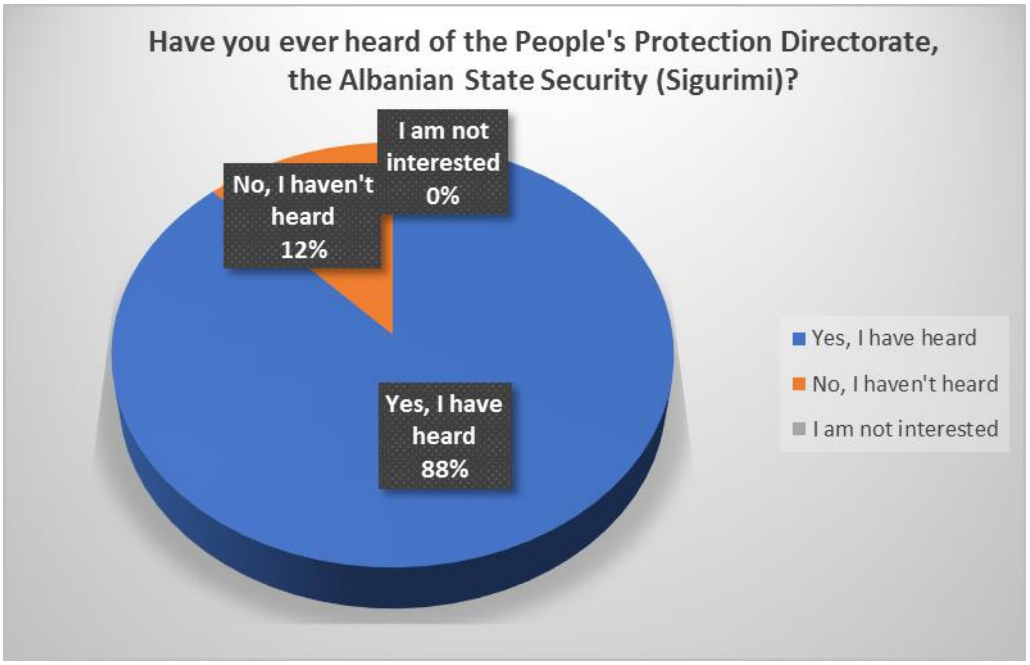
➲ Taking measures to protect the state border, as well as to maintain order and public peace.

➲ The destruction of armed "gangs", the discovery of secret weapons, and the provision of information on the situation on the ground according to the districts.[3]

How Albanians see State Security (Sigurimi) after the fall of the communist regime

The Sigurimi operated under this name until 1991. To see the perception of the Albanian public, what they think about the beginnings of secret police and the repressive measures implemented, an online survey was conducted, where different categories of people were selected. The survey titled: "Albanian public perception on the State Security (Sigurimi) during the years 1944-1946" conducted on July 11 - August 12, 2023 (by the author). The survey aimed to collect information from the Albanian public on how they see the communist past, as well as measuring their knowledge of Secret Police.

The main goal is to see the way citizens face and approach the communist past, and how informed they are about the intensity of state violence carried out through the State Security. From the respondents, it turns out that - 88% of them have heard about the Directorate of People's Protection (Albanian State Security), 12% have not heard about this body of the dictatorship and are not informed.

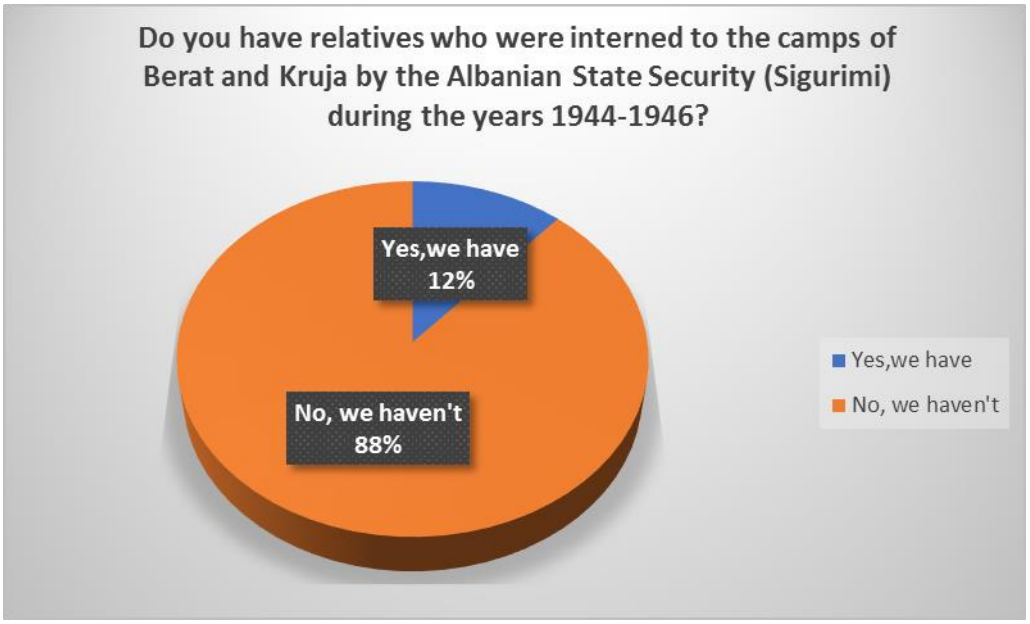


*(**Chart no. 1**) Have you ever heard of the People's Protection Directorate, the Albanian State Security (Sigurimi)?*

RARE PIN BADGE, i disponueshëm [online] në: https://www.ebay.com/itm/OZNA-1944-1964-Yugoslav-Secret-Police-State-Security-Service-RARE-PIN-BADGE-/162610369051, tërhequr më 1 janar 2022; Коста Николић, *Мач револуције: ОЗНА у Југославији 1944–1946* (Београд: Службени гласник, 2013).

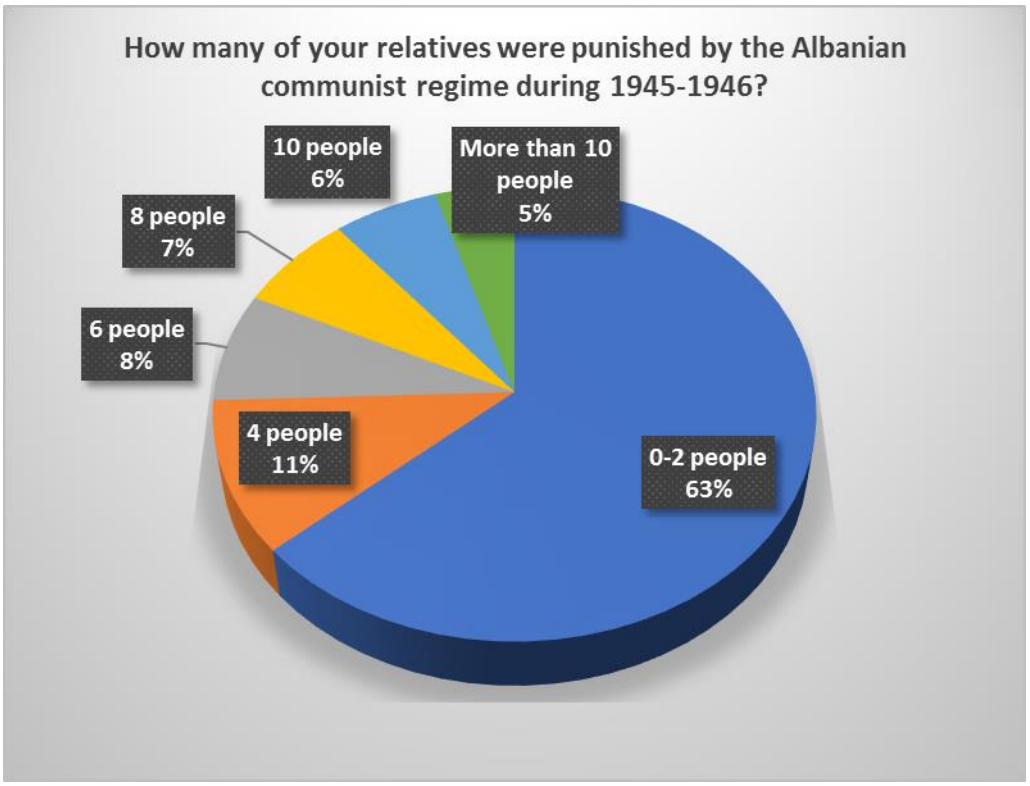
[3] Konsultohuni më gjerësisht në: AMB, F. 4, (Kutia 261-264), Historikët e Sigurimit të Shtetit të degëve të punëve të brendshme Shkodër, Dibër, Kukës, Tiranë, Elbasan, Vlorë, Sarandë.

Respondents were also asked about the first two camps of the communist regime (Berati and Kruja). They admit that they had relatives who were convicted and who served the sentence in the camp of Berati and Kruja. 12% of them stated that they had relatives in these camps, and 88% did not.



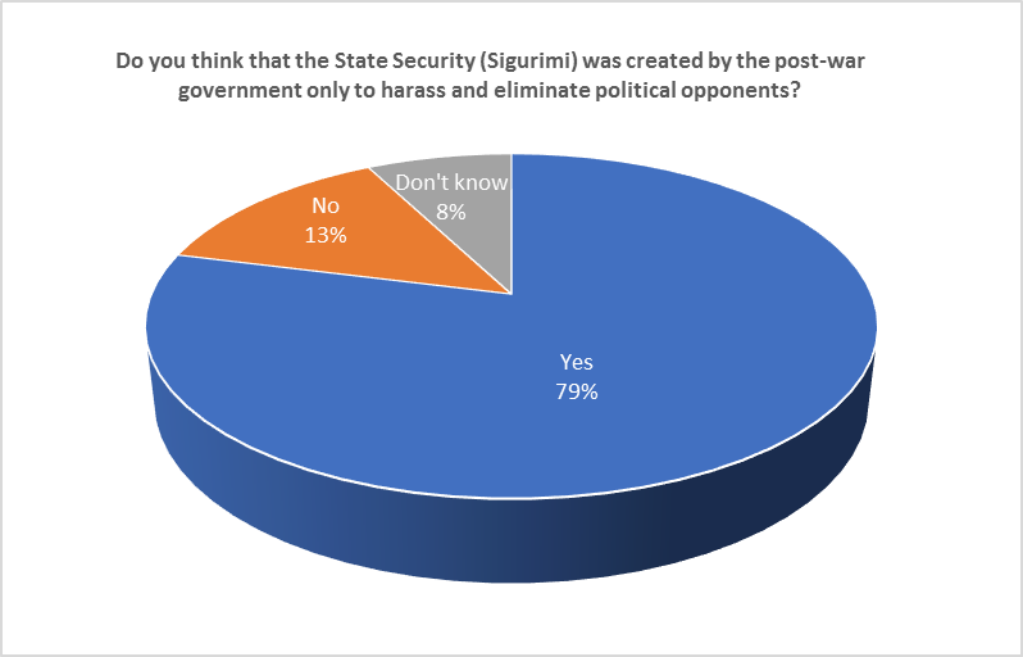
*(**Chart no. 2**) Do you have relatives who were interned to the camps of Berati and Kruja by the Albanian State Security (Sigurimi) during the years 1944-1946?*

According to the survey, it turns out that the respondents have relatives who have been punished by the regime, as follows: 0-2 people 63%, 4 people 11%, 6 people 8%, 8 people 7%, 10 people 6%, and over 10 people 5%.



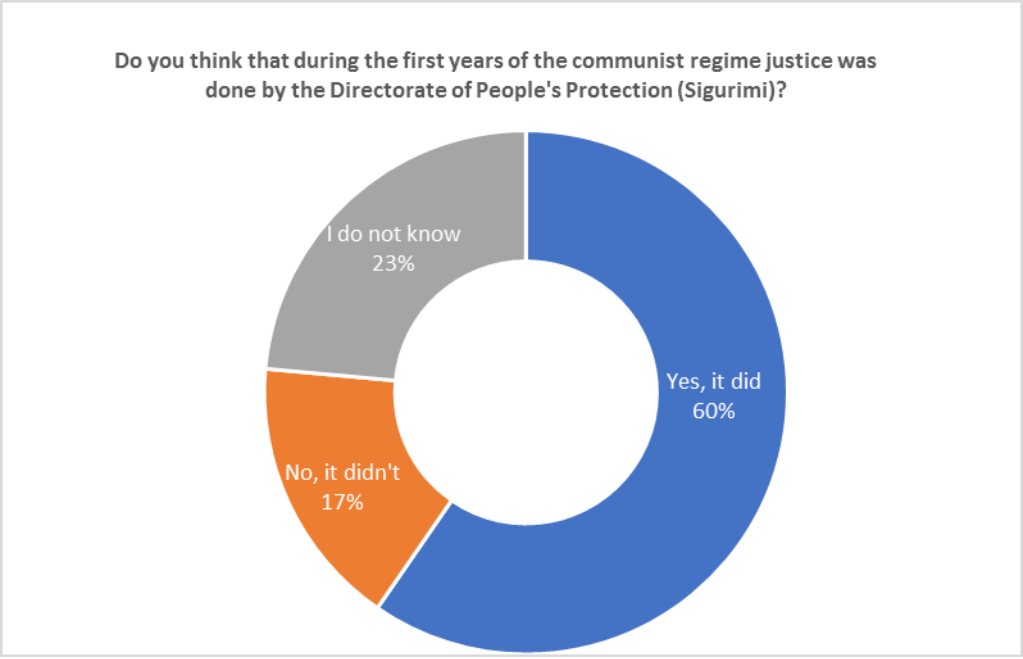
*(**Chart no. 3**) How many of your relatives were punished by the Albanian communist regime during 1945-1946?*

Respondents were asked, - if the State Security was created by the post-war government only to persecute political opponents? About 79% of them think that it was created just for this reason, and 13% of them did not think that it was created for this reason, and 8% of them did not know.



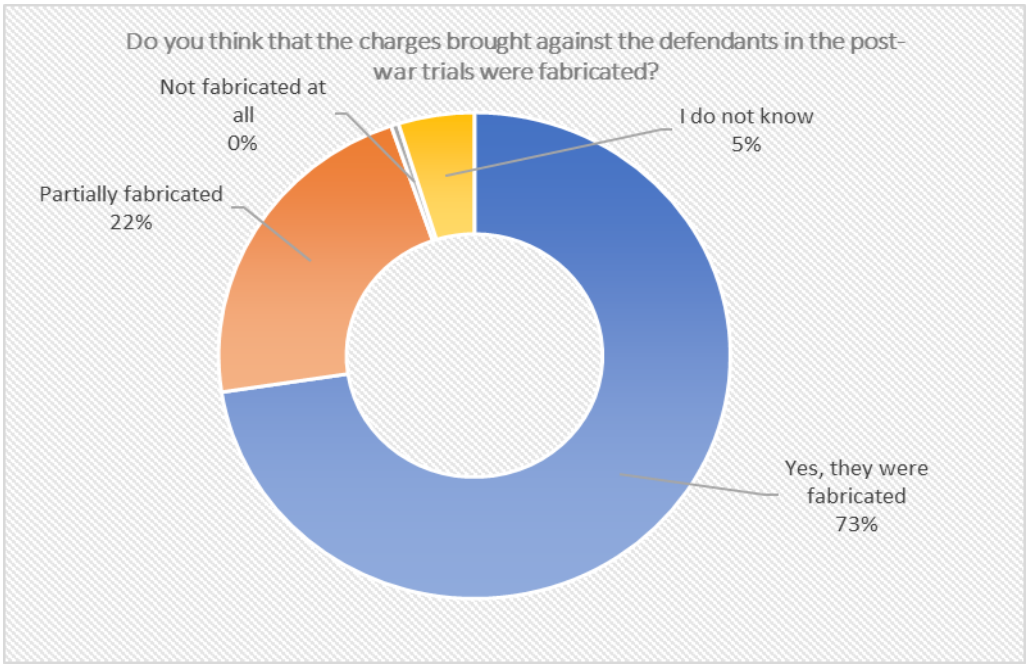
*(**Chart no. 4**) Do you think that the State Security (Sigurimi) was created by the post-war government only to harass and eliminate political opponents?*

When asked if justice was done by the Directorate of People's Protection (Sigurimi) in the first years of the regime, it turns out that, - 60% of the respondents thought that it did justice; 17% did not think it did justice, and 23% of them did not know, did not have a correct answer.



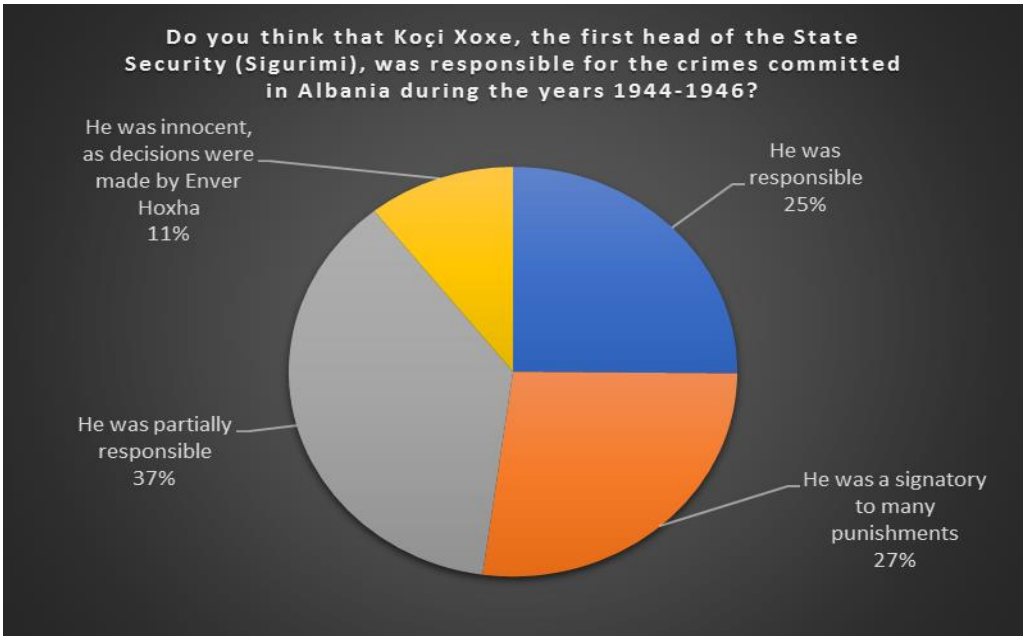
*(**Chart no. 5**) Do you think that during the first years of the communist regime justice was done by the Directorate of People's Protection (Sigurimi)?*

73% of the respondents said that the charges brought against the defendants in the post-war trials were fabricated; 22% stated that they were partially fabricated; 0%, not made up at all, 5% said they don't know.



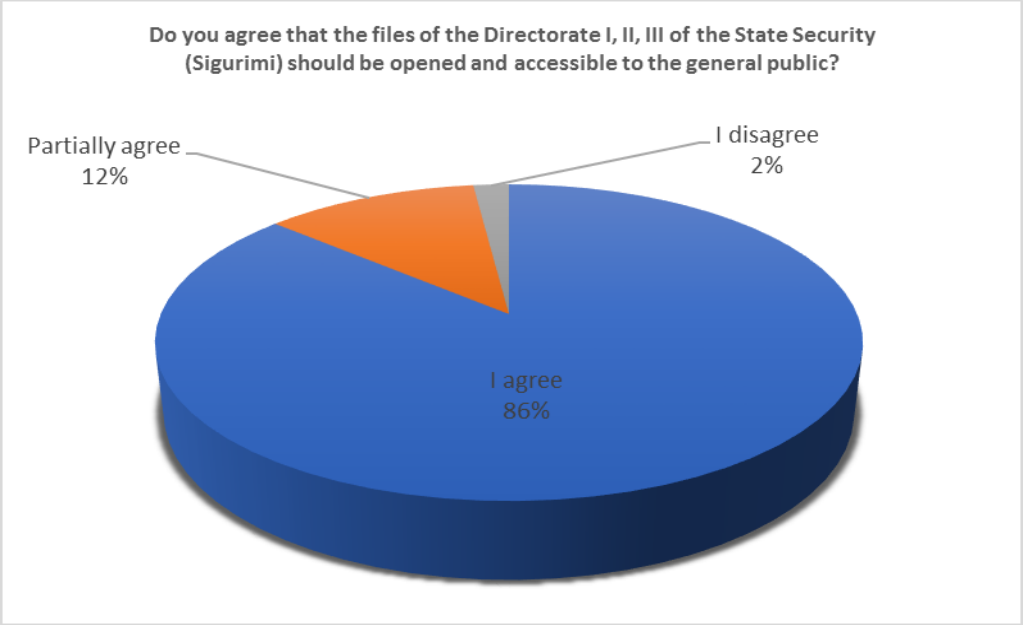
*(**Chart no. 6**) Do you think that the charges brought against the defendants in the post-war trials were fabricated?*

Quite interesting is the harassment of the respondents to the head of the Directorate of People's Protection regarding the responsibility of the crimes committed by the body he led. 25% stated that he was responsible; 27% that he was a signatory of many sentences; 37% that he was partially responsible and 11% said that Enver Hoxha made the decisions.



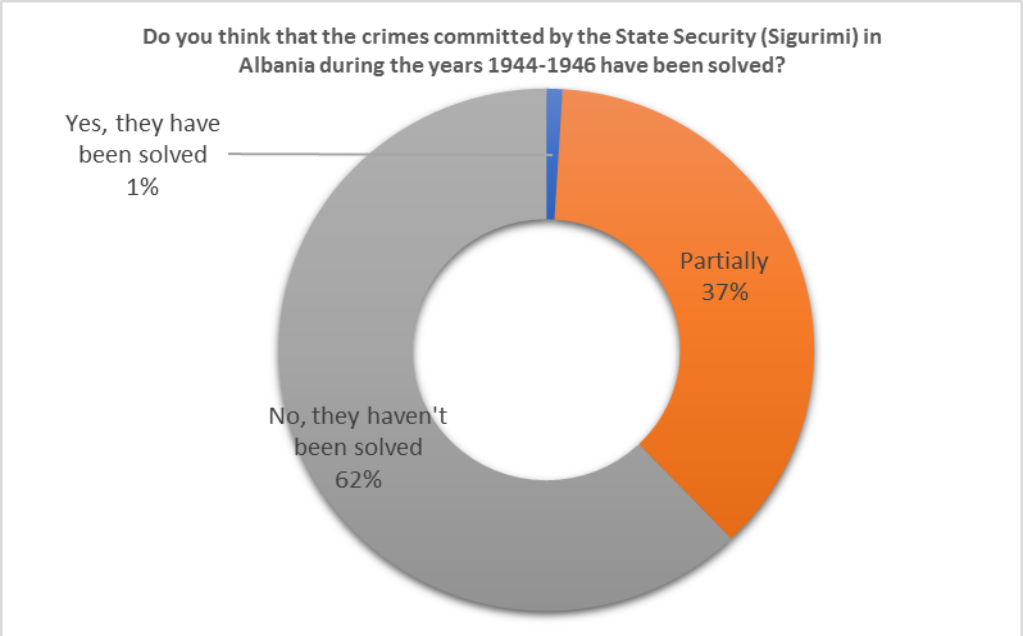
*(**Chart no. 7**) Do you think that Koçi Xoxe, the first head of the State Security (Sigurimi), was responsible for the crimes committed in Albania during the years 1944-1946?*

The opening of the files seems to be in the interest of the majority, as 86% of the respondents are in favor of opening the files of the Sigurimi (Directorate I, II, III of State Security) and the documentary material being accessible to the general public. 12% partially agreed and only 2% disagreed.



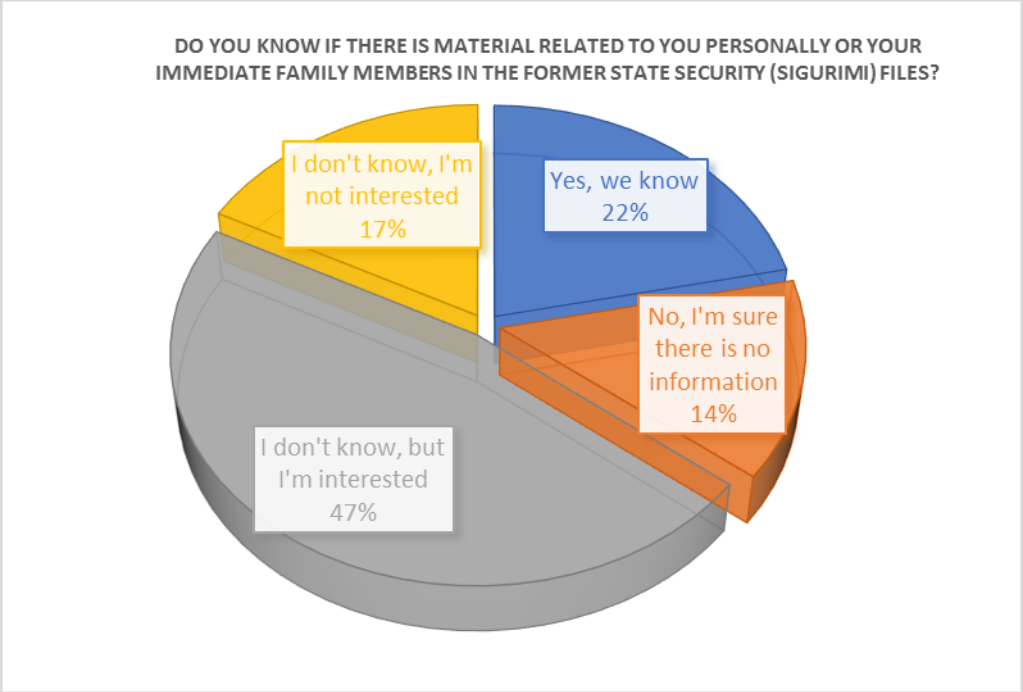
*(**Chart no. 8**) Do you agree that the files of the Directorate I, II, III of the State Security (Sigurimi) should be opened and accessible to the general public?*

1% of the respondents think that the crimes committed by the Sigurimi during the first years of the communist regime have been uncovered; 37% think that they have been partially whitened, and 62% think that they have not been whitened.



*(**Chart no. 9**) Do you think that the crimes committed by the State Security (Sigurimi) in Albania during the years 1944-1946 have been solved?*

22% of the respondents were aware that their relatives have materials in the files of the former Sigurimi; 14% are sure that there are no materials for them; 47% did not know if there are materials for them in the Sigurimi files, but were interested, and only 17% did not know and were not even interested.



*(**Chart no. 10**) Do you know if there is material related to you personally or your immediate family members in the former State Security (Sigurimi) files?*

Conclusions

The Albanian public sees the communist past as a problem that has not yet been done enough to clarify the crimes committed during the installation of the dictatorship in Albania. The survey highlights some of these issues, such as:

1. The non-disclosure of the crimes committed by the Sigurimi. This is seen by the respondents as a problem of the communist past. Based on the statistics, the respondents state that, - not enough has been done in uncovering the crimes of the Sigurimi (secret police) in the first two years of the communist regime. Only 1% of respondents think that these crimes have been solved, 37% think that they have been partially solved, and 62% think that they have not been solved.

2. Not fully opening the Archives. In order to recognize the crimes of the State Security (Sigurimi), the files it administers (AIDSSH)[4] should be made available not only to researchers, but also to the public or interested parties. The opening of these files seems to be in the interest of the majority, as 87% of respondents are in favor of opening the files of the Sigurimi (Directorate, I, II, III) and that the documentary material be accessible to the general public. 12% partially agreed and only 2% disagreed.

3. Interest in the communist past. The survey highlights that 47% of the respondents have expressed their interest and for the relatives they have, if they have documentary material of the Sigurimi on them, in order to get to know the contents of the files, as well as to get to know better the typology of that time. 14% of the respondents are sure that there are no documents for them, and 17% of them did not know, nor were they interested in the file. A small percentage of 22% knew about the documentary material for them and their relatives.

4. Information on how the judicial system worked and the judicial procedures applied during the years 1944-1946. The survey shows that the Albanian public had good knowledge of how justice was developed in that period. 60% of the respondents thought that justice in these years was done by the Directorate of People's Protection (Sigurimi), and 73% of them say that the accusations in the post-war trials held in Albania were fabricated.

[4] Dosjet e Drejtorisë të parë (1945-1991), dytë (1955-1992), tretë/zbulimi politik (1945-1975) të Sigurimit të Shtetit kanë qenë pjesë e Arkivit të Ministrisë së Brendshme. Në vitin 2015 me krijimin e Autoritetit për Informimin mbi dokumentet e ish-sigurimit të shtetit, tre Drejtoritë e Sigurimit të Shtetit u shkëputën nga arkivi i AMB dhe kaluan në administrimin e AIDSSH.

5. The number of persons convicted by the regime. The respondents think that, - Sigurimi was an instrument that was created by the post-war government to eliminate political opponents. A significant number of the regime opponents were arrested and convicted. 63% of respondents stated that they had 0-2 people convicted by the regime, 11% had up to four people, 8% up to 6 people, etc.

6. Responsibility for the repression exercised by the Sigurimi. For all the repression, the crimes that occurred in this period, according to the respondents, burden the first head of Sigurimi, Koçi Xoxen. 52% of the respondents highlight his responsibility for the crimes committed by this body, 37% think that he was partially responsible and only 11% of the respondents think that he was innocent, since the decisions were made by Enver Hoxha.

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Mathematical sciences

WEATHER FORECASTING USING MACHINE LEARNING ALGORITHMS

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Abstract

This papers aims to utilize the power of machine learning to improve the accuracy and efficiency of weather forecasts. The main tasks include the development and implementation of machine learning models capable of learning complex patterns from historical meteorological data, satellite images and other relevant atmospheric parameters.

Keywords: Weather Forecasting, Machine Learning Algorithms, Decision Tree, Random Forest, K-nearest Neighbors (KNN), Data Preprocessing, Real-Time Prediction, Feature Selection

Introduction

Weather forecasting, a critical aspect of modern life, influences diverse sectors such as agriculture, transportation, and disaster management. The conventional methods of weather prediction, relying on numerical models and statistical analyses, often grapple with the intricate dynamics of the Earth's atmosphere. In recent years, the integration of machine learning (ML) algorithms has emerged as a promising avenue to enhance the precision and adaptability of weather forecasts [1].

The project, titled "Weather Forecasting with Machine Learning Algorithms," endeavors to harness the capabilities of machine learning to revolutionize the accuracy and efficiency of weather predictions. This exploration involves the development and application of machine learning models adept at deciphering intricate patterns within historical meteorological data, satellite images, and other pertinent atmospheric parameters [2-4].

Our pursuit encompasses several key components. First and foremost is the meticulous collection and preprocessing of comprehensive datasets, ensuring the quality and reliability of the input information. The subsequent phase involves strategic feature selection and engineering, aiming to discern pivotal variables that significantly contribute to precise weather predictions [5-6].

The crux of our endeavor lies in the development of machine learning models. This includes the exploration and implementation of various algorithms such as regression models, decision trees, support vector machines, and notably, the k-nearest neighbors (KNN) algorithm. The performance of these algorithms is rigorously evaluated using metrics such as Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and accuracy.[7] Machine learning combines data from multiple sources to produce an output prediction, identifies patterns in the dataset and then finds relationships between these patterns using a training dataset. it learns and adapts to test or validation data without the intervention of human intervention [8].

Materials and methods

Decision tree algorithm

Decision Tree Algorithm. Belongs to the family of supervised machine learning, where data are continuously partitioned according to a certain parameter and represented in the form of a tree structure. It is used to solve classification and regression problems and is one of the most popular machine learning algorithms [9].

Random forest classifier

A random forest classifier is a set of tree-based classifiers whose results add up to a single result; it is an ensemble machine learning algorithm that can be implemented for both classification and regression tasks and consists of a set of classifiers known as a decision tree (Tin Kam Ho 1998) (Breiman Leo 2001), the random forest classifier is known for giving accurate predictions, providing flexibility and reducing the risk of overestimation.[10]

KNN

A method for solving classification and regression problems based on the search for the nearest objects with known values of the target variable.[12]

These algorithms were chosen for the task as they have been used in other weather forecasting models and have shown high predictive performance, they were implemented in python programming language using Colabatory notepad and various libraries including pandas, ski-learn and Matplot library were imported for analysis.

Dataset Description: For our proposed system weather data is collected from Kaggle.com and processed using python. We are considering the attributes and their summary for the prediction [12].

Using the Columns :

- precipitation
- temp_max
- temp_min
- wind

We are going to predict the weather condition :

- drizzle
- rain
- sun
- snow
- fog

Decision Tree

```
# Data Processing
import pandas as pd
import numpy as np

pima = pd.read_csv("/content/seattle-weather.csv")

pima
```

	date	precipitation	temp_max	temp_min	wind	weather
0	2012-01-01	0.0	12.8	5.0	4.7	drizzle
1	2012-01-02	10.9	10.6	2.8	4.5	rain
2	2012-01-03	0.8	11.7	7.2	2.3	rain
3	2012-01-04	20.3	12.2	5.6	4.7	rain
4	2012-01-05	1.3	8.9	2.8	6.1	rain
...	...	...	...	...	...	...
1456	2015-12-27	8.6	4.4	1.7	2.9	rain
1457	2015-12-28	1.5	5.0	1.7	1.3	rain
1458	2015-12-29	0.0	7.2	0.6	2.6	fog
1459	2015-12-30	0.0	5.6	-1.0	3.4	sun
1460	2015-12-31	0.0	5.6	-2.1	3.5	sun

1461 rows × 6 columns

Figure 1. “North Kazakhstan” weather prediction dataset

Results and discussion

Make our all varibles numeric with function map():

```
# Data Processing
import pandas as pd
import numpy as np

pima = pd.read_csv("/content/seattle-weather.csv")
d = {'snow': 0, 'rain': 1, 'drizzle': 2, 'sun': 3, 'fog': 4}
pima['weather'] = pima['weather'].map(d)
pima
```

	date	precipitation	temp_max	temp_min	wind	weather
0	2012-01-01	0.0	12.8	5.0	4.7	2
1	2012-01-02	10.9	10.6	2.8	4.5	1
2	2012-01-03	0.8	11.7	7.2	2.3	1
3	2012-01-04	20.3	12.2	5.6	4.7	1
4	2012-01-05	1.3	8.9	2.8	6.1	1
...	...	...	...	...	...	...
1456	2015-12-27	8.6	4.4	1.7	2.9	1
1457	2015-12-28	1.5	5.0	1.7	1.3	1
1458	2015-12-29	0.0	7.2	0.6	2.6	4
1459	2015-12-30	0.0	5.6	-1.0	3.4	3
1460	2015-12-31	0.0	5.6	-2.1	3.5	3

1461 rows × 6 columns

Figure 2. The code fragment for modifying the string

We need to divide the given columns into two types of variables - dependent (or target variable) and independent (or trait variable).

```
feature_cols = [ 'precipitation', 'temp_max', 'temp_min','wind']
X = pima[feature_cols]
y = pima['weather']
```

Figure 3. The code fragment for feature and target selection

We splited the dataset using the train_test_split() function and we need to pass three parameters: feature columns, target and test_set size.

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=1)
```

Figure 4. The code fragment for model validation procedure

Furthermore, we created a decision tree model using Scikit-learn:

```
clf = DecisionTreeClassifier()

clf = clf.fit(X_train,y_train)

y_pred = clf.predict(X_test)
```

Figure 5. The code fragment for building DecisionTreeClassifier model

In the next step, we estimated how accurately the classifier or model can predict the type of cultivars.

```
print("Accuracy:",metrics.accuracy_score(y_test, y_pred))
```

Figure 6. The code fragment for calculating accuracy score

In Figure 7 to be sure of accuracy, let's show the original and predictade varibles.

```
result_df = pd.DataFrame({'Original_Value': y_test, 'Predicted_Value': y_pred})

print(result_df)
```

```
      Original_Value  Predicted_Value
1374               2                3
885                3                2
414                1                1
1003               3                1
201                1                1
...              ...              ...
498                1                1
1119               1                1
1129               1                1
1173               3                3
1168               1                1

[439 rows x 2 columns]
```

Figure 7. The weather forecasting result

In figure 7, we obtained Predicted_Values for North Kazakstan region, where ‘rain’:1, ‘drizzle’:2, ‘Sun’:3.

Table 1.

Results of researches

Algorithm	Number of iterations	Number of features	Number of targets	Train Size,%	Test size, %	Accuracy_score
Decision Tree	1	4	1	70	30	0.76
	2	4	1	80	20	0.75
	3	4	1	60	40	0.74
	4	4	1	90	10	0.82
	5	4	1	40	60	0.76
Random Forest	1	4	1	30	70	0.82
	2	4	1	50	50	0.83
	3	4	1	70	30	0.81
	4	4	1	90	10	0.86
	5	4	1	60	40	0.84
KNN	1	4	1	20	80	0.875
	2	4	1	50	50	0.92
	3	4	1	40	60	0.93
	4	4	1	70	30	0.97
	5	4	1	60	40	0.98

Table 1 shows the results of the iterations using the KNN, Random Forest Classifier and Decision Tree Classifier algorithms.

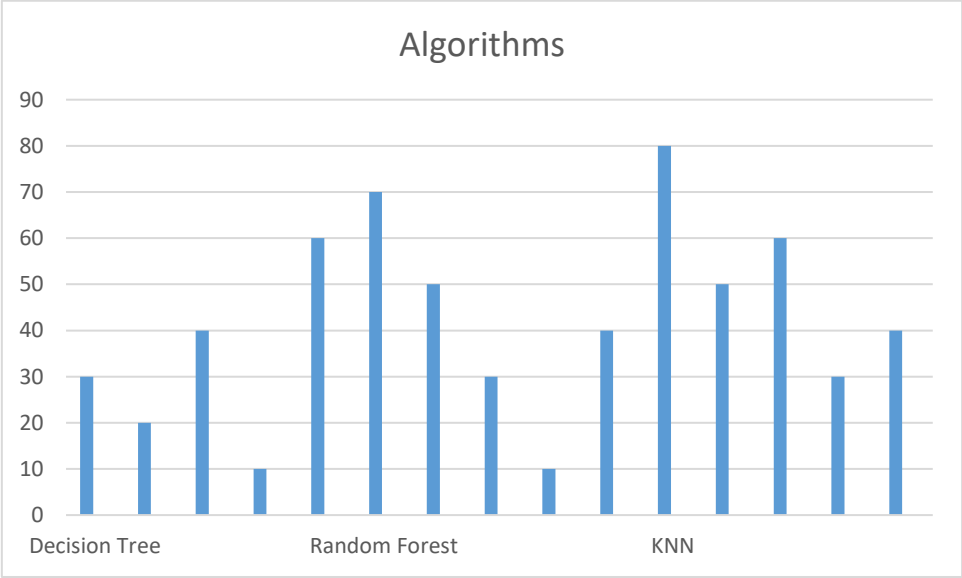

Figure 8. Diagram of the results of iterations using the KNN, Decision Tree Classifier and Random Forest algorithms

Conclusion

In conclusion, the evaluation of these algorithms on the dataset revealed varying performance metrics. Looking at the results on Figure 1 the best classifier for predicting KNN. But each algorithm has its strengths and weaknesses, which should be considered based on the specific requirements of the classification task.

Our expedition through these algorithms illuminates a nuanced landscape. Further expeditions into feature engineering and the secrets of hyperparameters could unlock greater potential. Each algorithm presents its unique strengths and weaknesses, offering a spectrum of possibilities for tailored solutions.

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Medical sciences

THE VARIANTS OF THE ZYGOMATICOFACIAL FORAMEN IN THE ELDERLY AGE PERIOD

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Introduction. Due to its anatomical position, the zygomatic bone is considered one of the most important elements of the facial skeleton during osteotomies of the upper jaw, fractures of the midface, cosmetic interventions, and some other operations. In such operations, it is common practice to intervene on the facial surface of the zygomatic bone. The zygomaticofacial foramen has been proposed to be used as a landmark for orbitozygomatic osteotomy. Knowledge of its anatomy is important to facilitate the procedure of local nerve block during injuries [1]. The orbitozygomatic craniotomy is widely used in neurosurgical operations on the skull base. In this case, an important step of the craniotomy is to reach the lateral end of the inferior orbital fissure. This is possible by passing through the zygomatic bone and crossing over the lateral edge of the orbit. Thus, determining the lateral end of the inferior orbital fissure is of great importance [2]. According to [3], the presence of a single zygomaticofacial foramen is generally accepted as the most acceptable anatomical landmark. An incision made near this foramen reaches the inferior orbital fissure in 96% of cases. Increasing the number of zygomaticofacial foramen decreases the value of this structure in craniotomy.

The results showed that cases of detection of a single zygomaticofacial foramen were more frequent than cases of detection of two or more corresponding foramens (52.9%). The zygomaticofacial foramen is characterized as a structure with a high frequency of detection and is prone to anatomical variations. At the same time, a single zygomaticofacial foramen is mostly identified, although cases with two, three, and sometimes four zygomaticofacial foramen on one zygomatic bone have been described [4]. The zygomaticofacial foramen is located at the site where the zygomatic implants are placed [5].

Thus, the theoretical and clinical significance of the anatomical variants of the zygomaticofacial foramen is quite high; however, a review of the literature shows that not all studies have taken into account the age aspect of these variants. Therefore, we undertook a study of the variants of the zygomaticofacial foramen in the elderly age period.

Purpose of the study. The aim of the investigation was to study the variants of the zygomaticofacial foramen in the elderly age period.

Materials and research methods. 18 male skulls (age: 61–74 years) and 22 female skulls (age: 56–74 years) were used as material for the study. The cranioscopic method and the method of computed tomography were applied in the study. The classification of the variants of the zygomaticofacial foramen in our study is based on [6], according to which the following types of the zygomaticofacial foramens must be identified: absence of the foramen, a single small foramen, multiple small foramina, a single large foramen, one large and any number of smaller foramina, two large foramina, two large foramina, and any number of smaller foramina. The program "IBM Statistics SPSS-26" was used for statistical analysis; for analyzing the obtained arithmetic data, the Pearson Chi-Square Test and Mann-Whitney U test were used. The limit of statistical significance was taken as $p = 0.050$.

Research results. The study of variants of the zygomaticofacial foramen showed that on 18 male skulls of the elderly age period, the foramen was not found on the left side in 7 cases (38.9%) and on the right side in 6 cases (33.3%). On male skulls from the elderly age period, variants of a single small foramen and multiple small foramina were not found on both sides. A single large foramen as a variant of the zygomaticofacial foramen on the left side was found in 10 cases (55.6%) and on the right side in 9 cases (50%). The variant of one large and any number of smaller foramina was not found on the facial surface of the left zygomatic bone; on the right zygomatic bone, this variant was found in one case (5.6%). Two large foramina were found on the left side in one (5.6%) and on the right side in two (11.1%) cases. Two large foramina and any number of smaller foramina on male skulls of the elderly age period as a variant of the zygomaticofacial foramen were not detected.

On 22 female skulls, the zygomaticofacial foramen was not found on the left zygomatic bone in 7 cases (31.8%) and on the right zygomatic bone in 4 cases (19%). As well as on male skulls of the elderly age period variants, a single small foramen and multiple small foramina were not found on female skulls on both sides. A single large foramen on the facial surface of the zygomatic bone on the left side was found in 10 cases (45.5%), on the right side in 8 cases (38.1%). The variant of one large and any number of smaller foramina was not found on the left zygomatic bone; it was located on the right zygomatic bone in one case (4.8%). Two large foramina on the left zygomatic bone were located in 5 cases (22.7%) and on the right zygomatic bone in 6 cases (28.6%). Two large foramina and any number of smaller foramina on female skulls of the elderly age period were not found on the left side; on the right side, they were found in 2 cases (9.5%).

Overall, of the 40 skulls examined, the left zygomaticofacial foramen was absent in 14 cases (35%), and the right zygomaticofacial foramen was not found in 10 cases (25.6%). A single small foramen and multiple small foramina were not found on male and female skulls. A single large foramen was found on the left zygomatic bone in 20 cases (50%) and on the right zygomatic bone in 17 cases (43.6%). The variant of one large and any number of smaller foramina on the zygomatic bones was located in 2 cases (5.1%) and only on the right side. Two large foramina on the left zygomatic bone were located in 6 cases (15%) and on the right zygomatic bone in 8 cases (20.5%). Two large foramina and any number of smaller foramina on the left side were not found; on the right side, this variant of the zygomaticofacial foramen was found in 2 cases (5.1%).

The use of Pearson Chi-Square tests for the left zygomaticofacial foramen in the elderly showed that the difference was not statistically significant ($P\chi2 = 0.318$). The use of the Mann-Whitney U test showed that the difference was also not statistically significant for the left zygomaticofacial foramen ($PU = 0.310$). Also, the application of Pearson Chi-Square tests for the right zygomaticofacial foramen showed that the difference was not statistically significant ($P\chi2 = 0.373$). Application of the Mann-Whitney U test revealed that the difference for the right zygomaticofacial foramen was also statistically insignificant ($PU = 0.071$).

Conclusion. According to the data obtained, a single large foramen is the most common variant for the zygomaticofacial foramen in the elderly age period, although the absence of a foramen and two large foramina as variants of the zygomaticofacial foramen also occurred with some frequency. These findings may be useful in planning and performing facial surgical interventions.

Keywords: zygomaticofacial foramen, skulls, elderly age period.

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A STUDY OF STEAKHOLDER SATISFACTION IN A MULTIDISCIPLINARY HOSPITAL

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ИЗУЧЕНИЕ УДОВЛЕТВОРЁННОСТИ СТЕЙК-ХОЛДЕРОВ В МНОГОПРОФИЛЬНОЙ БОЛЬНИЦЕ

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Организация экстренной медицинской помощи в мирное время - одна из «молодых» наук, весь исторический опыт которой на протяжении одного века. В отличие от военной медицины, изначально складывающейся как медицина неотложных состояний (в первую очередь травм), о необходимости организации скорой помощи заговорили лишь в конце 19 века [3,4]. Это было обусловлено, в первую очередь, ростом городов и техническим прогрессом в области промышленности [5]. За 100 лет скорая помощь прошла путь от первых пароконных повозок до современной технологически насыщенной системы, включающей мощный догоспитальный и госпитальный этапы, сеть научно-исследовательских институтов [6].

Основы современных представлений о рациональной организации этого вида помощи были заложены в 60-70 годах 20 века, во многом благодаря усилиям сотрудников НИИ им. Н.В.Склифосовского под руководством профессора Б.Д.Комарова. Ими было сформировано представление об экстренной медицинской помощи как о специализированном виде помощи.

Всего нами было опрошено 265 пациентов, которым задали один единственный вопрос: «Как бы оценили оснащённость, имеющиеся помещения, комфортность пребывания и в целом организацию работы приемного отделения?» с возможностью дать один единственный ответ на выбор: отлично; хорошо; плохо; очень плохо. Получены следующие результаты:

1. «Отлично» - 13 пациентов (5 %).
2. «Хорошо» - 114 пациентов (43 %).
1. «Плохо» - 125 пациентов (47 %).
2. «Очень плохо» - 13 пациентов (5 %).

На рисунке 1 в виде диаграммы представлено распределение результатов опроса пациентов.

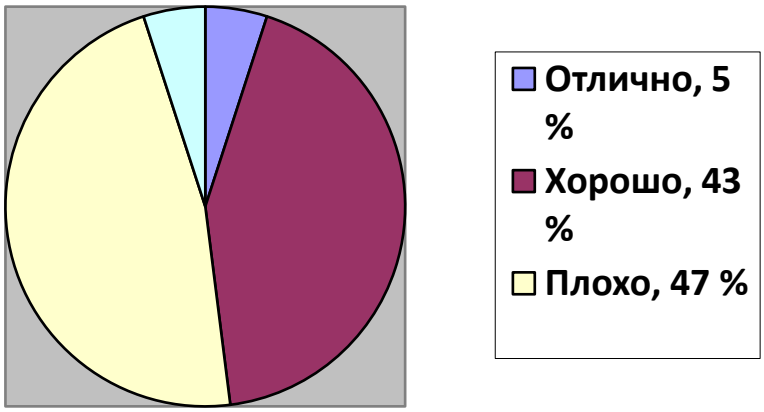

Рисунок 1. Результаты опроса врачей по удовлетворённости организацией приёмного отделения

Как видно из результатов проведённого опроса в структуре ответов пациентов преобладают неудовлетворительные оценки («плохо» и «очень плохо»), что составило чуть больше половины ответов респондентов - 52 %, против удовлетворительных оценок («отлично» и «хорошо») - 48 %. Также отмечаем, что получено сравнительно очень низкое число отличных оценок опрошенных респондентов - 13 пациентов из 265 пациентов (5 %).

Полученные результаты демонстрируют, что имеющаяся организация работы приёмного отделения Мангистауской областной многопрофильной больницы характеризуется очень низким количеством удовлетворённых пациентов (52 %). «Как бы вы оценили оснащённость, имеющиеся помещения, комфортность труда и отдыха, и в целом организацию работы приемного отделения?» с возможностью дать один единственный ответ на выбор: отлично; хорошо; плохо; очень плохо. Отмечаем, что опрашивались как штатные сотрудники, которые проводят в условиях приёмного отделения полноценный рабочий день, так и внешние/внутренние совместители, которые могут работать (дежурить) в приёмном отделении в ночное время, реже дневное время, выходные и праздничные дни. Получены следующие результаты:

1. «Отлично» - 0 медицинских работников (0 %).
2. «Хорошо» - 20 медицинских работников (28 %).
3. «Плохо» - 49 медицинских работников (68 %).
4. «Очень плохо» - 3 медицинских работника (4 %).

На рисунке 2 в виде диаграммы представлено распределение результатов опроса медицинских работников приёмного отделения.

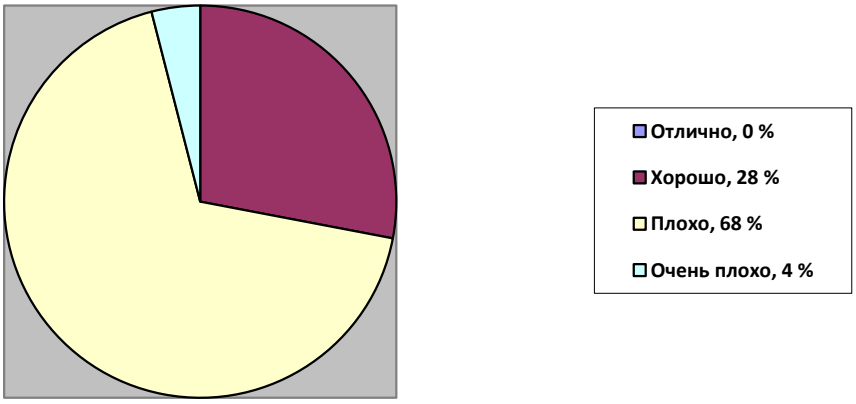

Рисунок 2. Результаты опроса медицинских работников по удовлетворённости организацией приёмного отделения

Как видно из результатов проведённого опроса в структуре ответов пациентов преобладают неудовлетворительные оценки («плохо» и «очень плохо»), что составило почти 3/4 всех ответов респондентов - 72 %, против удовлетворительных оценок («хорошо») - 28 %. Данный факт расценён нами как критический результат, свидетельствующий об абсолютной неудовлетворённости медицинских работников условиями труда и отдыха в приёмном отделении. Также их опыт, знания, соответствующее образование позволяет им достаточно объективно и "трезво" оценивать существующие реалии приёмного отделения.

Примечательно, что отличных оценок от медицинских работников, к сожалению, не получено.

Полученные результаты демонстрируют, что имеющаяся организация работы приёмного отделения Мангистауской областной многопрофильной больницы характеризуется крайне низким количеством удовлетворённых медицинских работников (72 %). Изучение удовлетворённости представителей пациентов приемного отделения: всего нами было опрошено 105 законных представителей пациентов, которым задали один единственный вопрос: «Как бы вы оценили оснащённость, имеющиеся помещения, комфортность пребывания, организацию работы приемного отделения?» с возможностью дать один единственный ответ на выбор: отлично; хорошо; плохо; очень плохо. Получены следующие результаты:

1. «Отлично» - 0 представителей пациентов (0 %).
2. «Хорошо» - 58 представителей пациентов (55 %).
3. «Плохо» - 46 представителей пациентов (44 %).
4. «Очень плохо» - 1 представитель пациента (1 %).

На рисунке 3 в виде диаграммы представлено распределение результатов опроса законных представителей пациентов приёмного отделения больницы.

Как видно из результатов проведённого опроса в структуре ответов пациентов неудовлетворительные оценки («плохо» и «очень плохо») составляют примерно половину - 45 %, против удовлетворительных оценок («хорошо») - 55 %.

Примечательно, что отличных оценок от законных представителей пациентов, к сожалению, не получено.

Полученные результаты демонстрируют, что имеющаяся организация работы приёмного отделения характеризуется достаточно низким количеством удовлетворённых законных представителей пациентов (55 %).

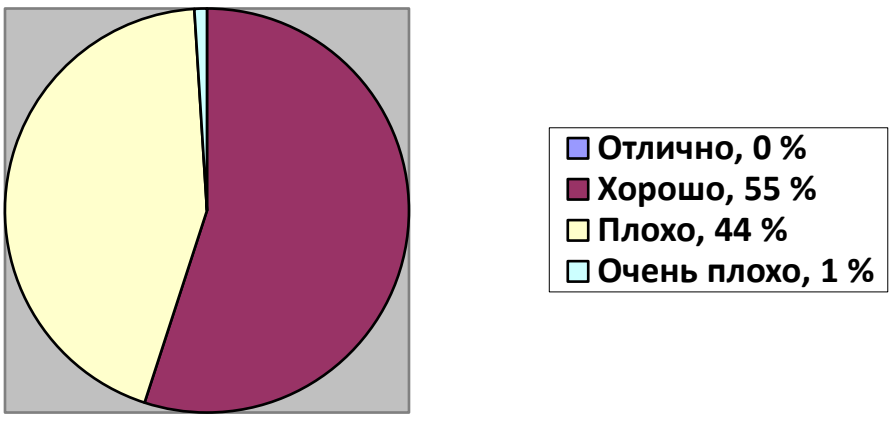

Рисунок 3. Результаты опроса представителей пациентов по удовлетворённости организацией приёмного отделения

Выводы. Отмечаем крайне низкую удовлетворённость качеством медицинской помощи населения Республики Казахстан (2022 год - 57,7 %) [2] и неуклонный рост числа жалоб.

Безусловно на этот показатель влияет и организация приёма пациентов, сортировка потоков в приемно-диагностических отделениях.

Имеющаяся организация работы приёмного отделения КГП " Мангистауская областная многопрофильная больницы" характеризуется очень низкой удовлетворённостью всех имеющихся стейк-холдеров (43,6 %) и требует значительной оптимизации всех площадей и процессов.

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AN INTEGRATED APPROACH TO THE ASSESSMENT OF AN ELDERLY PATIENT WITH ATHEROSCLEROSIS OF THE BRACHYCEPHALIC ARTERIES

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КОМПЛЕКСНЫЙ ПОДХОД К ОЦЕНКЕ ПОЖИЛОГО ПАЦИЕНТА С АТЕРОСКЛЕРОЗОМ БРАХИЦЕФАЛЬНЫХ АРТЕРИЙ

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Сердечно-сосудистые заболевания (ССЗ) это проблема общественного здравоохранения и основная причина смертности и заболеваемости во всем мире [1]. Основной причиной большинства сердечно-сосудистых заболеваний является атеросклероз, представляющий собой медленно прогрессирующее хроническое заболевание средних и крупных артерий, которое клинически проявляется ишемическими явлениями. [2] Нестабильная бляшка способствует внезапному возникновению острых коронарных событий или инсультов. Воспаление является главным компонентом атеросклероза. Интерлейкин 1 (IL-1) классический провоспалительный цитокин, который индуцирует выработку цитокинов и хемокинов в сосудистых клетках, в результате чего происходит прогрессия атеросклеротической бляшки. Клетки гладких мышц сосудов (VSMCs) одни из основных типов клеток, присутствующих на всех трех стадиях атеросклероза, включая начальную стадию, прогрессирование и конечную стадию атеросклеротической бляшки [3,4]. Исследования последних лет были сосредоточены на роли апоптоза VSMC и регуляции коллагена, полученного из VSMC, и внеклеточного матрикса в разрыве бляшек [5] .

Атеросклероз сонных артерий является одной из основных причин ишемического инсульта. Атеротромботические инсульты, вызванные симптоматическими каротидными бляшками, связаны с трехкратным риском раннего рецидива по сравнению с риском рецидива при других подтипах инсульта [6]. По этой причине, помимо фармакологического лечения, при этом подтипе инсульта можно рассмотреть оперативное лечение. Основными методами реваскуляризации являются каротидная эндартерэктомия, а так же стентирование сонных артерий. Доказано, что реваскуляризация является безопасной и эффективной преимущественно у мужчин с гемодинамический значимыми стенозами. [7,8]. Тем не менее, несмотря на существующие фармакологические и реваскуляризирующие методы лечения, необходимы новые профилактические методы лечения для снижения высокого числа рецидивов атеротромботического инсульта, а также первого случая у бессимптомных пациентов высокого риска с атеросклерозом сонных артерий.

Уровень физической активности считается одним из важных социальных проблем в настоящее время. «Стареющая» демография играет большую роль в развитых странах [9] и становится актуальным социальным и политическим вызовом [10,11]. Это демографическое изменение произошло из-за снижения рождаемости, смертности и заболеваемости, а также увеличения продолжительности жизни [12]. Учитывая увеличение продолжительности жизни, естественно у пациентов формируется полиморбидность. А в случае с распространением атеросклероза в артериальном русле, увеличивается количество пораженных бассейнов, приближая пациента к сосудистой катастрофе. [13,14]

Цель исследования: оценить функциональную активность и распространенность стенозирующего атеросклероза коронарных артерий у пожилых пациентов с атеросклерозом брахицефальных артерий.

Материалы и методы. В наше исследование включено 99 пациентов, старше 65 лет. Проведено на базе ОГБУЗ «Белгородская областная клиническая больница Святителя Иоасафа» в 2020-2021 в отделении сосудистой хирургии. Средний возраст обследуемых составил 69,54 года. Количество мужчин превалировало и составили 80,81%, а женщин 19,19%. Информация получена из медицинской документации, а так же анализ анкет пациентов с определением индекса Бартел.

Атеросклеротическое поражение определялось на основе стандартного ультразвукового дуплексного исследования.

Каждому пациенту определен индекс Бартел. Это функциональная шкала, применяемая преимущественно в реабилитации, относящихся к сфере самообслуживания и мобильности. Социальные и интеллектуальные способности в этой шкале не учитываются. Помимо суммарных значений индекса Бартел, нас интересовали отдельные показатели по видам активности.

В зависимости от наличия периферического атеросклероза данной локализации, пациенты были разделены на две группы, одна из которых включала обследуемых с соответствующей формой атеросклероза, а вторая – не содержала пациентов с указанной патологией.

Полученные результаты обрабатывались статистически с использованием компьютерной техники и пакета прикладных статистических программ STATISTICA. При сравнении средних значений использовался F-критерий Фишера. Различия считались статистически значимыми при вероятности ошибки первого рода менее 5% ($p<0,05$).

Результаты и их обсуждение.

В результате проведенного исследования было показано, что влияние атеросклеротического поражения на базовую функциональную активность пациентов неоднозначно.

У пациентов с атеросклерозом брахиоцефальных артерий замечены специфические особенности. Вероятно, это было обусловлено хронической ишемией мозговой ткани, приводящей к развитию дисциркуляторной энцефалопатии, которая, в свою очередь, нарушает адекватное восприятие пациентами своего состояния и может приводить к завышенной

самооценке своих функциональных возможностей. Обследуемые с атеросклерозом каротидных артерий, в среднем ощущали меньше затруднений, чем другие пациенты, в процессе одевания (9,39±0,40 и 8,33±0,28 баллов; $p<0,05$), а также при передвижении по ровной поверхности (13,79±0,53 и 12,35±0,38 баллов; $p<0,05$). В отношении общих значений индекса Бартел, в группах пожилых пациентов с признаками и без признаков атеросклероза брахиоцефальных артерий, значимых различий не было выявлено ($p>0,05$).

Ответы пациентов перенесших острое нарушение мозгового кровообращения, кардиально отличались. Так, пациенты, ранее перенесшие инсульт, по сравнению с другими обследуемыми, ощущали более выраженные ограничения базовой функциональной активности в процессе приема пищи (9,17±0,28 и 9,89±0,10 баллов; $p<0,05$), а также при попытках самостоятельного приема ванной (3,75±0,26 и 4,94±0,10 баллов; $p<0,05$).

Всем пациентам в нашей выборке превентивно выполнена коронарография. У 80% пациентов выборки ангиографически значимое поражение коронарных артерий, что в очередной раз доказывает мультифокальность поражения. При наличии периферического атеросклероза, высок риск развития коронарного атеросклероза. Тем самым возможно предотвращение коронарного события и при необходимости выполнение реваскуляризации миокарда

Заключение.

1. На показатели базовой функциональной активности влияет такой фактор, как острая или хроническая ишемия головного мозга.
2. Для таких пациентов необходимо формировать комплекс лечебно-реабилитационных мероприятий, для снижения социальной ограниченности пациентов.
3. Периферический атеросклероз, вероятно, является предиктором коронарного атеросклероза, что который раз доказывает необходимость детального дообследования таких пациентов.

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COMORBIDITY AS A FACTOR IN THE PROGRESSION OF CHRONIC HEART FAILURE OF ISCHEMIC ORIGIN

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Abstract

Recently, particular attention has been paid to episodes of decompensation of heart failure as events that significantly worsen the further course of the disease and increase the risk of death and repeated hospitalizations due to heart failure. Studies show that to reduce mortality and hospitalization in patients with coronary artery disease (CAD) with coronary artery involvement and low ejection fraction, coronary artery bypass grafting is recommended. Surgical treatment using the coronary artery bypass grafting method has become widespread in the treatment of CAD and is the gold standard of myocardial revascularization in multivessel coronary artery disease. Comorbid conditions further worsen the condition of patients with chronic heart failure (CHF) of ischemic origin, as this group of patients has a severe degree of left ventricular diastolic dysfunction. Inflammatory processes also play an important role in the pathophysiology of the cardiovascular system, and inflammation markers are an important predictor of worsening the course of ischemic heart failure.

Keywords: chronic heart failure, coronary artery disease, systemic inflammation, myocardial remodeling, myocardial revascularization.

Introduction

Among all diseases in the Russian Federation leading to high mortality, CAD occupies a leading position, contributing to 52.6% of the mortality structure [5]. CAD is one of the leading factors in the formation and progression of diastolic disturbances of the left ventricular. The basis of diastolic dysfunction may lie in relaxation disturbances and fibrotic processes arising as a result of the progression of atherosclerotic cardiosclerosis. [3; 4] Myocardial revascularization by coronary artery bypass graft (CABG) is highly effective for treating symptoms of angina and reduces the risk of death in certain patient groups (involvement of the main stem of the left coronary artery, three-vessel disease, occlusions, and multiple coronary artery involvement). In these patients, the long-term results of myocardial revascularization are better than percutaneous coronary intervention [1; 2].

The aim of the study is to explore the relationship between risk factors, the presence and nature of comorbid pathology, the effect of systemic inflammation in patients with chronic heart failure and high-class coronary artery disease, and the outcome of surgical intervention six months after coronary artery bypass grafting.

Materials and Methods

The study, conducted at the regional clinical hospital of Saint Ioasaph (Belgorod) from 2017 to 2022, included 160 patients with stable CAD, aged 44 to 80 years (average age 62.0 ± 5.0 years) with a high risk of ischemic complications: involvement of one or more main coronary arteries, planned for myocardial revascularization by aortocoronary bypass grafting (ACBG). The inclusion criterion was as follows: diagnosis of stress angina of functional class III and IV (according to the classification of the Canadian Cardiovascular Society), post-infarction cardiosclerosis, left ventricular ejection fraction of more than 40%, isolated ACBG, type 2 diabetes, chronic kidney disease stages 2 and 3. The exclusion criterion was patients needing simultaneous surgical intervention, patients with low ejection fraction (less than 40%), acute myocardial infarction, contraindications/intolerance to beta-blockers, participation in another study. Among the examined were 139 men (86.9%) and 21 women (13.1%) of different age groups. Of all included in the study, 55 people (34.37%) had obesity. The body mass index was 28.3±2.5. Dyslipidemia was observed in 71.25% (114 people), chronic obstructive pulmonary disease (COPD) - in 24 people (15.0%), peptic ulcer disease (PUD) – 20 (12.5%), type 2 diabetes (T2D) – 55 patients (34.37%), arrhythmias: atrial fibrillation – 23 (14.4%), in 120 patients (75.0%) there was post-infarction cardiosclerosis. Chronic kidney disease stage 2 was diagnosed in 52 people (32.5%), stage 3 — in 53 (33.12%). Hypertensive disease III stage was suffered by 154 people (96.2%), systolic blood pressure indicators were 137.5 ± 17.0 mmHg, diastolic blood pressure - 90 ± 10 mmHg. Heart rate 70 ±8 bpm. Ischemic heart disease III functional class (FC) was suffered by 103 people, which constituted 64.3% of the examined patients, at the same time, ischemic heart disease functional class IV was diagnosed in 57 people (35.6%). After successful surgical intervention within 6 months, patients received basic pharmacotherapy for CHF of ischemic genesis in accordance with current recommendations and considering concomitant pathology with subsequent assessment of structural and functional indicators during dispensary observation.

Results

All patients included in the study were divided into 2 groups depending on the initial left ventricular ejection fraction. After successful myocardial revascularization and during dispensary observation six months later, clinical and laboratory data of the patients were evaluated. Thus, patients who had a deterioration of structural and functional indicators after myocardial revascularization in the preoperative period had a greater amount of comorbid pathology [4; 5] than patients with improved indicators after aortocoronary bypass [2; 3] ($p < 0.001$). In our work, it was reliably determined that type 2 diabetes influenced 44.6% on the worsening of the course of CHF after myocardial revascularization, in the group with improvement it was less common and constituted 19% of the number of patients ($p < 0.001$). In addition, it was reliably established that the presence of chronic kidney disease in patients had an influence on 70.3% on the progression of CHF. In patients with progressing chronic heart failure, an inflammatory process was observed, which stimulated the processes of myocardial remodeling. In patients whose course of chronic heart failure worsened, an increase in platelets by 49% and neutrophils by 19.5% was observed compared to those whose chronic heart failure improved after myocardial revascularization ($p < 0.00$). In patients with worsening heart ejection fraction after surgery, creatinine values before surgery were 14% higher than those who had a positive dynamic after aortocoronary bypass ($p < 0.00$). When analyzing fibrosis markers, significant differences were found. In patients with progressing chronic heart failure after aortocoronary bypass, the concentration of the MMP-9 marker before surgery significantly exceeded the values in patients with a positive dynamic - 425.5 ng/ml versus 161.67 ng/ml ($p < 0.00$).

Summary

The presence of type 2 diabetes and chronic kidney disease in patients with heart failure with intermediate or preserved ejection fraction is an important predictor for forecasting the course of heart failure after successful coronary bypass. In cardiological patients, an increased index of systemic inflammation is associated with an increased risk of coronary artery disease and its greater severity, as well as with a higher risk of serious adverse cardiovascular events in patients with heart failure, after revascularization. Currently, the impact of systemic inflammation on the course of chronic heart

failure is being evaluated, taking into account comorbid diseases, which is one of the current directions.

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MECHANISMS OF FORMATION OF NEGATIVE SYMPTOMS IN PATIENTS WITH SCHIZOPHRENIA

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МЕХАНІЗМИ ФОРМУВАННЯ НЕГАТИВНИХ СИМПТОМІВ У ПАЦІЄНТІВ З ШИЗОФРЕНІЄЮ

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Abstract

252 patients with negative symptoms of schizophrenia took part in the study: 83 patients with the first episode of schizophrenia, 88 patients with schizophrenia in a state of exacerbation and 81 patients with schizophrenia in a state of remission. On the basis of the conducted correlation and factor analyses, it was established that the most significant for the formation of negative symptoms are the clinical and dynamic manifestations of the disease, namely: the duration of the disease and the current episode, the leading symptom complex in the state of an active course and in remission, features of the course, initial period and term the beginning of the manifestation of negative symptoms, the presence in the history of relapses, hospitalizations and various types of burden. Pathopsychological and psychopathological factors associated with negative symptoms of schizophrenia, which affected the affective, cognitive, motivational and social spheres, were established. It was determined that the changes had their specificity at different stages of the disease. The onset of the schizophrenic process was associated with manifestations of negative symptoms mostly in the social and motivational spheres, and changes in the affective and cognitive spheres were episodic and minimal in nature. When the symptoms worsened, there were, first of all, pronounced disorders of the social component, moderate changes in the motivational and affective components, and moderate and pronounced changes in the cognitive component of negative symptoms. In patients with negative symptoms of schizophrenia in a state of remission, pronounced violations of the social and motivational components, as well as moderate changes in the affective component and moderate and pronounced changes in the cognitive component of negative symptoms were observed.

Анотація

В досліджені прийняли участь 252 пацієнта з негативною симптоматикою при шизофренії: 83 пацієнта з першим епізодом шизофренії, 88 пацієнтів з шизофренією в стані загострення та 81 пацієнт з шизофренією у стані ремісії. На підставі проведеного кореляційного та факторного аналізів було встановлено, що найбільш значущими для формування негативної симптоматики є клініко-динамічні прояви захворювання, а саме: тривалість захворювання і поточного епізоду, провідний симптомокомплекс у стані активного перебігу та у ремісії, особливості перебігу, ініціального періоду та строку початку прояву негативної симптоматики, наявність в анамнезі рецидивів, госпіталізацій та різних видів обтяженості. Встановлені патопсихологічні та психопатологічні фактори, пов’язані з негативною симптоматикою шизофренії, які зачіпали афективну, когнітивну, мотиваційну та соціальну сфери. Було визначено, що зміни мали свою специфіку на різних етапах захворювання. Початок шизофренічного процесу був пов'язаний з проявами негативної симптоматики здебільшого у соціальній та мотиваційній сфері, а зміни в афективній та когнітивній сферах носили епізодичний та мінімальний характер. При загостренні симптоматики також спостерігались, перш за все, виражені розлади соціального компоненту, помірні зміні мотиваційного та афективного компонентів та помірні й виражені зміни когнітивного компоненту негативної симптоматики. У пацієнтів з негативною

симптоматикою при шизофренії у стані ремісії спостерігались виражені порушення соціального та мотиваційного компонентів, а також помірні зміни афективного компоненту та помірні і виражені зміни когнітивного компоненту негативних симптомів.

Keywords: negative symptoms, determinants, first episode of schizophrenia, schizophrenia in a state of exacerbation, schizophrenia in a state of remission

Ключові слова: негативні симптоми, детермінанти, перший епізод шизофренії, шизофренія у стані загострення, шизофренія у стані ремісії

Вступ. Шизофренія – це серйозний психічний розлад, який супроводжується різними симптомами, включаючи позитивні (галюцинації, маячня) та негативні (апатія, відсутність емоційної реакції) прояви [4,6]. Проблеми, пов'язані з виявленням факторів, що впливають на характер, вираженість, темп наростання негативних розладів, що формуються в рамках ендогенного процесу, дотепер залишаються одними з найбільш дискутабельних психіатрії [1,5]. При цьому, на думку більшості вчених, тяжкість негативних змін багато в чому визначається темпом прогредієнтності захворювання, його клінічним оформленням, віком початку захворювання [2,3]. Оскільки негативні симптоми (НС) при шизофренії пов'язані з несприятливим функціонуванням і виходом шизофренії, вкрай важливими є їх розпізнавання, розуміння механізмів формування, правильна оцінка і лікування [2,6]. Тому метою дослідження стало визначення факторів, що впливають на формування НС при шизофренії.

Матеріали та методи дослідження. Усього в дослідженні прийняли участь 252 пацієнта з негативною симптоматикою при шизофренії: 83 пацієнта з першим епізодом шизофренії, 88 пацієнтів з шизофренією в стані загострення та 81 пацієнт з шизофренією у стані ремісії. Накопичення, корекція, систематизація вихідної інформації та візуалізація отриманих результатів здійснювалися в електронних таблицях Microsoft Office Excel 2010. Для виявлення ступеня вираженості зв'язку між двома ознаками використовувався коефіцієнт рангової кореляції К. Спірмена. Для оцінки факторів, пов'язаних з психопатологічними та патопсихологічними характеристиками хворих на шизофренію, використовувався факторний аналіз із ротацією Varimax.

Результати. Проведений кореляційний аналіз дозволив визначити, що найбільш значущими для формування негативної симптоматики є клініко-динамічні прояви захворювання. Так, серед пацієнтів з першим епізодом шизофренії найбільший внесок в розвиток НС при шизофренії мали тривалість захворювання 1-3 роки (r = 0,861), тривалість поточного епізоду до 6-ти місяців (r = 0,803) та переважання астенічного симптомокомплексу у стані ремісії (r = 0,719). Значними, хоча й меншою мірою вираженості впливу є: затяжний ініціальний період (r = 0,682), наявність в анамнезі 1-2 рецидивів (r = 0,619) та початок прояву НС в пубертатному віці (r = 0,611). Найменший вплив на клініко-динамічні характеристики негативних розладів мають такі фактори як наявність сенесто-іпохондричного симптомокомплексу у період активного перебігу захворювання (r = 0,566), нефидеренційована форма шизофренії (r = 0,547), аутистичний симптомокомплекс у стані ремісії (r = 0,509) та наявність госпіталізації 1 раз на рік (r = 0,508).

Серед пацієнтів з НС при шизофренії у стані загострення найбільший внесок в розвиток НС мали поява НС у ініціальному періоді (r = 0,781), гострий ініціальний перебіг (r = 0,771), епізодично ремітуючий перебіг (r = 0,718) та апато-абулічний симптомокомплекс у стані ремісії (r = 0,711). Значними, хоча й меншою мірою вираженості впливу були поява НС у стані ремісії (r = 0,676), резидуальна форма шизофренії (r = 0,672), тривалість захворювання більше 4-х років (r = 0,642), зловживання пацієнтами алкоголю (r = 0,634), більше 3-х рецидивів (r = 0,613) та наявність гіпоафективного симптомокомплексу у стані ремісії (r = 0,609). Найменший вплив на клініко-динамічні характеристики негативних розладів мають такі фактори як наявність сенесто-іпохондричного симптомокомплексу у період активного перебігу захворювання (r = 0,599) та тривалість поточного епізоду до 1-го року (r = 0,580).

Серед пацієнтів з НС при шизофренії у стані ремісії найбільший внесок в розвиток НС мали тривалість захворювання 10-12 років (r = 0,872), більше 3-х рецидивів (r = 0,822) та зловживання алкоголю (r = 0,809). Значними, хоча й меншою мірою вираженості впливу були поява НС у стані ремісії (r = 0,715), виховання у неповних сім'ях (r = 0,711), резидуальна (r = 0,682) та проста (r = 0,633) форми шизофренії, наявність астенічного (r = 0,687) та апато-абулічного (r = 0,610) симптомокомплексів у стані ремісії і параноїдного симптомокомплексу у стані активного перебігу захворювання (r = 0,681), епізодичний перебіг з наростаючим дефектом (r = 0,608) та тривалість поточного епізоду до 1-го року (r = 0,601).

Був проведений факторний аналіз з обертом Varimax, який дозволив визначити 4 фактори, пов'язані з НС на різних етапах шизофренічного процесу. Було встановлено, що у пацієнтів з першим епізодом шизофренії патопсихологічні та психопатологічні фактори окреслювались порушеннями у 4-х сферах: афективної, когнітивної, мотиваційної та соціальної. Афективний компонент НС при першому епізоді шизофренії окреслювався, перш за все, незначними кількісними та якісними порушеннями емоційної сфери (r = 0,856 та r = 0,745 відповідно), мінімальними змінами в емоційних реакціях (r = 0,813), незначним рівнем неадекватності афекту (r = 0,728), а також мінімальним проявом притупленого афекту (r = 0,652), мінімальним рівнем зниження рухливості (r = 0,696) та виразності моторики (r = 0,544), слабким рівнем емоційної відчуженості (r = 0,581) та помірним рівнем недостатності мовних реакцій (r = 0,511).

Когнітивний компонент включав в себе наступні фактори, які окреслювали прояви НС при першому епізоді шизофренії: слабкі порушення плавності мови (r = 0,762), уповільнення мислення (r = 0,718), Незначні кількісні (r = 0,681) та якісні (r = 0,607) зміни в асоціативній сфері, порушення концентрації уваги (r = 0,632), нав'язливі думки (r = 0,634), мінімальні ознаки стереотипності мислення (r = 0,615) та слабкий рівень порушення абстрактності мислення (r = 0,603).

Мотиваційний компонент включав в себе наступні фактори, які окреслювали прояви НС при першому епізоді шизофренії: високий рівень апатії (r = 0,754), помірне зниження продуктивності у роботі і навчанні (r = 0,611), незначне порушення догляду за собою (r = 0,673), помірне зниження енергетичного потенціалу (r = 0,582), незначні кількісні та помірні якісні (r = 0,713) порушення вольової сфери, виражені порушення поведінкових складових мотивації (r = 0,769), відсутність мотивації до творчої активності (r = 0,602), низька потреба в комфорті (r = 0,526), спілкуванні (r = 0,628), загальної активності у житті (r = 0,516) та на роботі (r = 0,607).

Соціальний компонент НС при першому епізоді шизофренії окреслювався, перш за все, наявністю помірного рівню пасивно-апатичної соціальної відстороненості (r = 0,673), помірно зниженої активності у вільний час (r = 0,718), помірно зниженими сексуальними інтересами (r = 0,589), помірними порушеннями у відносинах з близькими (r = 0,614), зниженим рівнем психосоціальної адаптації (r = 0,658), а також порушеннями психосоціальної адаптації у сферах проведення дозвілля (r = 0,617), суспільного життя (r = 0,702) та інтересу до пізнання навколишнього (r = 0,766), вираженої потреби в залежності від оточуючих (r = 0,752), помірними порушеннями особової та соціальної взаємодії (r = 0,703) та помірним зниженням суспільно корисної діяльності, включаючи роботу та навчання (r = 0,687).

У пацієнтів з НС при шизофренії у стані загострення патопсихологічні та психопатологічні фактори прояву НС при шизофренії окреслювались порушеннями у 4-х сферах: афективної, когнітивної, мотиваційної та соціальної. Афективний компонент НС при шизофренії у стані загострення включав в себе помірний рівень вираженості притупленого афекту (r = 0,623) та емоційної відчуженості (r = 0,761), мінімальне зниження спонтанної рухливості (r = 0,615), виражене уникнення контакту поглядом (r = 0,784), помірний рівень неадекватності афекту (r = 0,759), помірну недостатність мовних інтонацій (r = 0,673), виражене спотворення емоційної сфери (r = 0,679), помірне суб'єктивне відчуття втрати емоцій (r = 0,611) та зниження позитивної емоційної реакції щодо оточуючих(r = 0,647).

Когнітивний компонент включав в себе наступні фактори, які окреслювали прояви НС

при шизофренії у стані загострення: слабкий рівень порушення абстрактного мислення (r = 0,744) та стереотипності мислення (r = 0,751), виражене збіднення тематики розмови (r = 0,812), помірні відповіді із затримкою (r = 0,638), виражені кількісні (r = 0,782) та якісні (r = 0,709) порушення в асоціативній сфері, виражене зниження уважності у контактах (r = 0,602) та при виконанні тестів (r = 0,688), порушення цілеспрямованості думок (r = 0,683), наявність нав'язливих думок (r = 0,769) та напливів думок (r = 0,722), зниження здатності розрізняти різні види емоцій (r = 0,643), підвищена чутливість до світлових/оптичних подразників (r = 0,605) та наявність акоазмів (r = 0,571).

Мотиваційний компонент включав в себе наступні фактори, які окреслювали прояви НС при шизофренії у стані загострення: виражений рівень апатії (r = 0,833), виражені порушення емоційного компоненту мотивації (r = 0,741), труднощі в усвідомленні власних проблем, зниження мотивації та ініціативи (r = 0,739), низька мотивація до суспільної корисності (r = 0,845), загальної та творчої активності (r = 0,716), комфорту й безпеки (r = 0,613), спілкування (r = 0,768) та набуття соціального статусу (r = 0,792), а також помірний рівень порушень (r = 0,655) та уваги (r = 0,684) у догляді за собою, помірне зниження продуктивності у роботі і навчанні (r = 0,598), незначні кількісні (r = 0,643) та помірні якісні порушення вольової сфери (r = 0,601).

Соціальний компонент НС при шизофренії у стані загострення окреслювався, перш за все, наявністю помірного рівню порушень у сфері комунікацій (r = 0,756), вираженим зниженням сексуальних інтересів (r = 0,718) та здатності відчувати інтимність і близкість (r = 0,759), вираженим рівнем соціальної ангедонії (r = 0,783), вираженим порушенням у відносинах з рідними та колегами (r = 0,804), помірним рівнем пасивно-апатичної соціальної відстороненості (r = 0,711), вираженою потреба в незалежності від оточуючих (r = 0,819), а також зниженим рівнем психосоціальної адаптації (r = 0,671) у сімейній (r = 0,756), робочій (r = 0,623) та фінансовій (r = 0,766) сферах, помірним зниженням активності у вільний час (r = 0,687), низькими очікуваннями від оточуючих щодо спілкування та емоційно близьких стосунків (r = 0,665) та вираженістю агресивних патернів поведінки (r = 0,616).

У пацієнтів з шизофренією у стані ремісії афективний компонент НС окреслювався, перш за все, помірною неадекватністю афекту (r = 0,813) та помірним спотворенням емоційної сфери (r = 0,804), середнім рівнем притупленого афекту (r = 0,709) і прояву емоційної відчуженості (r = 0,723), помірним збідненням міміки (r = 0,765), вираженим зниженням спонтанної рухливості (r = 0,682) і помірним зниженням виразності моторики (r = 0,557), помірним уникненням контакту поглядом (r = 0,542), помірним зниженням емоційних реакцій (r = 0,588), вираженою недостатністю мовних інтонацій (r = 0,674) та вираженими кількісними порушеннями емоційної сфери (r = 0,682).

Когнітивний компонент включав в себе наступні фактори, які окреслювали прояви НС при шизофренії у стані ремісії: помірні порушення абстрактного мислення (r = 0,783), стереотипності мислення (r = 0,622), спонтанності та плавності мови (r = 0,608), кількісні (r = 0,783) та якісні (r = 0,755) порушення асоціативної сфери, помірне збіднення словникового запасу (r = 0,715), помірні відповіді із затримкою (r = 0,677), виражена неуважність при контакті (r = 0,613), порушення переносимості роботи в умовах дефіциту часу (r = 0,675), уповільнення мислення (r = 0,693), порушення цілеспрямованості думок (r = 0,764) і негайного пригадування (r = 0,822), труднощі при необхідності вибору (r = 0,679), думкові персеверації (r = 0,687) та зниження здатності розрізняти види емоцій (r = 0,774).

Мотиваційний компонент включав в себе наступні фактори, які окреслювали прояви НС при шизофренії у стані ремісії: високий рівень апатії (r = 0,803), виражене зниження енергетичного потенціалу (r = 0,633), продуктивності у роботі і навчанні (r = 0,646), виражені кількісні порушення вольової сфери (r = 0,739), помірне спотворення вольової сфери (r = 0,748), порушення емоційного (r = 0,713), когнітивного (r = 0,784) та поведінкового (r = 0,643) компонентів мотивації, відсутність загальножиттєвих потреб у набутті соціального статусу (r = 0,682), знижена мотивація до комфорту у житті (r = 0,721), до роботи (r = 0,645) та загаль-

ної активності (r = 0,643), середній рівень потреби у забезпеченні себе матеріальними ресурсами життя (r = 0,564) та виражена суб'єктивна оцінка апато-абулічних порушень (r = 0,615).

Соціальний компонент НС при шизофренії у стані ремісії окреслювався, перш за все, наявністю високого рівню соціальної ангедонії (r = 0,832), низьким рівнем психосоціальної адаптації (r = 0,782) у сферах міжособистісних стосунків (r = 0,722), сімейних відносин (r = 0,764), суспільного життя (r = 0,833), включаючи роботу та навчання (r = 842), інтересу до навколишнього (r = 0,654), вираженого зниження сексуальних інтересів (r = 0,819), помірної пасивно-апатичної соціальної відстороненості (r = 0,708), вираженим зниженням активності у вільний час (r = 0,744), середнім рівнем порушень у сфері комунікацій (r = 0,698), вираженими порушеннями у відносинах з рідними та колегами (r = 0,581), помірним рівнем соціальної тривожності (r = 0,768), вираженістю соціального уникнення (r = 0,802), а також вираженим прагненням уникнення відповідальності (r = 0,598), вираженої потреби в залежності від оточуючих (r = 0,630) та порушеннями у сфері самообслуговування і догляду за собою (r = 0,598).

Отримані дані дозволили визначити механізми розвитку НС при шизофренії в залежності від етапу захворювання. На рисунку 1 видно, що у пацієнтів з першим епізодом шизофренії афективний компонент НС окреслювався *мінімальними* проявами змін афективної сфери, які на етапі загострення набували *помірних* (притуплений афект, неадекватність емоцій та емоційна відчуженість) та *виражених* (уникнення контакту поглядом, виражене спотворення емоційної сфери) значень. На етапі ремісії у пацієнтів з шизофренією НС в афективній сфері проявлялись нарощуванням кількості емоційних порушень, зниженням спонтанності рухливості та виразності моторики, збідненням мімічних та мовних інтонацій та помірним спотворенням емоційної сфери й уникненням контакту поглядом.

Рисунок 1 – Механізми формування афективних проявів НС у пацієнтів з шизофренією в залежності від етапу захворювання

Схожа тенденція спостерігалась і в динаміці когнітивних проявів НС у пацієнтів з шизофренією на різних етапах захворювання (Рис.2). Пацієнти з першим епізодом шизофренії ха-

рактеризувались більшою мірою *мінімальними* та епізодичними проявами когнітивних порушень у вигляді порушень абстрактності, уповільнення та стереотипності мислення, змін в асоціативній сфері та зниження плавності мови. У стані загострення шизофренічного процесу з'являлись *помірні* прояви порушень цілеспрямованості думок, напливи думок та відповіді із затримкою та *виражені* порушення асоціативної сфери, зниження уваги та збіднення тематики розмови. У стані ремісії шизофренії когнітивні аспекти НС характеризувались здебільшого *помірними* порушеннями асоціативної сфери, запам'ятовування, абстрактного мислення, цілеспрямованості думок, спонтанності та плавності мови, стереотипністю, думковими персевераціями, збідненням словникового запасу, відповідями із затримкою, труднощами при необхідності вибору та роботи в умовах дефіциту часу.

Рисунок 2 – Механізми формування когнітивних проявів НС у пацієнтів з шизофренією в залежності від етапу захворювання

На рисунку 3 видно динаміку мотиваційного компоненту НС на різних етапах шизофренічного процесу, яка полягала в переважанні *помірних* проявів якісних порушень вольової сфери, зниженні продуктивності у роботі і навчанні, зниженні енергетичного потенціалу, зниженні мотивації до творчої активності, комфорту, спілкування, загальної активності у житті та на роботі та у *вираженої* апатії та порушень поведінкових складових мотивації серед пацієнтів з першим епізодом шизофренії.

Рисунок 3 – Механізми формування мотиваційних проявів НС у пацієнтів з шизофренією в залежності від етапу захворювання

Серед пацієнтів з НС при шизофренії у стані загострення спостерігалось збільшення *помірних* порушень мотиваційного компоненту НС, що проявлялось у приєднанні зниження мотивації та ініціативи, порушень у догляді за собою, труднощів в усвідомленні власних проблем та низької потреби у суспільної корисності та набутті соціального статусу. При цьому *вираженими* залишався високий рівень апатії та приєднувались виражені порушення емоційних складових мотивації.

Серед пацієнтів з НС при шизофренії у стані ремісії спостерігалось збільшення *виражених* порушень мотиваційного компоненту НС, що проявлялось у зниженні енергетичного потенціалу, продуктивності у роботі і навчанні, кількісних порушень вольової сфери, високого рівню апатії та приєднання порушення когнітивного компоненту мотивації.

Динаміка соціальних проявів НС у пацієнтів з шизофренією на різних етапах захворювання полягала у відсутності мінімальних та виражених змін соціального компоненту НС у пацієнтів з першим епізодом шизофренії та наявністю *помірних* порушень, що полягали у пасивно-апатичної соціальної відстороненості, порушенні відносин з близькими, особової та соціальної взаємодії, психосоціальної адаптації у сферах проведення дозвілля, суспільного життя та інтересу до пізнання навколишнього, зниженні суспільно корисної діяльності, включаючи роботу та навчання, сексуальних інтересів і активності у вільний час (Рис.4).

Рисунок 4 – Механізми формування соціальних проявів НС у пацієнтів з шизофренією в залежності від етапу захворювання

У пацієнтів з шизофренією у стані загострення спостерігалось нарощування порушень соціального компоненту НС, що проявлялось у наявності *виражених* порушень у відносинах з рідними та колегами, вираженої соціальної ангедонії, зниження сексуальних інтересів і здатності відчувати інтимність і близькість, низьких очікувань від оточуючих щодо спілкування та емоційно близьких стосунків, вираженої потреби у незалежності та виражених агресивних патернів поведінки. У стані ремісії відбувалось переважне збереження *виражених* порушень соціальної ангедонії, соціального уникнення, порушень психосоціальної адаптації у сферах міжособистісних стосунків, сімейних відносин, суспільного життя, включаючи роботу та навчання, зниження активності у вільний час, порушення у відносинах з рідними та колегами, відсутність інтересу до навколишнього, зниження сексуальних інтересів, прагнення уникнення відповідальності та потреба в залежності від оточуючих.

Оцінюючи загальні механізми розвитку НС при шизофренії можна констатувати, що початок шизофренічного процесу був пов'язаний з проявами НС здебільшого у соціальній та мотиваційній сфері, а зміни в афективній та когнітивній сферах носили епізодичний та мінімальний характер. При загострені симптоматики також спостерігались, перш за все, виражені розлади соціального компоненту НС, помірні зміні мотиваційного та афективного компонентів НС та помірні й виражені зміни когнітивного компоненту НС. У пацієнтів з НС при шизофренії у стані ремісії спостерігались виражені порушення соціального та мотиваційного компонентів НС, а також помірні зміни афективного компоненту НС та помірні і виражені зміни когнітивного компоненту НС.

Висновки. Було встановлено, що найбільш значущими для формування негативної симптоматики є клініко-динамічні прояви захворювання, а саме: тривалість захворювання і поточного епізоду, провідний симптомокомплекс у стані активного перебігу та у ремісії, особливості перебігу, ініціального періоду та строку початку прояву НС, наявність в анамнезі рецидивів, госпіталізацій та різних видів обтяженості.

Встановлені патопсихологічні та психопатологічні фактори, пов'язані з НС при шизофренії, що зачіпали афективну, когнітивну, мотиваційну та соціальну сфери. Було визначено, що зміни за цими сферами мали свою специфіку на різних етапах захворювання та були встановлені механізми розвитку НС при шизофренії на різних на різних етапах захворювання. Початок шизофренічного процесу був пов'язаний з проявами НС здебільшого у соціальній та мотиваційній сфері, а зміни в афективній та когнітивній сферах носили епізодичний та мінімальний характер. При загостренні симптоматики також спостерігались, перш за все, виражені розлади соціального компоненту НС, помірні зміні мотиваційного та афективного компонентів НС та помірні й виражені зміни когнітивного компоненту НС. У пацієнтів з НС при шизофренії у стані ремісії спостерігались виражені порушення соціального та мотиваційного компонентів НС, а також помірні зміни афективного компоненту НС та помірні і виражені зміни когнітивного компоненту НС.

Отримані дані слід враховувати при діагностиці, проведенні психокорекційних заходів та оцінці факторів ризику прояву НС на різних етапах шизофренічного процесу.

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Pedagogical sciences

PRACTICAL LESSONS ON PHRASEOLOGY OF MODERN ENGLISH LANGUAGE

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ҚАЗІРГІ АҒЫЛШЫН ТІЛІНІҢ ФРАЗЕОЛОГИЯСЫ БОЙЫНША ПРАКТИКАЛЫҚ САБАҚ

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Фразеология — тұрақты тіркестер туралы ғылым. Фразеология термині белгілі бір тілдегі фразеологизмдердің тұтас жиынтығы деген мағынамен қатар, тіл білімінің фразеологизмдерді зерттейтін саласы деген ұғымда да қолданылады. Қазіргі ағылшын тілінің фразеологизмдерін оқып үйрену оқушылардың жалпы филологиялық даярлығының маңызды бөлігі болып табылады. Ағылшын тілін үйрену елімізде кеңінен таралған. Тілді, әсіресе ағылшын тілін жақсы білу оның фразеологизмдерін білмейінше мүмкін емес. Қазіргі ағылшын тілі аналитикалық тіл болып табылады. Ағылшын тілінің аналитикасының жоғарылауы оның бүкіл құрылымына еніп, кез келген синтетикалық тілге қарағанда фразеологиялық бірліктердің әлдеқайда дамыған ішкі жүйесін тудырады. Ағылшын тілінің аналитикалық сипаты ондағы N + N (зат есім + зат есім) сияқты тұрақсыз күрделі сөздер болып табылатын және оңай ажырап, сөз тіркестеріне айналатын сөз тіркестерінің кең таралуын түсіндіреді. Ағылшын тілінде әртүрлі құрылымдық типтегі фразеологиялық бірліктердің атрибутивтік қолданылуы да аналитикалық көрсеткіші болып табылады.

Фразеологиялық оралымдардың түрлері: фразеологиялық тұтастық, фразеологиялық бірлік, фразеологиялық тізбек.

Кейбір еңбектерде кездесетін фразеологиялық бірліктерді мұндай түсіндіру қазіргі уақытта ескірген. Фразеологизмдер тілдік жан-жақтылықтың бірі болып табылады, өйткені фразеологиялық бірліктері жоқ тілдер болмайды. Ағылшын фразеологизмдері бай және алуан түрлі және терең тарихы бар.

Фразеологизмдер – аса күрделі құбылыс, оны зерттеу тек өзіндік зерттеу әдісін ғана емес, сонымен қатар басқа ғылымдардың – лексикология, грамматика, стилистика, фонетика, логика және өлкетану ғылымдарының деректерін пайдалануды қажет етеді. Өз кезегінде фразеологизмдер социолингвистика, психолингвистика, мәтін теориясы, салыстырмалы және типологиялық лингвистика позицияларынан зерттеуге сарқылмас материал береді. Ағылшын фразеологизмдерін білу публицистикалық және көркем әдебиетті оқуды айтарлықтай жеңілдетеді. Зерттелетін тілдің фразеологиялық бірліктерін орынды қолдану сөйлеуді идиоматикалық және жасанды етпейді.

Қазіргі ағылшын тілінің фразеологиясын оқыту бағдарламасын жасап, оған келесі мақсатты қоюға болады:

а) оқушыларды фразеологиялық бірліктер туралы ғылымның негізгі ережелерімен, зерттелетін тілдің фразеологиялық қорымен және оны зерттеу әдістерімен таныстыру, яғни фразеологиялық құзыреттілікте концептуалды компонентті қалыптастыру.

б) меңгерілген теориялық материал негізінде оқушыларда практикалық сипаттағы негізгі дағдыларды, атап айтқанда: фразеологиялық бірліктерді тану, оларды түсіндіру және сөйлеуде орынды қолдану, сондай-ақ фразеологизмдерді жүргізу қабілетін дамыту.

Бұл мақсатқа жету келесі міндеттерді дәйекті түрде шешуді қамтиды:

1) фразеологиялық бірлік, оның тілдік белгілер жүйесіндегі ерекшелігі және фразеологизмдердің тілдік пәндер жүйесіндегі орны туралы білімдер мен түсініктер жиынтығын жеткізу;

2) оқушыларды тіл білімінің дербес саласы ретіндегі фразеологизмдердің тарихымен таныстыру, тіл білімінің осы саласындағы отандық ғылымның басымдылығына назар аудару;

3) қазіргі ағылшын тілінің фразеологиялық бірліктерінің шығу тегі туралы мәлімет беру;

4) фразеологиялық бірліктерді зерттеу әдістерін енгізу;

5) фразеологиялық бірліктердің орнықтылығы мен бірізділік мәселелерін талқылау;

6) қазіргі ағылшын тілінің фразеологиялық бірліктерінің құрылымдық, семантикалық және грамматикалық сипаттамаларын және оларды жіктеу принциптерін қарастыру;

7) әртүрлі таптар мен типтегі фразеологиялық бірліктердің қызмет ету заңдылықтарын ашу;

8) тілдік және экстралингвистикалық факторлар кешенімен айқындалатын фразеологиялық бірліктердің дамуының жетекші тенденцияларын анықтау;

9) оқушыларды фразеологиялық бірліктердің коммуникативтік мәнін, оның стильдік және эмоционалдық бояуын анықтауға және контекстен фразеологиялық бірліктердің прагматикалық рөлін көруге үйрету.

Фразеология теориясының негізгі ережелері бағдарламада қарастырылады, содан кейін семинар және практикалық сабақтарда толықтырылып, нақтыланады. Нәтижесінде, теорияны түсіну фразеологиялық бірліктердің анықтамаларын тұжырымдау және оларды ауызша және жазбаша сөйлеуде қолданудағы негізгі практикалық дағдыларға айналуы керек. Практикалық сабақтардың бір бөлігі түпнұсқа мәтіндерді талдауға, оларда қолданылған фразеологиялық бірліктерді анықтауға, олардың тілдік статусын, стильдік бояуын және контексттегі прагматикалық қызметін анықтауға арналған.

Оқу бағдарламасы тестлеумен аяқталады. Тестлеуге оқу бағдарламасына толық қатысқан, практикалық сабақтарға және осы бағдарламада қарастырылған өзіндік жұмыстың барлық түрлерін орындаған оқушылар жіберіледі. Қорытындылау картасы практикалық сабақтарда қарастырылған барлық теориялық материалдарды қамтитын сұрақтардан тұрады. Өзіндік оқу материалын білу тестілер мен әңгімелесу нәтижелері бойынша бағалануы да мүмкін.

Оқушылардың өзіндік жұмысын ұйымдастыру бойынша ұсыныстар:

Практикалық сабақтардың материалдары оқушылардың фразеологиялық мәселелер бойынша өзіндік жұмысына негіз болуы керек. Бұл бағдарлама шеңберінде оқушыларға келесі өзіндік жұмыс түрлері ұсынылады:

- фразеологиялық мәселелер бойынша мақалаларды конспектілеу; бақылау нысаны – жазбаларды тексеру, әңгімелесу;

- ағылшын идиомалары бойынша шетел авторларының кітаптарын оқу, қорытындылау және аннотациялау; бақылау нысаны – рефераттар мен аннотацияларды тексеру, әңгімелесу;

- дербес картотека құрастыру – кең мағыналы етістік немесе жиі кездесетін зат есім бар фразеологиялық бірліктердің жүйесіне құрылымдық-семантикалық талдау жүргізу; бақылау нысаны – картотеканы тексеру және жазбаша талдау; сұхбат; Оқушының ғылыми жұмыстар конкурсына қатысу үшін жұмыстар ұсынылуы мүмкін.

Өз бетінше оқуға келесі тақырыптар ұсынылады:

1. Интерективті фразеологизмдер. Бақылау түрі конспектілерді тексеру, семинар сабағында жұмыс жасау.

2. Интеръективті емес сипаттағы фразеологиялық бірліктер. Бақылау нысаны – тақырып бойынша тест, әңгімелесу.

Қорыта келе, фразеологизм мағынасындағы елтану потенциясының пайда болу принциптері тіл арқылы елтану бағытының еншісі болып табылады. Тіл арқылы елтану теориясының пайда болып дамуы фразеология саласын жаңа қырынан, яғни фразеологизмдерді кез келген халықтың ұлттық мәдени дамуының айнасы ретінде қарастыруға мол мүмкіндік береді.

Әдебиет

1. Мықтыбаева Т.Ж. Қазақ және ағылшын тілдеріндегі анималистік фразеологизмдердің коннотативтік семантикасы: Дисс.филол.ғ.к. – Алматы, 2005

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FOSTERING INTERCULTURAL COMMUNICATIVE COMPETENCE OF THE STUDENTS AT THE SENIOR STAGE OF SECONDARY SCHOOL

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Abstract

This study addresses the imperative of developing senior pupils' intercultural communicative competence in response to the escalating demand for foreign language proficiency and the need to meet European educational standards. Emphasizing the intricate connection between language, cultural practices, and group beliefs in Foreign Language Teaching, the research explores the multifaceted nature of intercultural communicative competence. The study aims to pinpoint factors influencing competence development and effective teaching methods. The essence of this competence and its relevance in relation to general education school are investigated, the possibilities of audiovisual materials, project methodology for the formation of intercultural communicative competence are revealed.

Keywords: foreign language teaching, intercultural communicative competence, cultural diversity, visual materials, audiovisual media, project methodology, intercultural dialogue

Introduction

Increasing modern requirements to the level of foreign language proficiency of students necessitate the search for new technologies of foreign language teaching. This is related to the learners' aspiration to be able to interact in a real intercultural environment and to meet European educational standards. The European language competences emphasize such intercultural knowledge and skills as the ability to compare one's own and foreign language cultures, flexibility in communicating with representatives of other cultures and effective resolution of conflict situations caused by cultural differences.

FLT is based on the importance of being able to communicate in a foreign language. However, it affects not only the ability to use language to communicate, but also relates to the interplay between language, cultural practices, and group beliefs. Because language serves as the basis for expressing the complexity of these practices and beliefs, both explicitly and by implicit meaning, and for the interplay between language and identity, mastery of a foreign language means mastery of the cultural practices and beliefs it expresses for particular social groups, even though the learner may use it for other purposes as well. Therefore, teaching language ability and teaching intercultural competence cannot be considered separately.

This study deals with the topical issue of developing students' intercultural communicative competence at the upper secondary school level. In the conditions of globalization and diversity of cultures and nationalities, the ability to effectively communicate and interact with representatives of different cultures is becoming more and more important and in demand. This research article is aimed at identifying factors influencing the development of students' intercultural communicative competence, as well as at identifying effective teaching methods and approaches that contribute to the formation of this competence.

Theoretical background

There are many definitions of intercultural communicative competence. According to one of the most widely accepted definitions, intercultural communicative competence can be conceptualized as "the ability to think and behave in a culturally acceptable way" [1]. Given that each culture is different from other cultures and that cultures have their own ways of thinking and behaviors that they consider appropriate, it also becomes clear the importance of intercultural communicative competence, which emphasizes the ability to act in accordance with norms and attitudes considered acceptable in a particular culture. In other words, intercultural communicative competence can be defined as a development process involving the transformation of acquired and mostly implicit knowledge about intercultural attitudes and behavior within the framework of the culture in which a person exists. In light of these definitions, intercultural communication competence can be expressed as the ability to create a common perception and meaning between cultures by organizing elements (such as encoding, encoding, message, channel, and feedback) within the basic elements of the communication process between source and recipient in such a way as to create a meaning that representatives of different cultures want to convey [2].

Dell Hymes has made a significant contribution to the understanding of intercultural communicative competence by dividing it into four components: linguistic, sociolinguistic, discursive and strategic. Linguistic competence refers to the knowledge of language, sociolinguistic competence refers to the understanding of cultural norms, discursive competence refers to the ability to construct texts, and strategic competence refers to the ability to overcome difficulties in communication.

Dell Hymes (1972) coined the term "communicative competence" based on N. Chomsky's concept of "linguistic competence", which describes the internal mental grammar of an individual. Hymes argued that this grammar represents language as abstract rules reflected in an individual's intuitive ideas about language. He defined communicative competence as an internal knowledge of the situational relevance of a language. Thus, it includes knowledge of native and other languages, providing ways of interaction and communication, as well as the ability to perform social roles and use communication skills to solve specific situations. The communicative competence is structured and includes various competencies that together provide a complete picture of the foreign language communicative competence [3].

In the context of foreign language teaching (FLT), communication does not just mean transmitting information and sending messages, as is prevalent in current methods of "communicative language teaching". Even the exchange of information requires an understanding of how what is said or written can be perceived and interpreted in another cultural setting. It depends on the ability to grasp and accept the listener's or reader's point of view. However, the success of "communication" is not measured only by the effectiveness of the exchange of information; it aims at establishing and maintaining relationships. In this context, the effectiveness of communication depends on the use of language that expresses a willingness to establish a relationship, often expressed by indirect politeness rather than a direct and "efficient" approach with excess information. It is known that forms of politeness vary from language to language and culture to culture, but this is often limited to formal rules. Nevertheless, politeness is only a visible sign of a deeper phenomenon: differences in the beliefs, behaviors, and meanings through which people interact with each other. These differences can be incompatible and contain the germs of conflict if relationships are not maintained through politeness.

As previously mentioned, successful communication goes beyond mere information exchange. Effectively communicating across different cultures requires an understanding of the culture-specific elements of communicative culture, which can pose challenges in intercultural communication. According to researchers I.Y. Markovin and Y.A. Sorokin, these cultural components encompass:

a) traditions, customs, and rituals;

b) everyday culture, often referred to as traditional and everyday culture due to its connection with traditions;

c) everyday behavior, including mimic and pantomimic codes used by speakers within a specific linguocultural community;

d) national peculiarities of thinking that reflect how individuals from a culture perceive the surrounding world;

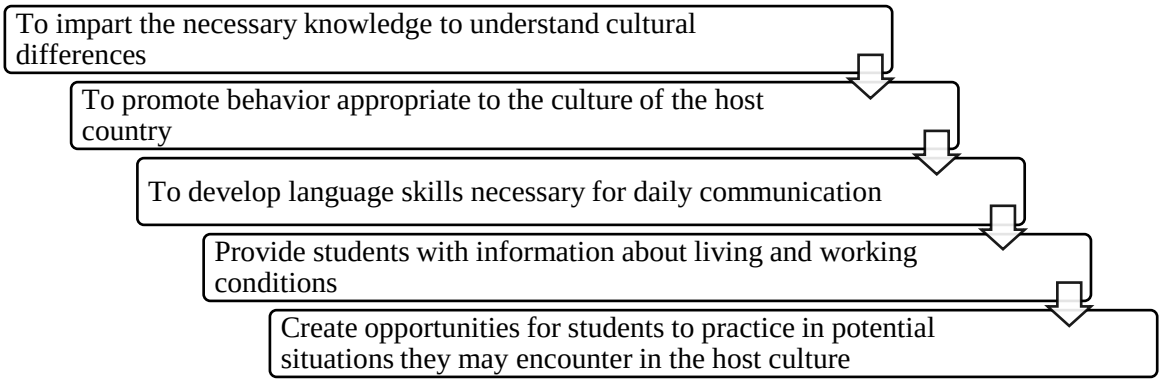
e) artistic culture, which mirrors the cultural traditions of an ethnos [4].

In essence, the primary objective of any communicative process is to effectively convey information, knowledge, and experiences to the communication partner. Intercultural communication research focuses on examining the culture-specific aspects of communicative behavior among participants in the communication process. This involves developing practical skills and knowledge that enable individuals to comprehend those from foreign cultures speaking foreign languages – essentially, fostering the development of intercultural competence.

Results and Discussion

Modern education attaches special importance to intercultural communicative competence, since future graduates will not only have to interact in an intercultural environment in the professional sphere, but also actively contribute to the formation and development of intercultural competence in their future professional activities. Modern education is aimed at fostering intercultural personalities, ensuring the readiness of graduates of higher education institutions to successfully interact with different cultures in the process of sharing values, knowledge and methods of activity. The use of various information technologies at foreign language lessons plays a special role in the development of intercultural communicative competence of students.

In today's educational context, teachers are faced with the tasks necessary to develop intercultural communicative competence. These tasks are summarized below:



To develop intercultural communicative competence and enhance the effectiveness of learning a foreign language, a cultural component was integrated. This means that students acquire knowledge not only about the language and culture of the country whose language they are studying, but also about their native country. This is due to the fact that people often evaluate other cultures through the prism of their own values and norms. In order to create the missing linguistic socio-cultural environment, it is important to interact with native speakers using texts with cultural components. These texts introduce students to the culture, traditions and holidays both in their own country and in the country whose language they are studying. Therefore, at the present time, along with such topics as "The United Kingdom of Great Britain and Northern Ireland", such topics as "Culture of Kazakhstan", "The image of the Kazakh people" have also been included in the curriculum. However, it is important to note that foreign books are not ideal for the development of intercultural competence, as they do not contribute to a real dialogue between cultures. Therefore, along with the main authentic educational materials, it is necessary to use additional educational resources that reflect the cultural diversity of the native country.

The spatial fullness of the educational space is of key importance for the development of intercultural communicative competence in learning English. The use of visual materials reflecting the cultural aspects of English-speaking countries creates a learning environment conducive to deep perception and understanding of cultural characteristics. Spatial design can also include elements that

encourage interaction and communication between students, contributing to the development of intercultural communication skills and creating a stimulating educational atmosphere. Namely, a map of the target language and the native country; photos of attractions; tables with grammar of the language of the studied country; audio and video recorders.

Moreover, the implementation of creative forms and methods in the teaching process, such as video lessons, project work, learning situations and presentations, provides unique opportunities for the effective development of students' oral and written language skills.

Video lessons are an important tool that provides a visual context for language material, which contributes to a better perception and understanding of cultural aspects of the language. It is essential to familiarize students with audio and video materials as part of foreign language learning, as it stimulates their cognitive and communicative activity. The teaching packages provide authentic information that expands the understanding of the professional sphere, cultural and linguistic diversity of the world. Students, performing the tasks, not only enrich their linguistic luggage, but also form comparative ideas about the culture, traditions, customs and achievements of their own nation and English-speaking societies.

Numerous authors emphasize the significant advantages of using audiovisual media in foreign language lessons. According to L. P. Pressman (1974), they increase the efficiency of learning linguo-country aspects and expressing non-verbal features of the people of the target language [5]. A. M. Gelmont (1961) notes that they facilitate the explanation of complex phenomena, turning them into visual and convincing illustrations that surpass the teacher himself, while the others emphasizes that audiovisual means create realistic situations of native speakers' communication [6]. These and other works clearly demonstrate that the need for their use is perceived differently not only by teachers, but also by many methodologists.

People maximize their learning by doing. This is where the project methodology comes in handy. The project method is one of the most interesting and actively implemented methods in pedagogical practice, through which intercultural communicative competence is being developed. According to Pedagogical Encyclopaedic Dictionary, project technology is an educational system where students' knowledge and skills are formed in the process of planning and performing progressively more complex practical tasks – projects. This technique is always aimed at stimulating active independent work of students [7].

As W. Kilpatrick noted in his work, the formation of communicative competence through the project method requires active thinking activity to solve problems. It is important that students pay attention to the content of their statements, expressing the thought in language. Project methodology not only promotes the development of cognitive skills, but also allows students to form knowledge independently, creatively approaching the information space. This approach enables individualized work, increases interest and motivation. During the project, pupils investigate different sources, developing analytical skills. Also, they are involved in interdisciplinary knowledge, which helps in solving problems. In addition, the methodology promotes the development of intellectual and creative abilities, as well as the formation of communicative skills [8].

Therefore, the project approach aids in acquainting the students at the senior stage with the traditions, language, and culture of the studied country, fostering critical thinking, and gaining skills for comparative analysis in the context of intercultural communication.

Conclusion

In conclusion, the modern demand for foreign language proficiency necessitates innovative teaching technologies to foster intercultural communicative competence. The European language competences underscore the significance of navigating cultural differences effectively, intertwining language proficiency with cultural practices and group beliefs. Beyond information exchange, successful communication involves establishing and maintaining relationships, demanding an understanding of cultural nuances for effective interaction.

Integrating a cultural component into foreign language teaching is paramount, emphasizing the creation of a linguistic socio-cultural environment. Visual materials reflecting cultural aspects

contribute to spatial fullness in educational settings, fostering deep understanding. Creative teaching methods, including video lessons and project work, enhance both oral and written language skills while nurturing intercultural communication.

Audiovisual media play a crucial role in language lessons, providing a visual context for language material and expanding understanding of cultural aspects. The project methodology emerges as a powerful tool, stimulating active independent work and fostering critical thinking. It acquaints students with the traditions, language, and culture of the studied country, contributing to the development of intercultural communicative competence. In conclusion, adopting innovative teaching methods, integrating cultural components, and emphasizing active learning are essential for nurturing students' intercultural communicative competence in the ever-evolving landscape of language education.

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COURSE "MODERN UKRAINE" IN THE CONTEXT OF EUROPEAN EDUCATION OF FOREIGNERS

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КУРС «СУЧАСНА УКРАЇНА» В КОНТЕКСТІ ЄВРОПЕЙСЬКОЇ ОСВІТИ ІНОЗЕМЦІВ

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Сучасна європейська освіта, скерована у своїх напрямках статтею 165 Договору про функціонування Європейського Союзу, розвивається шляхом викладання та поширення мов держав-членів ЄС. У той же час європейське навчання є відкритим для сусідніх країн, інтеграція освітніх систем яких у європейський простір відбувається з дотриманням тих засад, що визначили для себе держави-учасниці.

Україна, яка обрала структуру освітньої системи європейського зразка та приєдналась до Болонського процесу 2005 року упровадженням дворівневого університетського навчання, бере активну участь у формуванні загального освітнього простору. За умов жвавої мобільності викладачів і студентів, сприяння визнанню дипломів і співпраці між навчальними закладами цілком виправданим є обмін не лише в технічно-інформаційних галузях науки, а й гуманітарних, що реалізується через упровадження освітніх програм із кількома мовами навчання, у тому числі для іноземних студентів. Здобувачі таких програм мають оволодіти найбільш затребуваними на сучасному ринку праці лінгвістичними навиками, а також опанувати мовно-культурні особливості країни, де вони навчаються.

Ураховуючи місію європейської вищої освіти, що полягає у формуванні всебічно розвиненої гармонійної особистості студента й виходить із загальнолюдських цінностей, обґрунтованою є орієнтація навчального процесу не лише на отримання теоретичних знань і практичних навичок, а й на виховання та плекання в майбутньому фахівцеві чеснот, що становлять основу людяності. Будь-яка галузь навчання, особливо гуманітарна, в освітньому процесі керується як педагогічними настановами, так і бере до уваги соціальні та психологічні аспекти формування особистості майбутнього спеціаліста, спираючись на етнокультурні, лінгвістичні й ментальні чинники. На окрему увагу в цьому плані заслуговує освіта іноземних студентів, бо зазначені вище фактори відіграють подвійну роль у ситуації міжкультурної взаємодії. Важливим елементом виступають тут навчальні курси, що спрямовані як на становлення цілісної особистості студента, так і на розширення його світогляду, самоідентифікацію, виважену життєву позицію.

Актуальність нашої роботи полягає в потребі теоретичного і практичного аналізу дисципліни «Сучасна Україна» як елемента європейського освітнього процесу, зокрема на теренах Словацької Республіки, що дає можливість унаочнити здобутки університетського навчання в контексті Болонської системи та розкриває важливість гуманітарної освіти для подальшої соціалізації студента, його взаємодії з діловим і ближнім оточенням.

Перспективною обрана тема є і тому, що на конкретних прикладах розкриватиметься роль навчального курсу в іншомовному студентському середовищі, відображатиметься вплив дисципліни на адекватне оцінювання молоддю сучасної ситуації на світовій політичній арені,

екстраполюватимуться набуті знання на раніше відомі факти з історії та реалій власної держави, транслюватимуться стереотипи, притаманні українській спільноті в міжкультурній комунікації.

У дослідженні ми звертаємось до нормативних документів, що регламентують сучасний європейський освітній процес, праць із методики викладання, зокрема для студентів-іноземців, Л. Баличевої та Л. Добрунової, О. Резван, П. Шляхтуна, Г. Яковенко та ін., а також спираємось на розвідки з питань сучасного економічного та культурного розвитку України О. Берегової, В. Громченка, А. Зінченка, В. Кулика, І. Макарчук та ін., беремо до уваги аналіз українського національного характеру Я. Головацького, В. Гримича, Я. Марковича, Д. Чижевського, В. Яніва та ін., послуговуємось висновками з психології та ментального дискурсу Ю. Візниці, М. Поповича, Ю. Прохаська, В. Роменця, А. Фурмана та ін, дослідженнями ціннісних орієнтацій особистості М. Боришевського, Є. Борінштейна, В. Русавської, В. Ямницького та ін.

Мета нашої роботи – розкрити специфіку викладання курсу «Сучасна Україна» для іноземних студентів у навчальних закладах Словаччини; проаналізувати результати опанування дисципліни слухачами; підкреслити значущість обов'язкового предмета в становленні світогляду магістрантів, роль курсу у формуванні їхніх ціннісних орієнтирів.

Об'єкт дослідження – курс «Сучасна Україна» для іноземних студентів спеціальностей «Російська мова в міжкультурній і діловій комунікації» та «Викладання російської мови та літератури в комбінації з іншими предметами» у вищому закладі освіти Словацької Республіки.

Предмет дослідження – специфіка, значущість і результати вивчення курсу «Сучасна Україна» в магістратурі словацького університету.

Курс «Сучасна Україна» як елемент магістерської програми для іноземних студентів словацьких вищих навчальних закладів вивчається на останньому році зазначеного освітнього рівня. Опанування цієї дисципліни відбувається на базі раніше отриманих знань із таких предметів, як «Історія та реалії України», «Українська культура», «Культура національних меншин», «Практичний курс української мови», «Мовленнєва практика з української мови».

Ця навчальна дисципліна знайомить студентів із засадами формування українського національного характеру, демонструє становлення символіки України; аналізує географічне положення, кліматичні умови, ландшафт великої східноєвропейської країни; описує модель її територіального поділу, особливості державно-політичного устрою; характеризує міський і регіональний розвиток, транспортну інфраструктуру; презентує важливі аспекти соціального та культурного життя держави, приділяючи окрему увагу видатним українцям.

Варто підкреслити значущість використовуваних форм навчання з цього предмета. Студенти не лише відвідують лекції, а й беруть активну участь у семінарах, що дає змогу слухачам висловити власну думку з проблемних питань, презентувати свій погляд на актуальні та дискусійні тенденції розвитку української держави. Важливим для словацьких, польських, казахських студентів є обмін думками та припущеннями з одногрупниками-вихідцями з України. Зважаючи на вже набутий навчальний, а також життєвий досвід, іноземні здобувачі з зацікавленням не лише обговорюють теми сучасного національного складу населення та його віросповідання, розбираються в соціальних перевагах, функціонуванні політичних партій, державному й місцевому урядуванні, але й міркують про розвиток науки, освіти, спорту в Україні, про функціонування суб- і контркультур, визначають переваги сільського господарства в державі, що має статус головної житниці Європи.

Студенти, які вже володіють певною інформацією про Україну, на перших заняттях із дисципліни визначають її основними здобутками красу міст, насичене минуле, багате мистецьке та архітектурне надбання, а ознаками української спільноти називають талант, художній смак і творчий хист (див. Гістограма 1).

Україномовні студенти, що є громадянами України та приїхали здобувати освіту до Європейського Союзу, окреслюють наступні риси рідної нації: духовність і чуйність, активну життєву позицію, повагу до своїх традицій, високу працелюбність, креативність, дружність. Також акцентують увагу на інтелектуальних здібностях українського народу, що позначається

на прискореному розвитку ІТ-індустрії, зокрема швидкому просуванні й удосконаленні різних мобільних застосунків, які полегшують життя пересічного користувача.

Таке відчуття свого народу є природним, бо його історію людина сприймає через призму стереотипного, поняттєвого, традиційного, що базується саме на розумовому компоненті та досвіді. Ці уявлення формуються внаслідок описаної Л. Леві-Брюлем партиципації [4], яка передбачає пояснення сучасною людиною мислення та психології попередників шляхом відносної «співучасті» в певних процесах. Але така «зануреність» у минуле здійснюється без нав'язування результатів авторитетних психоаналітичних досліджень, здебільшого – через самосприйняття й індивідуалізований підхід.

На думку сучасного літературознавця та психоаналітика Ю. Прохаська, умови сьогодення закріпили у свідомості українського народу й таку рису менталітету як самоокресленість [6], що виявляється насамперед у любові до рідної землі та виходить із автохтонності нації, і, як наслідок, реалізується в прагненні їй кращого майбутнього, утіленні цього бажання в результатах своєї праці, насамперед творчої. Національні шедеври мистецтва, неперевершені зразки етніки – усе це уособлює потяг української душі до краси та любові.

Відомий прилуцький письменник-мемуарист XVIII ст. Я. Маркович, характеризуючи соціально-політичний устрій Гетьманщини, її усну народну творчість, історію, природу та побут, зазначав, що «дух людини є дзеркало оточуючих його предметів, мініатюрний портрет країни, де він заснував своє житло» [6, с. 127]. Здатність відчувати красу довкілля та передавати її в зразках художньої творчості – характерна риса української нації.

Ще на початку XXI ст. натхненні багатством українського орнаменту відомі європейські дизайнери Дж. Гальяно, Ж.П. Готьє, П. Гурунг і Г. П'ю, Ф. Джанніні, М.Г. Кюрі, П. Піччолі створили свої колекції для модних домів Dior, Gucci, Valentino [1, с. 138], оздобивши витвори українською вишивкою. Сучасні українські модельєри О. Караванська, І. Максимів, М. Приймак, О. Романова, Я. Чорна та ін., популяризуючи фольклорні мотиви, вишуканість національного одягу, навіть локації-подіуми для показу своїх колекцій оформлюють із використанням етнічних мотивів [1, с. 139].

Інтерес студентів до теми національного костюма як елемента цього навчального курсу обумовлений сучасними подіями в Україні. Як зазначає дослідниця О. Матюхіна, «одяг декларує приналежність людини до певної нації, відбиває зв'язок із національною самосвідомістю» [5]. Він уособлює естетичний ідеал, цінності, що складались у конкретній етнічній спільноті протягом століть.

Із повагою до національних здобутків України студенти презентують під час семінарів доповіді про етнічний одяг українців, акцентуючи увагу на елементах-символах, якими він прикрашений. Як зазначають майбутні філологи та викладачі, включення елементів національного одягу в сучасний міський костюм свідчить про патріотизм українців, їхню вірність своїм ідеалам. Іноземні магістранти на семінарських заняттях підкреслюють і те, що звернення до традицій та актуальність елементів національного вбрання в повсякденному одязі відбувається в складні моменти історії держави і віддзеркалює зв'язок із національною ментальністю, а також виступає вагомим фактором у вихованні почуття громадянства, є проявом шанобливого ставлення до духовних цінностей рідного народу.

Зацікавлення в студентів викликає порівняльний аналіз українського національного вбрання з етнічним одягом їхніх народів. Енергійне обговорення породжує територіальна символіка та багатство вишивки, якою оздоблені українські сорочки. Студенти відзначають розмаїття локальних прикрашальних елементів жіночого вбрання, його яскравість, знакове навантаження; підкреслюють багатство гаптування порівняно з іншими слов'янськими національними костюмами.

Українська культура – це сфера, яка отримує максимально позитивні відгуки від слухачів курсу. Набуті за попередні навчальні роки знання поглиблюються в результаті самостійного опрацювання більш вузьких тем. До кола інтересів слухачів потрапляють не лише загальновідомі факти, а й ті, що не є масштабними, але відображають позитивні зрушення в сучасній

культурі, на зразок проведення етнічних фестивалів, зйомок документальних стрічок, створення цікавих арт-об'єктів і т.п. У цьому плані ціннісними є доповіді іноземних студентів, які відвідали подібні заходи, були учасниками таких культурних after party чи просто мали можливість спілкуватись із членами робочих груп. Їхні схвальні відгуки посилюють позитивне враження про Україну, активізують до неї інтерес тих магістрантів, хто знайомиться з державою заочно. Результат таких дискусій благотворний: одностайно іноземні студенти висловлюють бажання відвідати Україну, скуштувати її національні страви, насолодитися затишком львівських вуличок і прогулятись по історичних місцях столиці.

Жвавої дискусії на заняттях набувають аспекти соціальної сфери, бо вони якнайкраще відображають рівень життя в державі. Україномовні студенти в якості переваг указують можливість отримати безкоштовне медичне обслуговування в Україні та безоплатне навчання як у школах, так і в закладах вищої освіти. Вагомим фактором, на думку опитаних магістрантів, є перебування жінки в декреті до досягнення дитиною віку трьох років, що позитивно позначається на здоров'ї та формуванні молодого покоління.

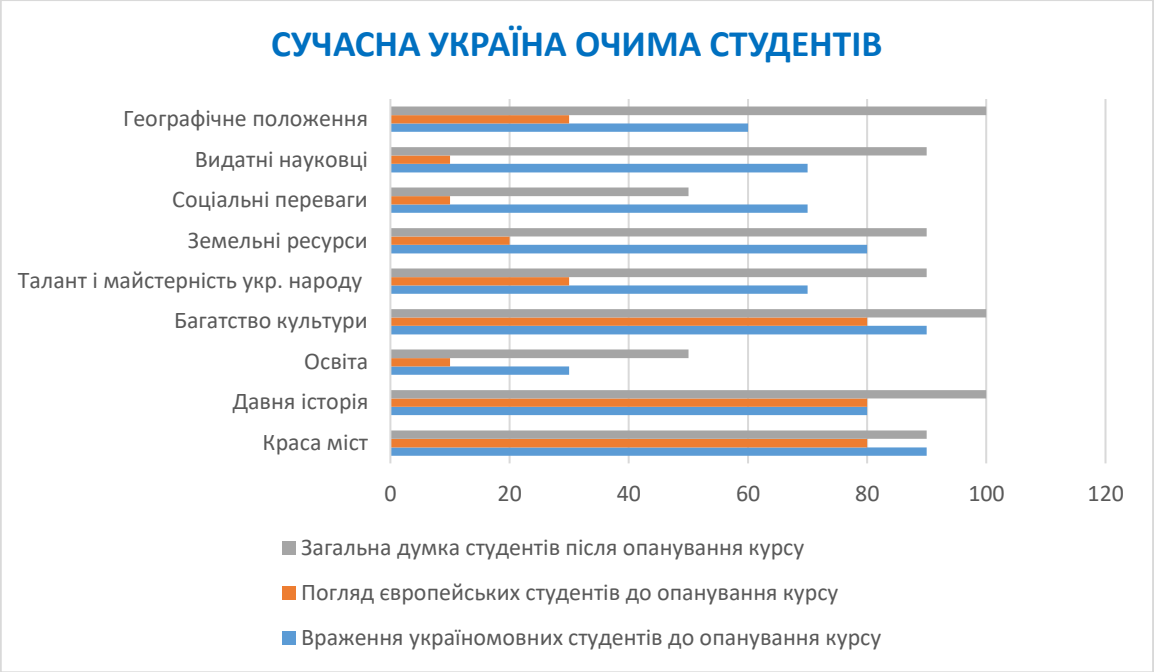
І якщо соціальні та компенсаційні виплати населенню не викликають особливого здивування в іноземних студентів, адже грошові трансферти цільовим групам як елемент соціального захисту наслідуваний державою за європейською моделлю, то отримання безкоштовної професійної медичної допомоги є додатковою заслугою у формуванні шанобливого ставлення до України. Підкреслена українськими слухачами курсу відчайдушність і талант українських медиків, що рятують людям життя в надзвичайних ситуаціях, а також відданість справі українських педагогів, які отримують сьогодні найвищі нагороди на міжнародних конкурсах за професіоналізм і просвітницьку діяльність, суттєво змінили ставлення іноземних студентів до соціальної сфери в Україні (див. Гістограма 1).

Не менш цікавою темою занять стала ситуація в сучасній науці та освіті. Особливу увагу студентів привернули постаті українських вчених, чия дослідницька спадщина набула значення світового масштабу. Дізнавшись про таких науковців і винахідників, як розробники різних методів електрозварювання Євген і Борис Патони, фізик І. Пулюй, авіаконструктор І. Сікорський, творець першого кінескопа Й. Тимченко, мікробіолог В. Хавкін та ін., магістранти зібрали й презентували маловідомі факти з їхньої діяльності, відкривши для себе незнаний і тривало замовчуваний світ геніальної української науки. Кожен студент, хто звітував за цією темою на семінарах, був вражений величчю внеску науковця, обраного ним для доповіді.

Ураховуючи, що найважливішою мотивацією для цих іноземних студентів є ціннісні орієнтації, які передбачають не просто перебування на заняттях заради отримання диплома, а самоствердження себе в якості гарного майбутнього фахівця, показником важливості досліджуваного курсу в освітньому процесі стала небайдужість та активність студентів на екзамені, де вони презентували гідний рівень знань із раніше маловідомого, а почасти й незнайомого для них предмета.

До того ж змінились результати сприйняття реалій української держави до знайомства з цим навчальним курсом і наприкінці його опанування. Аналіз отриманих знань і вражень від опрацьованого матеріалу показав, що навіть україномовні студенти, які отримують освіту в європейському університеті, по закінченні семестру мають більш зрілий, виважений погляд на дійсність (див. Гістограма 1). Теоретичний матеріал і плідна практична робота дала можливість слухачам обґрунтувати власну позицію щодо сьогоднішньої України, а акцент на духовні цінності, що є невід'ємною частиною сучасної освіти, дозволив зберегти провідну настанову сучасного навчання – бути корисним і надавати втіху.

Гістограма 1.



Проведений аналіз дозволяє зробити наступні *висновки:*

1. Курс «Сучасна Україна», що вивчається на другому (останньому) році магістратури в словацьких вищих навчальних закладах, є обов'язковим предметом, враховуючи важливість його опанування магістрантами гуманітарного напрямку;

2. Він охоплює основні тенденції розвитку великої східноєвропейської держави і надає можливість досить детально ознайомитись із маловідомими фактами біографії українського суспільства;

3. Запропоновані форми навчання сприяють кращому засвоєнню матеріалу, поєднуючи лекційний виклад із самостійною дослідницькою роботою, аналізом важливих тем;

4. Опанування досліджуваного курсу дозволяє майбутнім філологам і викладачам трансформувати власний погляд на реалії України, виробити усталену виважену позицію щодо окремих фактів світової історії, науки, соціології, політології;

5. Викладання курсу передбачає дотримання вимог сучасної освіти щодо виховання гармонійно розвиненої особистості студента. Відповідно, основний акцент робиться на збереженні, популяризації та формуванні загальнолюдських цінностей.

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HOW TO IMPLEMENT DIFFERENTIATED LEARNING IN TEACHING

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Abstract

This article will focus on specific scenarios for using differentiated instruction for all types of students, providing specific examples in the context of various academic disciplines, including, but not limited to, reading, writing, science, and others. The goal of this approach is the real integration of differentiated learning into the educational process, considering specific educational disciplines.

Like the uniqueness of each student's fingerprint, it is characterized by the individuality of each student's learning styles. Diversity in approaches to educational material, as well as in the level of knowledge and abilities, creates the need for an individualized approach in education. Considering this issue, there is a need to optimize the interaction between the class and each student. Differentiated learning, although widely known, does not always find practical application. This article examines aspects of understanding and implementing differentiated instruction, as well as assessing its advantages and disadvantages.

Differentiating instruction may mean teaching the same content to all students using different teaching strategies or may require teachers to use different teaching methods depending on each student's abilities.

Teachers who practice differentiated instruction in their classrooms may try to develop instruction, group students by similar interests, topics, or abilities for assignments, use formative assessment to assess student learning, and manage the classroom in a targeted manner to create a safe and supportive environment. Constant assessment and adjustment of learning content is carried out in accordance with the needs of students.

Keywords: differentiated learning, individualization, pedagogy, methodology, teaching method.

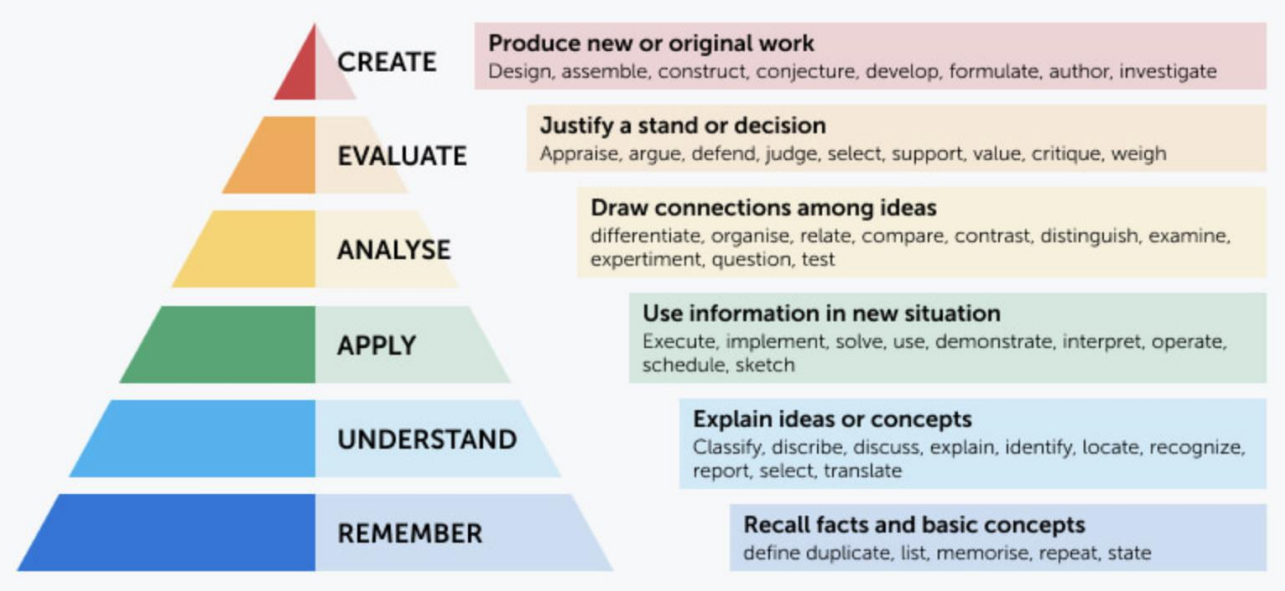
Four methods of differentiated guidance. Tomlinson believes that teachers can differentiate teaching through four methods: content, procedures, outcomes and learning environment. [1]

Content. As is known, the content of the basic course should cover learning standards based on school or educational standards. However, some students in the class may not be familiar with the concepts in the lesson, some students may only have mastered part of the lesson, and some students are familiar with the class content before class begins.

It is my responsibility to provide differentiated instruction by designing different activities for each group based on Bloom's learning objectives. [2]

Bloom's learning objectives, grounded in Bloom's Taxonomy, delineate a hierarchical structure for educational objectives. These aims span from rudimentary information retrieval to advanced cognitive abilities including analysis, synthesis, and evaluation. Integration of tasks consistent with Bloom's Taxonomy enables educators to orchestrate enhanced learning encounters conducive to cultivating critical thinking, problem-solving aptitudes, and creative ideation within students.

Working with the six levels of thinking, including remembering, understanding, applying, analyzing, evaluating, and creating, is a systematization of thought processes from less complex to higher levels of intellectual activity. (Pic. 1)



Pic. 1. Bloom's Taxonomy of Educational Objectives

Students unfamiliar with class content may be able to perform lower-level tasks such as memorization and comprehension. Students who have mastered the unit can apply and analyze its content. Students with good academic performance can complete assessment and creative tasks.

Cases of differentiated teaching activities include matching words with their meanings, recalling a particular person's situation in history and presenting different outcomes, identifying different facts from a point of view, analyzing an author's opinion with providing evidence to support that opinion, and creating educational materials in presentation format for summarizing the lesson content. [3]

Steps. Every student has a different learning style and preferences, and successful differentiated instruction includes each style of delivery: visual, auditory, kinesthetic, and textual learning styles. This process approach also shows that not all students require the same level of support from teachers and that students may choose to work in pairs, small groups, or individually. Some students may benefit from one-on-one time with a teacher or classroom aide, while others may improve on their own. Teachers can support students' learning based on their individual needs.

Examples of differentiated instructional procedures include providing visual learners with books, allowing learners to use electronic audiobooks, and allowing kinesthetic learners to complete interactive online tasks.

Exit. The result is content that students creatively demonstrate mastery of in the classroom. This may be in the form of a test, project, report, or other activity. You can have students complete tasks that demonstrate mastery of content based on their preferred learning styles.

Learning environment. Optimal learning conditions include both physical and psychological factors. Flexible and flexible classroom organization is key. It includes furniture and controls to support individualization and variety of group activities. From a psychological perspective, teachers must use classroom management technology to create a safe and conducive learning environment.

Ecological layouts with differentiated guidance may include dividing several students into groups to discuss a reading task, providing opportunities for individual reading, creating a calm environment, and avoiding distractions.

Differentiated learning strategies. A variety of teaching strategies can be used in the classroom, including tiered problems, choice boards, streamlining, affinity groups, flexible grouping, and learning contracts. [4]

The purpose of tiered activities is to teach the same skills but have students create different pieces to demonstrate their knowledge based on their understanding of the skills.

Choice boards allow students to select activities they would like to engage in to learn skills chosen by the teacher. The board usually has options for different learning styles: kinesthetic, visual,

auditory and tactile. Once students have mastered the knowledge taught in class, compression can help them move on to the next stage of learning.

To make acceleration more effective, educators assess students' knowledge levels, develop a learning plan that avoids learning what they already know, and provide free time to practice acceleration skills.

Interest centers or groups are one way to support students' independent learning. Flexible groupings allow teams to be more flexible based on activities or topics.

In the final stage, the student and teacher agree on a teaching contract that sets out the teacher's expectations of the required skills presented by the students and establishes the requirements for the task. Students write down the methods they plan to use to complete the task. These agreements allow students to learn according to their learning style preferences, at their desired pace, and promote the development of independent planning skills. [5]

Below I will indicate several strategies arising from the basic principles of these approaches.

1. Differentiated strategies for teaching mathematics.

Provide students with choices using the board. They can learn concepts through playing games with peers, watching videos, reading textbooks, or solving problems on worksheets. Provide smaller classes for individuals or groups of students who have difficulty understanding material taught in larger classes. It also provides an opportunity for faster learning for those who have already mastered the subject. Use manipulatives, especially with students who have difficulty grasping concepts. Ask those who have already mastered the topic to take notes for those still learning. Encourage students who successfully complete the course to provide a detailed step-by-step explanation of the solution process to avoid rigidity in the process, given that even correct answers require an in-depth understanding of the underlying concepts.

2. Differentiated strategies for teaching natural sciences.

Creating “help stations” where peers can provide mutual support is an effective differentiated strategy. Students with deeper knowledge of a subject can teach those who are struggling, turning this learning into an additional activity. Organizing a question-and-answer session can also be helpful, where students could ask questions of the teacher or classmates to address knowledge gaps before conducting an experiment.

Another strategy is to create a visual wall of text, using images and related labels to remember terms and stimulate interest. For example, when studying dinosaurs, you could create a dig center, a reading center, a dinosaur anatomy art project, and a video center. Providing material in a variety of formats, such as videos about dinosaurs, worksheets with pictures and captions, and fill-in-the-blank activities with fun facts about dinosaurs, also promotes more effective learning.

3. Differentiated strategies for teaching reading.

Tiered assignments can be integrated into readings to allow students to demonstrate their knowledge at a level appropriate to their abilities. For example, one student might create a visual storyboard while another might write a book report. Reading groups can select books based on interests or receive reading assignments that match their skill level.

Teachers should be encouraged to support learning by providing clear and concise explanations accompanied by visual materials for verbal and visual understanding. The use of reference diagrams, pictures, diagrams and reference guides promotes a more complete and clear understanding of the material. If possible, provide videos for additional visual learning.

Flexible grouping can also be used effectively. For example, students may study phonics in one group according to their level, but prefer reading in another group due to greater interest in the chosen book.

Conclusion

Concluding the article on the implementation of differentiated learning in teaching, we can summarize its advantages and disadvantages. Research convincingly demonstrates the effectiveness of this approach for both high-ability students and those facing disabilities, covering a wide range of difficulty from easy to difficult tasks.

Giving students more freedom to choose how they learn the material encourages them to actively participate and take responsibility for their educational process. While the benefits are clearly visible, it must also be recognized that implementing differentiated instruction requires additional effort and time on the part of teachers.

Challenges schools face during implementation include organizational challenges, lack of resources, and the need for teacher professional development. Considering this, critics have raised the need for more research to confirm how much the benefits of differentiated instruction can offset the increased labor costs of implementing it. Thus, the successful implementation of differentiated instruction requires careful consideration of all these factors and a balance between innovation and established practices in the educational environment.

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THE ROLE OF USING ANIMATED FILMS IN ENGLISH LANGUAGE TEACHING

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Abstract

This research article delves into the transformative potential of animated films in English language teaching, with a specific emphasis on refining students' listening skills. The article contends that animated films uniquely contribute to language learning by providing students with not just auditory exposure but also visual context. Drawing upon scientific research validating the positive impact of visual components on language comprehension, the study examines how animated films activate the listening process and foster an immersive English-speaking environment, stimulate interest in language acquisition, and evoke positive emotions during the learning journey. The article delves into the methodology of selecting animated films for instructional purposes, providing insights into the criteria for appropriateness and offering illustrative examples.

Keywords: animated films, cartoons, listening skill, language, foreign language learning, teaching method.

Introduction

In the field of modern education, the focus is on making the learning process effective and engaging. Innovative methods and approaches are key to achieving this goal. One of the brightest representatives of innovative techniques in English language teaching is the use of animated films. The improvement of listening skills is facilitated by animated films, which not only expose students to authentic dialogues but also allow them to visually comprehend the accompanying context. This visual element enhances the educational journey, enabling students to grasp and retain English language intricacies more profoundly.

The development of listening skills is a crucial aspect of successful foreign language proficiency. The use of audio has become a standard in learning over the decades, but animated films offer a unique contribution to the process. They provide students with the opportunity to not only hear real conversations but also to see and visualise the context in which those conversations take place. This context, enriched with vivid images and stories, creates a deeper and more memorable experience for learners.

Listening is a crucial language skill that plays a significant role in the teaching process. It is a fundamental mental ability that enables learners to comprehend and engage with the world around them. Linguists define listening as the process by which spoken language is transformed in the mind into meaning. During listening, Solovova notes that it is not only the ability to hear that is considered, but also additional aspects. Listening is an active process that involves comprehending, attending to, analyzing, and evaluating the spoken message, and possibly taking actions based on what has been heard. It is not a passive perception and recording of auditory information. Listeners interpret what they hear by applying their own background and linguistic knowledge to the information contained in the auditory text. [1] In essence, listening involves comprehending a text by utilising various aspects of phonology, grammar, background knowledge, and personal experience.

Theoretical background

Audiovisual teaching tools, including animated films, are crucial in pedagogical practice. Animated films are multimedia works created using computer graphics, drawn animation or a combination of these technologies. They have the unique ability to visualise stories and concepts using vivid imagery and dynamic visual effects. In the context of English language learning, animated films are not only a means of entertainment but also a powerful educational resource.

When learning a foreign language, it is crucial to hear the correct pronunciation of speech sounds and words through audiovisual means. This helps to ensure that you can pronounce them correctly and understand the culture to which the language belongs. Animated films are a versatile tool for improving teaching and training, which can be used individually or in groups of any size. The use of cartoons has an immediate impact on language learners, regardless of their age, and can capture their attention and interest. Additionally, cartoons can promote comprehension, motivation to learn, improve attitudes and productivity, and strengthen the bond between teacher and learners. The benefits of animated films are their capacity to immerse students in an English-speaking environment, stimulate interest in learning a foreign language, and elicit positive emotions from the learning process.

From a language education perspective, animated films are a significant source of children's linguistic input during the language development process. Cartoons offer numerous advantages, particularly in developing listening and speaking skills:

- They are considered suitable for learners of all levels.
- These forms of expression reflect language representation with developed elements of humour, vivid characters, and interesting visual and auditory stimuli.
- They can enhance learning by allowing children to see language and movement in parallel.
- Additionally, they provide a suitable basis for activating prior knowledge and collaborative discussion.
- They can facilitate the learning of writing due to their functions, as they reflect children's imagination. [2]

One of the main advantages of animated films is their ability to develop learners' linguistic guesswork. By watching video fragments of cartoons, learners can guess the meaning of certain words and expressions from the context, which is particularly helpful for beginners. Additionally, animated films can aid in the acquisition of correct pronunciation and intonation when learning a language. Animated films can significantly aid in this regard because their voiceovers and dialogues serve as accurate models of English speech.

E. B. Bulavkina notes that cartoons are authentic material and one of the most effective teaching methods as they combine word text and pictures. [3] According to I.A. Bredikhina, the use of cartoons can activate both the visual and auditory memory of learners. Cartoons can help learners understand various processes in the surrounding world, satisfy emotional needs, and create a comfortable atmosphere in the classroom for the active development of foreign language speech. [4]

R. I. Abdurahmonova's study suggests that cartoons can effectively hold learners' attention and present information in a stress-free atmosphere. Furthermore, they have the potential to develop thinking processes and discussion skills. It is important to note the potential benefits of using cartoons in educational settings. [5]

O. I. Vorobiova in her works notes the use of video materials in foreign language teaching, based on the principle of visibility. Watching cartoon materials allows for auditory-visual synthesis, which forms the basis for audiovisual and audiolingual methods of teaching a foreign language. Cartoons can create a learning environment that closely resembles a film-language setting, and can reproduce speech situations through visual and audio means. These features make cartoons a useful tool for enhancing the learning process and promoting communication. [6]

It is widely acknowledged that audiovisual aids can enhance learning. They capture the learner's attention, create a natural environment, and facilitate the understanding of words, concepts, and sentence structures. Additionally, they are effective in developing correct language habits through repetition. [7] Similarly, animated films have a positive impact on children's learning. Animated films

can be effective in language learning for children as they allow for emotional reactions and simplify complex concepts. This is particularly true for foreign-made cartoons, as children can learn the language by observing the culture and making connections between what they hear and see, which aids in memorisation. On the other hand, foreign cartoons can expose children to different cultures, languages, and environments. This can spark their interest in learning a foreign language and broaden their understanding of the world.

Cartoons can be a valuable source of cultural insight, particularly in regards to children's perceptions of what is acceptable in their society. For example, we can see what children think. Children already know what is allowed and not allowed in their culture. Quality cartoons have a moral or teach a lesson. The most obvious reason for using a cartoon in the educational process is our desire to use its content to discuss a topic. Many cartoons tell a story about something. Others, such as The Simpsons, often contain topical issues that are easily incorporated into the context of the lesson.

The use of animated films as a tool for teaching a foreign language has several advantages. Firstly, cartoons are designed for children and use simple language that is easy to understand, even for beginner learners. In addition, they often feature repetitive phrases and dialogues, which aids in the retention of new vocabulary and expressions. Secondly, cartoons can be utilised to improve listening comprehension skills. Children can improve their pronunciation and listening comprehension in a foreign language by listening to and repeating phrases. Admittedly, cartoons provide visual support for understanding a foreign language as children can see images that correspond to words and phrases, aiding in better understanding and memorisation of new material.

Discussion

Modern English language teaching requires innovative and effective methods to engage students and make the learning process more effective. In recent decades, animated films have become a popular tool in education, and many linguists and teachers are incorporating this approach into their practice. This approach not only brings an element of entertainment into the classroom but also actively promotes the development of students' language skills.

One of the most noticeable effects of using animated films in learning is the improvement of listening skills. Modern teaching methods prioritize communicative competence and the ability to use language in real-life situations. Therefore, listening skills become crucial in ensuring that students comprehend speech by ear, including various accents, voice timbres, and different speech situations. By watching various scenes and dialogues, students can develop their ability to comprehend spoken language. Animations often present language in diverse contexts, which enhances the listening experience.

When selecting animated film clips to teach listening comprehension, it is important to adhere to several criteria for effective learning outcomes. Firstly, the clips should be appropriate for the learners' age and language experience. For instance, if the pace of the characters' speech is too fast or too slow, learners may struggle to comprehend the information. [8] Additionally, it is advisable to choose films in which the characters speak a language that the learners can understand. They may use abbreviations, children's vocabulary or slang terms. These features increase the load of learning a foreign language, but also provide an opportunity to get to know the jargon and everyday form of the language. [9] The length of the fragment should be appropriate for the age of the learners, as listening to foreign speech for 10-15 minutes and then completing tasks can be challenging for learners. [10] Secondly, fragments of cartoons should contain new and interesting information for students. When selecting a fragment, the teacher needs to determine the needs, interests and motivations of the students. Additionally, it is essential to choose a cartoon that can enhance knowledge of the target language's country, as it contributes to the intercultural approach of perceiving foreign cultures from one's own perspective and one's own culture from another's perspective. [11] Thirdly, the cartoon fragment should present the situation, characters, and circumstances in a natural way. Fourthly, a cartoon fragment should evoke an emotional response. The impact of emotions contributes to the formation of students' personal attitudes towards what they have seen. Cartoons can also aid in the development of various aspects of students' mental activity, such as attention and memory. The use

of multiple channels of information input, including auditory, visual, and motor perception, has a positive influence on the retention of country and language material. [12]

Examples of practical application:

- Transcription and comparison

Select a short extract from an animated film and provide students with a transcription. Task: listen and compare the pronunciation to the text. Example: “The Incredibles” - a scene with the main characters exchanging lines.

- Understanding the plot

Use animation with a simple plot. Students are given the task of listening and understanding the main points of the plot. Example: The short film “Paperman” to work on details and characters.

- Plot discussion

After watching the animated film, students discuss the plot, details and characters. The task is to listen and reproduce key points. Example: “Zootopia” for a conversation about prejudice and tolerance.

- Audio quest

Create an audio quest based on an animated film where students have to listen and problem solve. Example: “Toy Story,” a quest to find lost toys using audio clues.

- Listening and dialogue development

Provide dialogue from an animated movie and ask students to understand and analyze it. Example: “Up” - dialogues between Carl and Russell to learn expressions and everyday vocabulary.

Conclusion

The use of animated films in English language teaching has been shown to be an effective method for improving students' listening skills. The educational potential of animated films lies in their ability to engage learners, stimulate visual and auditory senses, and create a dynamic language-learning environment. From a pedagogical perspective, animated films offer a versatile tool applicable to learners of all ages and language proficiency levels. The benefits encompass not only language acquisition but also the development of crucial cognitive skills. Researchers such as E. B. Bulavkina, I.A. Bredikhina, R.I. Abdurahmonova, and O. I. Vorobiova have underscored the effectiveness of cartoons in activating visual and auditory memory, promoting understanding of language in diverse contexts, and fostering a positive and stress-free learning atmosphere. Moreover, the advantages extend to children's language development, where animated films serve as a significant linguistic input. The combination of humor, vivid characters, and auditory stimuli aids in the enhancement of listening and speaking skills. The imaginative nature of cartoons also supports writing skills by reflecting and stimulating children's creativity.

Animated films can facilitate linguistic guesswork, especially for beginners, which enhances vocabulary acquisition and pronunciation. The authenticity of cartoons, as emphasised by E.B. Bulavkina, makes them a valuable resource for language educators. In practical terms, the selection of suitable film clips is crucial, considering factors such as learners' age, language experience, and cultural relevance. The examples provided, including transcription and comparison tasks, understanding the plot, plot discussions, audio quests, and dialogue development, showcase diverse applications of animated films in the language learning process.

As the educational landscape continues to evolve, the incorporation of animated films offers a dynamic and engaging approach to language teaching. It not only addresses the technical aspects of language acquisition but also nurtures a positive and enjoyable learning atmosphere. With its multifaceted benefits, animated films emerge as a valuable ally in the quest for effective and enjoyable language education, bridging the gap between theoretical knowledge and practical language application.

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Philological sciences

STEM IS AN INTERDISCIPLINARY APPROACH TO LEARNING

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Abstract
To prepare competitive human capital, it is not enough to teach individual sciences, it is necessary to consider education in an integrative and interdisciplinary context. This is the foundation of STEM education, which means that skills are developed simultaneously in the fields of natural sciences, Technology, Engineering and Mathematics (Science, Technology, Engineering and Mathematics).

Keywords: natural sciences, integrative, interdisciplinary, technology, engineering, mathematics, STEM education, integration.

The world is changing, the reason is technological progress. In modern conditions, many jobs and actions are performed by robots, computers, and digital technologies.
Therefore, new creative approaches to non-standard thinking, efficiency, multifunctionality and the ability to quickly respond to rapidly changing vectors of new technologies are needed.
In a rapidly changing world, the education system undoubtedly needs to change. To prepare competitive human capital, it is not enough to teach individual sciences. In this regard, it is necessary to consider learning in an integrative and interdisciplinary context. This idea was the basis of STEM education, that is, the simultaneous development of skills in the fields of natural sciences, technology, engineering and mathematics (Science, Technology, Engineering and Mathematics).

But don't children study these subjects at school now? – it is also appropriate to raise the question. The peculiarity of the STEM approach is that all disciplines in it are closely interrelated. For example, suppose we are faced with the task of launching a space rocket, building a bridge, refining oil, or assembling a robot. Obviously, this becomes more complicated without extensive knowledge and skills in various fields of physics, chemistry, mathematics and programming. Thus, STEM combines subjects into a single learning scheme when preparing "projects", rather than combining them. Therefore, integrated training is conducted not by subjects, but by topics and projects. In such an educational environment, children learn and learn to use them immediately.

The challenges of STEM education:

- Insufficient qualifications and skills of the teacher in STEM learning;
- Lack of STEM programs;
- Weak training of school graduates in the field of STEM;
- Lack of skilled labor in STEM specialties;
- Lack of STEM literacy;
- Difficulties in planning and organizing STEM lessons.

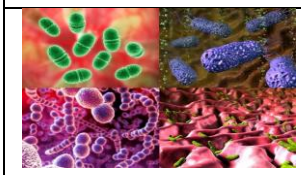
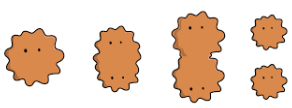
In order to solve these problems, it is necessary to expand the educational experience of individual STEM disciplines using problem-oriented educational activities, during which students have the opportunity to comprehensively understand complex concepts. In addition, it is important to integrate knowledge in STEM disciplines in order to better understand the content of the disciplines, which will ultimately lead to increased opportunities for students to choose a specialty in technical or scientific fields in the future. The training itself should be based on a problem-oriented learning activity that combines scientific principles, technology, design and mathematics into one STEM program.

Based on the STEM approach, the following basic skills and competencies are formed, if the content of the disciplines, general topics are taught in an integration context:

1. Asking questions (science) and accepting tasks (engineering).
2. Creating and using models.
3. Planning and conducting research.
4. Data analysis and interpretation.
5. Develop and use the types of thinking necessary for conducting mathematical operations and calculations.
6. Be able to give explanations (based on science) and find design solutions (engineering).
7. The ability to prove based on the available facts.
8. Receiving, evaluating and correctly transmitting information.

Here, the term "Engineering" is used in a broad sense and includes systematic human participation in solving technical or technological problems important to society. The term "Technology" refers to all artificial (human-designed) production systems and processes. It is not limited to new nano - and biotechnologies, information technologies, etc. At the same time, students and teachers should understand: that technologies aimed at meeting human needs are conditioned by the results of purposeful work of engineers.

So, if we consider ways to introduce STEM learning in biology lessons on the topic of "bacteria".

S **Science** **(Natural Science)**	**T** **Technology**	**E** **Engineering**	**M** **Mathematics** **(making calculations)**
Bacteria and the study of their structure	Working with a microscope	Modeling bacteria from available materials	For example, bacteria multiply quickly under favorable conditions (split in two). The resulting young cell divides every 20 minutes. Then how many bacteria can be formed, including 2 stem breaks?
			

Research in the field of engineering and technology forms a context in which students can verify the results of their research and apply new knowledge to solve practical problems. As a result, their understanding of science deepens, and many develop an interest in natural science.

Although the study of a certain specific discipline is important in the learning process, conducting interdisciplinary work has a positive impact on a better study of disciplines. Kerry (2007) believes that the approach to interdisciplinary communication is based on the work of John Dewey, who considered education to be an interconnected phenomenon. This approach to teaching and learning is closely related to a constructive approach to learning, as students work together to discuss and discuss

issues between subjects (Hayes, 2010). Students can use problems learned within one subject for another subject, or improve the study of another subject based on one subject. The integration of knowledge in subjects is aimed at increasing the interconnectedness and importance of the educational process for students. The subjects taught in natural sciences by students of the main middle and high grades should be considered in contact, since interdisciplinarity allows them to model their learning most effectively.

At the present stage, the methodology for the formation of scientific knowledge "natural science" is based on the doctrine of the unity of nature and man, as well as approaches to a single systematic analysis of the features of nature and human existence. This reflects the close relationship of scientific natural science subjects with each other, and also manifests itself as a single subsystem of its own level, in which the subject "natural science" is in close contact with other subjects in the class. Therefore, in the lessons there is a need to consider interdisciplinary communication and continuity in Natural Science Education.

In teaching a discipline, interdisciplinary communication has a number of functions. Methodological activity: students ' dialectical-materialistic views on nature, their views on the relationship between nature and society, on the unity of laws in nature are formed. Educational activity: through interdisciplinary communication, the theoretical foundations of the composition of substances and chemical processes occurring in different environments are revealed. The developmental activity of interdisciplinary communication is determined by the role of students in the development of systematic and creative thinking. Interdisciplinary communication does not allow one-sided thinking from the point of view of a specific subject, it encourages students to think broadly and broadens their horizons. With the help of the constructive activity of interdisciplinary communication, the teacher improves the content of educational materials, types and methods of organizing training.

Interdisciplinary integration in teaching increases with the perception of subject material by students. The principle of educational integration is aimed at giving an idea of the world around us, the formation of integrative thinking of students. Integrative Learning is a powerful regulatory factor in establishing and strengthening links between all academic disciplines and Sciences. The problem of a person and his attitude to the world around him is the center of the content of Education. Knowledge is a single world and should remain the same for the student. To remove barriers between subjects, knowledge must be integrated around the main objects or topics. This allows you to consider the subject from different angles, to reveal all its interrelationships. Integrative Learning of a discipline refers to the integration of previously allocated one and different components (goals, content, methods, compositions, technologies, conditions) into a single education.

In the integrated lesson, first of all, it is necessary to identify the main problems for the subject. This includes: the science of the subject, important data, laws, theories, the formation of practical skills, maintaining environmental cleanliness, protecting nature; staying away from harmful aspects, knowing the basic chemical composition of substances used, found in life.

In the integrated lesson with geography, students can familiarize themselves with the products of the chemical industry and their application and significance in the national economy of the Republic. The use of local materials in teaching chemistry, familiarization with various branches of the chemical industry in the Republic: ferrous and non-ferrous metallurgy, chemical and petrochemical industries will strengthen the student's knowledge.

And what is integrated reading in general? What is the advantage of the built-in training program? Let's study the answers to these questions. The main principle of the integration principle is to provide students with scientific and synthesis knowledge about the unity of the world, conditionally considering scientific and natural knowledge in a separate area of knowledge. The STEM learning itself, which is used today, is considered integrated. In modern pedagogical technology, interdisciplinary communication is considered a model of integrated education. Interdisciplinary communication creates structural and scientific-substantive blocks, combining common topics of various fields of knowledge, sometimes a common element, section, argument, theory, concept laws, forming a comprehensive learning system.

What is the importance of integrated teaching of subjects in the educational process?

- to study in accordance with the needs of students;
- to increase the share of problem situations in the structure of the lesson;
- to activate the student's thinking, which forms a research culture of the individual;
- to give the student control over the entire process of performing actions at the same time, from setting goals to achieving results;
- to increase the information capacity of the lesson;
- to increase the motivation of students, activate their educational and cognitive activity;
- to give importance to the direct connection of the topic covered in the lesson process with the life of a person and society;
- to develop students ' creative thinking;
- to help them to be able to apply the knowledge they have gained in life.

Subject	Learning objective	Built-in task
Chemistry Section "7.2 B simple chemical reactions"	7.3.4.4 determination of alkalis and acids using the Universal Indicator: 7.3.4.5 understanding the neutralization of acids on the example of the use of " stomach powder;	Development of a memo "how to deal with high acidity". **A. General concept.** Description of the role of gastric juice for human digestion (Biology). Highlighting the causes of high acidity (chemistry). Description of the acid determination method using a universal indicator (chemistry) Description of the effect of antacid drugs on the elimination of high acidity. Writing in words the reaction of neutralization of hydrochloric acid by baking soda (chemistry) . Indentation in each paragraph, spacing between lines of text 1.5 (Computer Science) . **B. The main part is "memo".** Recommendations for proper nutrition and the fight against high acidity, preventive measures (Biology, Chemistry). Setting up bulleted and numbered lists when performing the task (Computer Science)
Biology Section "7.2 C "nutrition"	7.1.2.3 comparison of the structure of the digestive system of invertebrate (earthworm), ruminant (cow) animals and humans	
Computer science Section "7.2 A Information Processing"	7.5.1.1 insert indents and intervals in the text; 7.5.1.2 placing bulleted and numbered lists	

Integration is a general and multifaceted process of establishing links between information, knowledge, science, as well as ensuring their integrity and unified structure, which includes all components in dialectical unity. Also, integrated tasks have a special place in the implementation of interdisciplinary communication in the acquisition of a certain concept and knowledge. That is, taking into account the cognitive needs of the student, it has a great impact on the development of higher thinking skills.

The integration of academic disciplines contributes to the growth of variability, personal orientation, the formation of the integrity of students ' knowledge and through the differentiation of Education. Integration is a necessary condition for the modern educational process, which allows the formation of universal educational activities and cognitive activity of the student.

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CONTEXTUAL APPROACH IN TEACHING ENGLISH TO STUDENTS OF PHILOLOGICAL SPECIALTIES

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Abstract

The article characterizes the essence of contextual learning and the specifics of its use in the process of teaching English to students of philological specialties. The essence of using the technology of contextual language teaching is revealed, which consists in creating specific pedagogical conditions and adjusting the forms of work with students of philological specialties.

It is noted that the realization of the potential of contextual foreign language teaching is to expand and deepen professional knowledge with the help of a foreign language and to update professional skills. It was emphasized that the contextual approach consists in the implementation of a number of professional and pedagogical functions in the process of teaching a foreign language.

Keywords: contextual approach, contextual learning principles, contextual learning methods, students of philological specialties training, contextual learning implementation.

The theoretical and methodological basis of the study is based on scientific articles on the contextual approach, the principles and methods of which we have applied in the process of training philology students. The theory of contextual learning is studied by Berry B.[1], Carey B.[2], Claxton G.[3], Fadel Ch.[4], Gee J.P.[5], Damon W.[6], Gardner H.[7], Galinsky E.[8], Hirsh-Pasek K.[9], Wagner T.[11] and others.

Scientists pay considerable attention to actualizing the cognitive activity of students of philological specialties. This is facilitated by the methods of modeling a communicative situation, business conversation, public presentation, and the use of information technology in teaching.

It has been found that the realization of the potential opportunities of contextual learning in foreign language learning is to expand and deepen professional knowledge using a foreign language, to actualize professional skills.

The effectiveness of contextual foreign language teaching depends on the following pedagogical conditions:

a) inclusion of thematic sections in the content of the discipline "Foreign Language", the content of which allows the universal competencies development: "Ability to build relationships", "Effective business communication in the context of different cultures and conditions", etc.:

b) systematic use in the process of learning a foreign language of a set of interactive teaching methods and appropriate ways of organizing learning activities: discussions, case studies, role-playing games, projects; frontal, group;

c) creating an educational and developmental environment.

The main principles of contextual learning are:

psychological and pedagogical support for the student's personal involvement in learning activities. It is worth noting that socialization takes place throughout a person's life in interaction with the environment, resulting in the acquisition of social experience, active realization of the individual, changing life circumstances in accordance with his or her tasks. Socialization is carried out through communication, as well as through the identification of a person with society and the separation of the individual in it;

consistent modeling of the holistic content of the forms and conditions of professional activity of specialists in the educational activities of students. In contextual learning, the main thing is not the transfer of information, but the development of students' abilities to competently perform professional functions, solve professional problems and tasks, that is, to master holistic professional activities. In

such conditions, there is a transition from learning to the development of skills to perform professional duties. The student realizes what has been (established models of theory and practice), what is (cognitive activity performed by him/her) and what will be (modeled situations of professional activity). All this motivates cognitive activity, and, as a result, educational information and the learning process itself acquire a personal meaning, information is transformed into personal professional knowledge of the student;

problematic content of learning. The peculiarity of problem-based learning is that students do not have a ready-made theory or a formed vision of the problem. There is no goal to create a specific product and no ready-made solution. All this needs to be formed. In other words, problem-based learning is a more exploratory way of working compared to case studies and even projects. It is not for nothing that it is called the Socratic or heuristic method, exploratory learning, etc. And this is the difficulty and advantage. Problem-based learning is relevant for any subject. Of course, you need to be creative in your preparation and choose not just interesting problems, but those that are relevant to the topics you are working on;

adequacy of the forms of organization of students' learning activities to the goals and content of learning. The form of organization of learning is an external expression of the coordinated activity of the teacher and students, carried out in a certain order and in a certain mode;

the leading role of joint activity, interpersonal interaction and dialogues in the educational process. The teacher's activity is always about communication and interaction with others in the course of performing their own professional functions. The ability to establish productive communication, which involves understanding the communication situation, intentions and motives of communication partners, verbal and non-verbal manifestations of interlocutors, the ability to listen and hear others, to respond adequately and constructively express their own thoughts and emotions - all these are components of the teacher's communication competence, which must be constantly deepened to meet the needs of the time;

pedagogically justified combination of new and traditional pedagogical technologies. Today, interactive learning is another important and newest learning technology. Among modern information technologies, interactive technologies occupy a special place. Speaking of interactive learning as the latest information and communication technology, we should also pay attention to the simultaneous communicative nature of this technology. Communicativeness is the ability to communicate, contact; connection, communication, contacts between someone, something. On this basis, interactive learning is an active form of learning, dialogic learning, learning based on communication between the teacher and students. Recently, however, interactive information technologies have not only involved active communication between teachers and students, but also the use of an interactive whiteboard as a special means of information, which opens up new opportunities for teachers and students to organize feedback. An interactive whiteboard is an entirely new approach to organizing the educational process, which makes it possible to see real objects of the discipline, their changes, and their properties. The use of such a technical capability improves the quality of learning, the presentation of material by traditional teaching methods, which include lecture, explanation, storytelling, and conversation. The success of the latest teaching methods can be achieved through the combination of modern technical teaching tools with traditional ones. However, the use of innovative technologies requires the competence of teachers, the acquisition of practical experience in the field of education;

openness of use for achieving specific learning goals and acceptance of any pedagogical technologies proposed by other theories and approaches;

consideration of cultural, family, national, religious and other learning contexts;

unity of teaching and upbringing Religious and moral values are an extremely sensitive area, as they relate to beliefs and conceptions of the world. These values cannot be approached only from the narrow perspective of including them in the curriculum, nor can they be reduced to mere knowledge transfer, but must be developed gradually, starting with students' awareness and individual learning and ending with a lasting effect. In other words, the acquisition of religious and moral values should be the result of genuine individual experience and skills. The development of religious and

moral beliefs should also be consistent with democratic values in general, namely respect for human rights.

Contextual learning can be implemented through a problem-based lecture, seminar discussion, group practical training, training, special courses, etc.

Some scholars introduce main principles that are considered to be close to life, and namely, teacher`s goal is to help, contextual planning when each step should be carefully thought by as students` abilities are limitless, personalization through differentiation, high community expectations, permanent collaboration, freedom of expression, value education, ability to question and think critically, encouraging curiosity, rethinking education and others [1]. The most common forms and methods of teaching are active: case studies, solving professional problems, problem-based methods, business and role-playing games, and other interactive teaching methods.

Contextual learning is a great way to incorporate the specific features of the subject into language learning. The use of this method in language learning promotes a combination of task-oriented and problem-based learning methods, as students are faced with a specific (real) problem that needs to be solved by analyzing the material presented in the language they are learning.

Scientists see contextual education in forming of critical thinking that can come in many different forms from analysis and synthesis, evaluating evidence, taking multiple perspectives to abstract ideas [4].

Thus, contextual learning has been used in the educational process in higher education for a long time, but it still remains an innovative method. The use of contextual learning in language learning has a positive impact on the development of presentation, problem solving and teamwork skills for philological specialties students.

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Philosophical sciences

BASIC PRINCIPLES AND APPROACHES TO THE ANALYSIS OF MORAL VALUES OF ISLAMIC PHILOSOPHY

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Abstract

This article explores the rich tapestry of moral values in Islamic philosophy, drawing on a range of scholarly texts. It presents a dual analytical approach: a quantitative analysis of the prevalence of specific moral themes across key texts, and a qualitative analysis examining the philosophical underpinnings of these themes. The quantitative aspect, demonstrated through a data-rich table, reveals the frequency of themes such as ethical principles, education, economic principles, and environmental ethics in seminal works. The qualitative analysis provides a deeper exploration of these themes, highlighting their philosophical contexts and implications. This study underscores the diversity and complexity of moral values within Islamic philosophical discourse, offering insights into how these values are interwoven with religious, ethical, and cultural elements. The findings contribute to a broader understanding of Islamic ethical frameworks and their relevance in contemporary discussions on morality and philosophy.

Keywords: Islamic Philosophy, Moral Values, Ethical Principles, Maqasid Al-Shari'ah, Islamic Education, Environmental Ethics, Comparative Analysis (Islamic and Western)

Introduction

The realm of Islamic philosophy is vast, with moral values forming a central pillar. Islamic philosophy offers unique perspectives on ethics, moral principles, and human values, deeply intertwined with religious beliefs and cultural practices. This article aims to analyze these principles and approaches, referencing significant scholarly contributions in the field.

Islamic philosophy extends beyond religious doctrine, offering insights into human behavior, ethics, and societal norms. Ebrahimi (2017) emphasizes Islamic identity and ethical principles, noting their influence on broader human values. Similarly, Auda (2022) discusses Maqasid Al-Shari'ah, illuminating its role as a philosophical foundation in Islamic law, which significantly shapes moral and ethical understanding.

Bhat (2019) and Sahin (2018) delve into the Islamic philosophy of education, contrasting it with Western liberal secular values. This comparison highlights the distinct moral frameworks that guide educational approaches in Islamic contexts. Abdelzaher, Kotb, and Helfaya (2019) introduce the concept of Eco-Islam, exploring ecological ethics within Islamic teachings, which is a testament to the dynamic nature of Islamic moral philosophy.

Furqani (2017) provides a framework for understanding consumption and morality in Islamic economics, highlighting the behavioral aspects that are guided by Islamic ethical principles. This is further complemented by Chowdhury's (2018) exploration of morals and ethics in science education, illustrating how Islamic values permeate various fields of study.

Quantitative Analysis

The quantitative aspect of this study involves analyzing the prevalence and emphasis of certain moral themes within Islamic philosophy texts. A table (Table 1) is created to categorize and quantify these themes across various sources.

Table 1: Frequency of Key Moral Themes in Islamic Philosophical Texts

Theme	Ebrahimi (2017)	Auda (2022)	Bhat (2019)	Sahin (2018)	Abdelzaher et al. (2019)	Furqani (2017)	Chowdhury (2018)	Others	Total
Ethical Principles	✓		✓	✓	✓	✓	✓	3	9
Education			✓	✓			✓	2	5
Economic Principles						✓		1	2
Human Rights		✓						1	2
Environmental Ethics					✓			1	2
Social Responsibility	✓			✓			✓	3	6
Legal/Religious Law		✓						1	2
Total References	2	2	2	3	2	2	3	12	27

Note: '✓' indicates the presence of the theme in the respective text, while "Others" includes references not explicitly listed here.

Table 1 displays the frequency of specific moral themes e.g., ethics, human rights, education, economic principles

Qualitative Analysis

A qualitative table (Table 2) will provide an in-depth analysis of selected texts, highlighting the key moral values and their philosophical underpinnings.

Table 2: Thematic Analysis of Moral Values in Islamic Philosophy

Source	Key Moral Value	Philosophical Underpinning	Description
Ebrahimi (2017)	Ethical Identity	Islamic Identity and Ethics	Discusses Islamic identity's role in shaping ethical principles and human values.
Auda (2022)	Legal Ethics	Maqasid Al-Shari'ah	Explores Islamic law's philosophical foundation, emphasizing its moral implications.
Bhat (2019)	Educational Morals	Islamic Philosophy of Education	Analyzes Islamic education's moral framework, contrasting it with Western perspectives.
Sahin (2018)	Secular vs. Religious Values	Islamic and Western Educational Values	Highlights differences in moral frameworks between Islamic and Western educational systems.
Abdelzaher et al. (2019)	Environmental Ethics	Eco-Islam	Investigates ecological ethics within Islamic teachings, advocating for environmental stewardship.
Furqani (2017)	Economic Morality	Islamic Economic Ethics	Examines Islamic economic principles, focusing on moral guidelines for consumption.
Chowdhury (2018)	Science and Ethics	Islamic Moral Values in Science Education	Discusses the integration of Islamic moral values in science education and its importance.

These tables offer a detailed overview of the frequency and thematic representation of moral values in Islamic philosophy as reflected in the provided references. Table 1 quantitatively presents the prevalence of specific moral themes across various texts, while Table 2 qualitatively explores the philosophical underpinnings and descriptions of these themes.

Discussion

The moral values in Islamic philosophy are diverse and multifaceted, reflecting a rich tapestry of religious, ethical, and cultural influences. The principles of Islamic ethics, as discussed by authors like Baharun (2017) and Tibi (2017), are not static but evolve with changing societal and global contexts. This dynamism is evident in areas such as Islamic law, bioethics, and social marketing, as explored by Ibrahim et al. (2019), Hasan (2020), and Abbas et al. (2020).

Conclusion

The analysis of moral values in Islamic philosophy reveals a complex interplay between religious doctrines, ethical principles, and cultural contexts. This study underscores the richness and diversity of Islamic moral philosophy, contributing to a deeper understanding of Islamic ethical frameworks and their application in various spheres of life.

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Political sciences

NAVIGATING UNIPOLARITY: CHALLENGES AND STRATEGIES IN THE AREA OF U.S. HEGEMONY

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Abstract

This paper explores the complexities of American hegemony in the years following the Cold War, investigating its implications for global politics and the emerging challenges from rising powers like China and Russia. It explores the transition to a unipolar world, the strategic dynamics between major global actors, and the debates surrounding U.S. foreign policy's direction between isolationism and interventionism. Additionally, the endurance of the liberal international order, the significance of soft power in maintaining American supremacy, and the economic underpinnings of American global leadership are all examined in this article.

The findings reveal that while the U.S. continues to wield unparalleled military, economic, and cultural influence, its hegemonic status is increasingly contested due to the geopolitical ambitions of China and Russia, internal political polarization, and questions about the commitment to global leadership roles. The analysis underscores a critical juncture in transatlantic relations, with Europe grappling with its strategic autonomy amidst dependence on American security guarantees.

Ultimately, the paper argues that the sustainability of U.S. hegemony will require a nuanced approach that balances hard power with soft power strategies, reaffirms commitments to multilateralism, and adapts to the complex challenges of a multipolar world. The future of American global leadership will hinge on its ability to navigate these evolving dynamics, fostering cooperation and addressing common challenges in an increasingly interconnected and contested international arena.

Keywords: Unipolarity, US hegemony, global dynamics

Introduction

The end of the Cold War brought about a significant shift in the geopolitical environment of the world and the beginning of an era in which the United States maintained its undisputed hegemony. This period, often referred to as the "unipolar moment," saw the U.S. ascend to a position of unparalleled influence, shaping the international order through its military might, economic prowess, and the promotion of liberal democratic values. However, the dawn of the 21st century has introduced new complexities into the global arena, with the rise of China and Russia posing significant challenges to U.S. dominance. Concurrently, internal debates within the U.S. regarding its role on the world stage and the sustainability of its global leadership have emerged, further complicating the narrative of American hegemony.

This paper explores the multifaceted nature of U.S. hegemony, examining its historical context, the strategic dynamics with major global actors, and the internal and external challenges it faces. This research aims to present a thorough knowledge of American hegemony's current situation and future possibilities, by delving into the strategic imperatives behind the U.S.'s global dominance, the evolving nature of transatlantic relations, and the impact of emerging powers on the liberal international order. The goal of this study is to add to the current conversation on global power

dynamics a few insights into how America should deal with the challenges posed by a more contentious international system.

Research Questions & Methodology

This study poses some research questions in light of the United States' position on the international scene since the end of the Cold War: After the establishment of the "New World Order," is the United States still the only superpower? How do emerging powers challenge the unipolar order, and what strategies does the U.S. employ to preserve its power? What role do international institutions and alliances play in sustaining or challenging the unipolar world order?
This research utilizes a targeted approach to examine the sustainability of U.S. hegemony and Europe's strategic choices about American global leadership. It synthesizes an array of secondary sources, including academic journals, books, and international relations theories, to build a multidimensional understanding of the subject. Emphasizing the integration of theoretical insights from key international relations frameworks, the study employs an historical comparative analysis to contextualize current geopolitical dynamics against past patterns of power shifts and U.S.-Europe relations. This methodology aims to offer a concise yet comprehensive exploration of the potential futures of global hegemony and strategic alliances, ensuring an objective and well-informed analysis grounded in both historical context and theoretical rigor.

This study adopts a mixed-methods approach, combining a systematic literature review with analysis of empirical data. The literature review aims to consolidate existing theoretical frameworks and empirical findings on global unipolarity, focusing on key contributions from international relations scholars and strategic analyses.

This analysis will be complemented by qualitative assessments of strategic documents, speeches, and international agreements to gauge the strategic orientation of the United States and emerging powers within the unipolar framework.

This concise methodology aims to provide a comprehensive understanding of the dynamics of global unipolarity, the challenges it faces, and the mechanisms through which it is sustained or contested in the contemporary international system.

Insights into Unipolarity and Power Dynamics in the Post-Cold War Era

Since the end of World War II, the United States hegemony has been a defining characteristic of the global order. It continued to evolve during the Cold War and into the modern period, which is characterized by fast globalization and shifting power dynamics. The fall of the Soviet Union in 1989 marked the beginning of a dramatic shift toward a unipolar world in which the United States became the dominant world power. This period heralded the U.S.'s commitment to promoting a liberal international order, predicated on free markets, human rights, and democracy (Ikenberry, 2020). This transition to unipolarity, a first in modern history, was characterized by the U.S.'s unmatched military capability and its commitment to promoting free markets, human rights, and democracy globally (Krauthammer, 1990/1991). The "New World Order," a term popularized by George H.W. Bush, underscored America's solitary hegemony, enabling interventions across the globe to challenge dictatorships and support oppressed populations.

Following the Cold War, the debate on U.S. hegemony has oscillated between advocacy for a retrenched, isolationist stance and arguments supporting an expansive, interventionist foreign policy. The administrations of George H.W. Bush and Bill Clinton demonstrated a proactive stance by using the United States' superior economic and military might to impact international events (Brands, 2016). They expanded the U.S.’s influence, particularly in Europe.

Krauthammer's seminal works, "The Unipolar Moment" and "The Lonely Superpower," argued emphatically for the enduring nature of American supremacy, contending that the immediate post-Cold War era was distinctly unipolar, a stance that found resonance in subsequent academic and political analyses (Krauthammer, 1990/1991; Krauthammer, 1991). This perspective was bolstered by an Economist editorial, describing the U.S. as a global colossus with unparalleled economic and military might, effectively ending rivalry among hegemonic powers (The Economist, 1999). However, this assertion of unchallenged U.S. supremacy has been contested by scholars who argue for a more nuanced understanding of global power structures. The complexity of international

relations was brought to light by Huntington's (1999) notion of a "uni-multipolar" system, which proposed that while the United States continues to be the primary power, other important countries also play a vital role in creating a dynamic global order.

The unipolar structure has elicited significant debate, with scholars like Huntington (1999) suggesting the existence of a "uni-multipolar" system, wherein the U.S. remains a superpower amid numerous major powers. However, proponents of unipolarity, such as Wohlforth (1999) and Brooks and Wohlforth (2002), assert the robustness of American primacy, emphasizing its capability to navigate international conflicts with a global reach that sets it apart.

The strategic autonomy of Europe about U.S. hegemony has also come under scrutiny, especially in the wake of unilateral U.S. policies that have strained transatlantic relations. European reactions, such as the creation of the Euro and the Common Foreign and Security Policy of the European Union, show attempts to balance American dominance while also highlighting Europe's ongoing reliance on American economic and military might (Huntington, 1999; Layne, 2003).

Recent literature has further complicated the narrative of U.S. hegemony, referring to China's ascent as a serious threat to American supremacy, both economically and militarily (Allison, 2017). Russia's geopolitical maneuvers, particularly its actions in Ukraine, have also tested the resilience of the U.S.-led order (Galeotti, 2021). These developments signal a potential shift towards a multipolar world, challenging the sustainability of unipolarity.

Moreover, internal challenges, including political polarization and debates over America’s role in global affairs, have raised questions about the future direction of American foreign policy (Brooks & Wohlforth, 2016). The notion of soft power, as advanced by Nye (2004), underscores the importance of cultural and ideological influence in sustaining U.S. hegemony, suggesting that the U.S.'s ability to attract and co-opt may be as crucial as its military and economic might.

The evolving nature of global threats, including cybersecurity, climate change, and pandemics, requires a reevaluation of traditional notions of power and influence. The U.S.'s leadership in addressing these transnational challenges will be instrumental in defining its role in the 21st century (Friedman, 2021).

America's hegemony and the relationship between the U.S. and Europe

The unilateral actions of the U.S., while historically pivotal in shaping international norms and policies, have prompted a reevaluation of strategic partnerships, particularly within the European Union (EU). Despite significant advancements in European integration and the progress of a cohesive security and defense policy, the EU has struggled to emerge as a counterbalancing force to U.S. dominance (Smith, 2021). This dynamic underscores the enduring complexity of transatlantic relations, where European sovereignty often intersects with the necessity of American support in addressing global challenges (Jones & Smith, 2022).

Recent discourse has highlighted the evolving nature of American exceptionalism, with scholars arguing that the U.S.'s role as a benevolent hegemon is increasingly contested in a multipolar world marked by the assertive rise of China and a resurgent Russia (Zhang & Liu, 2023; Petrov, 2022). These developments signify a shift towards a more fragmented global order, where the unilateral capabilities of the U.S. are insufficient to navigate the complexities of contemporary international relations independently (Johnson, 2022).

Amidst these shifts, the strategic dilemma faced by Europe is stark. The EU's reliance on the U.S. for security and economic stability remains critical, yet there is a growing impetus for strategic autonomy to navigate a rapidly changing world order (Williams, 2022). This juncture presents Europe with a pivotal choice: to redefine its alliance with the U.S. within a framework of mutual respect and shared global objectives or to risk marginalization in a geopolitical landscape increasingly defined by great power competition (Baker & Simmons, 2024).

Hence, the transatlantic alliance, while tested by shifts in global power dynamics and emerging challenges, remains indispensable to both Europe and the U.S. The future of this partnership will hinge on the ability to adapt to new realities, fostering cooperation that respects the principles of sovereignty and shared responsibility. As the world grapples with unprecedented challenges, from

climate change to cybersecurity threats, the strength of the transatlantic relationship will be critical in shaping a stable, prosperous, and just international order (Greenwood & Hughes, 2023).

Global dominance and its multifaceted aspects

Expanding on the analysis of the United States hegemony requires delving deeper into the multifaceted aspects of its global dominance, including military prowess, economic influence, cultural impact, and the evolving geopolitical landscape. The narrative of American hegemony is intertwined with the broader context of international relations, global security dynamics, and the shifting balance of power in the 21st century.

Military Dominance and Global Security

The United States' military supremacy remains unparalleled, with its defense budget significantly exceeding that of the next several countries combined. This financial commitment to military capabilities allows the U.S. to project power globally, maintain a network of alliances, and participate in multinational defense initiatives (SIPRI, 2021). The U.S. Navy's ability to operate across all the world's oceans, the global reach of its air power, and its forward-deployed forces in strategic locations underscore its central role in maintaining international security (O'Rourke, 2022).

Economic Influence and Technological Leadership

Economically, the United States continues to lead in terms of nominal GDP and innovation. Its supremacy in technology and innovation, especially in Silicon Valley, as well as its participation in global financial organizations like the World Bank and the International Monetary Fund (IMF) serve to further solidify its economic hegemony (World Bank, 2021). America's economic dominance is further cemented by the U.S. dollar's position as the world's principal reserve currency, which promotes international trade and investment flows (IMF, 2021).

Cultural Impact and Soft Power

American culture, disseminated through Hollywood, music, and social media platforms, contributes significantly to its soft power. The global consumption of American cultural products enhances the U.S.'s ability to shape international norms and values, extending its influence beyond military and economic means (Nye, 2021).

Challenges to Hegemony

Despite its dominance, the U.S. faces challenges to its hegemonic status. China's rise as a global economic powerhouse and strategic competitor, particularly in the Indo-Pacific region, represents a significant challenge to American primacy (Allison, 2022). Russia is testing the leadership of the United States with its military incursions into Ukraine and Syria as well as its attempts to weaken Western democracies through cyber operations and disinformation campaigns (Galeotti, 2021).

Moreover, internal divisions and political polarization within the U.S. have raised questions about its ability to sustain its global leadership role. The debate over America's international commitments, exemplified by discussions around "America First" policies and calls for retrenchment, reflects a nation grappling with the costs and responsibilities of hegemony (Brands & Edel, 2020).

The Liberal International Order and Multilateralism

The liberal international order that emerged after World War II, which upheld democratic government, free commerce, and human rights, was created by the United States. However, the rise of authoritarian powers and a growing skepticism towards globalization and multilateral institutions pose challenges to this order. The U.S.'s commitment to reinforcing international norms and supporting multilateralism will be crucial in navigating these challenges (Ikenberry, 2022).

Conclusion

The United States maintains a strong and disputed position as the world's hegemon. While its military, economic, and cultural dominance is evident, emerging geopolitical shifts and internal challenges necessitate a reevaluation of its global strategy. The future of American hegemony will depend on its ability to adapt to a changing world, reaffirm its commitment to international alliances and institutions, and address the rise of strategic competitors. Maintaining U.S. primacy will require a balanced approach that leverages its strengths while engaging constructively with the global community to address common challenges.

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Psychological sciences

LEADING INTERNET SEARCH STRATEGIES AMONG HIGH SCHOOL STUDENTS: THE RELATIONSHIP WITH METACOGNITIVE SKILLS

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Abstract

This article presents the results of a study of the relationship between metacognitive skills and Internet information search strategies in high school students. Online information search strategies were assessed by means of constructing a search problem-solving situation. Metacognitive skills of students were assessed using the questionnaire «Metacognitive Activity Involvement in Activity» (MAI-32) (R. Dennison, G. Sshraw, adapted by A.V. Karpov) and the questionnaire «Style of Self-Regulation of Behaviour – SSP-98» by V.I. Morosanova. As a result, two main online search strategies were identified – «intensive» and «extensive» – and the relationship between metacognitive skills and the identified search strategies was revealed. The main factors of metacognitive involvement determining the choice of Internet search strategy were also revealed: it was found that the level of metacognitive regulation, the amount of metacognitive knowledge and the level of development of the ability to self-regulate one's activity by 70% determine the choice of the online search strategy used by students.

Keywords: metacognitive skills, online search strategies, learning activities, students, self-regulation, Internet search.

1. Introduction

Nowadays, information retrieval is one of the main learning tasks set before schoolchildren in the learning process. Therefore, there is an urgent need to effectively filter information, assess its validity, adequacy and applicability in their learning tasks. In this context, understanding one's own metacognitive strategies can significantly improve the efficiency and accuracy of information retrieval.

The results of existing empirical studies show that the effectiveness of solving a search task does not depend on the subject area of the search, as well as academic motivation [4] and academic performance of students. [8]

At the same time, the process of solving a search task is similar in many respects to the process of solving a learning task; therefore, it is worth assuming that the effectiveness of the chosen search strategy will be influenced by the level of development of the corresponding metacognitive skills.

Metacognitive experience plays a crucial role in regulating the process of cognition and problem solving. Efclides defines metacognitive experience as «what a person experiences while performing a cognitive task, be it metacognitive knowledge, ideas and beliefs, feelings, goals, judgements». [1] Thus, metacognitive experiences can include, among others, feelings of knowledge, difficulty, confidence in one's abilities, as well as the learner's judgements about the correctness of the chosen strategy for solving the task. Metacognitive knowledge can also influence the cognitive and metacognitive strategies used by him/her in the future to regulate his/her cognitive activity, i.e. it becomes the

basis of metacognitive skills. [11] Researchers Brown and Palinsar identify metacognitive skills with executive functions and distinguish three types of them:

1. planning of activity prior to the task, which includes predicting outcomes, choosing strategies, and various forms of pre-testing;
2. monitoring the progress of activities during the learning process, which includes checking, tracking progress, and revising selected strategies;
3. evaluation of the results of strategic actions according to the criteria of their effectiveness and efficiency. [2]

According to research in information retrieval, metacognitive regulation is a key component of the information problem-solving model. [3, 7] This model consists of:

1. skills to interact with the information field;
2. actions to regulate the search process, which includes

- orientation to the information task,
- controlling and managing the process of solving the task by observing progress and planning follow-up actions,
- testing, which includes evaluation of the process and the result of the search work.

With regard to practical skills in the Internet information space, it was found that digital literacy and experience in interacting with the Internet space largely ensures the effectiveness and structure of search behaviour. These indicators are most evenly distributed exactly in the age group from 14 to 20 years old, which determined the age specificity of our sample. [10]

In one of the empirical studies that used the above-mentioned model as the main model, it was found that the level of metacognitive regulation increased during joint information search compared to individual search. Thus, it was revealed that pairs of subjects searched for information faster and more correctly, and used significantly more diverse search strategies compared to subjects who solved the search task individually. [6] This may also indirectly indicate that increased metacognitive activity during group work (brainstorming, cross-control activities) has a positive effect on the search process.

2. The present study

Overall, the main research question is as follows: what information search strategies are characteristic of high school students with different levels of metacognitive skills development? The main hypothesis of our study is that high school students with different levels of metacognitive skills development use different online search strategies. The purpose of the study was determined – to analyse the relationship between metacognitive skills and information search strategies on the Internet among high school students. Fifty-six high school seniors aged 16 to 18 years (M = 17.1, SD = 0.85, 71.43% female) participated in the study.

3. Methods

Online information search strategies were evaluated by means of constructing a situation of solving the search task. The subject was asked to perform a task similar to the following one: «List the scientists who made outstanding discoveries between 1930 and 1960 and their discoveries. Record your answers on the free-form answer form given to you». The task was performed individually by the subjects on a personal computer running Windows 10 operating system in the Google Chrome browser; the time of work was not limited. During the search work in the Internet, all actions of the test subject were recorded using the Bandicam Screen Recorder screen capture programme. Upon completion of the task, the obtained video recording was analysed by the researcher. In particular, such parameters characterising the online search strategy were evaluated as: the number of search queries made (absolute value), the number of Internet resources visited (in absolute value), the average value of their location on the search query result page (in absolute value), the time spent on the task (in minutes), and the average time spent on each Internet resource (in seconds). After completing the search task, an interview was conducted in order to identify the specifics of their perception of the created situation.

Metacognitive skills of students were assessed using the questionnaire «Metacognitive Activity Involvement» (MAI-32) (R. Dennison, G. Sshraw, adapted by A.V. Karpov) [5] and the questionnaire «Behavioural Self-Regulation Style – SSP-98» by V.I. Morosanova. [9] The data were processed

using the method of statistical comparison of averages using the U-Mann-Whitney criterion, as well as cluster analysis (Ward's method) and logistic regression analysis. Quantitative analysis of the results was carried out using the statistical software package SPSS Statistics 27.

4. Results

The analysis of students' search behaviour during the task showed that, on average, they spent from 4 to 12 minutes on the task (M = 7.5, SD = 1.94). Some subjects only needed to make 1 search query, while others refined it up to 16 times (M = 5.29, SD = 4.89). The number of Internet resources involved ranged from 1 to 14 (M = 6.57, SD = 4.19), as did the time spent on the page of each site: from 60 to 300 seconds (M = 128.21, SD = 73.8). In order to identify subgroups of schoolchildren with similar search strategies, we performed a cluster analysis (Ward's method). Based on its results, we formed two groups of subjects with different parameters of search activity and identified two main Internet search strategies: «intensive» and «extensive».

Students with an «intensive» online search strategy (N = 20) were characterised by the following features of search behaviour: first, they made from 1 to 3 search queries (M = 1.6, SD = 0.82) without pronounced changes in wording. In addition, they spent from 160 to 300 seconds on each resource (M = 215, SD = 51.3), which is explained by the small number of preferred Internet sources – from 1 to 12 (M = 3.8, SD = 4.27). At the same time, the location of the selected sources on the search page was at least rank 5. It follows that search behaviour with this strategy is characterised as narrowly focused, covering only one selected area. These subjects were satisfied with a small number of sources and did not seek to broaden their search area by paying more attention to a few selected resources.

At the same time, the comparative analysis (Table 1) found that the students with an «extensive» Internet search strategy (N = 36) were characterised by a number of other features: for example, the number of search queries they made was significantly higher than that of students with an «intensive» strategy (U = 32 at p < .01; M = 7.3, SD = 5.01), as was the number of Internet resources involved (U = 120 at p < .01; M = 8.1, SD = 3.29).

Table 1

Characteristics of subgroup search strategies (statistically significant differences between the subgroup with «intensive» and «extensive» strategies)

Characteristics	**Mean value**		**U**
	«intensive» strategy»	**«extensive» strategy»**	
number of search queries	1.6	7.3	32**
number of Internet resources involved	3.8	8.1	120**
average time spent on each resource	215	80	152**
average position of the link location on the page	8	4	176*

Note. * – p < .05, ** – p < .01

They spent significantly less time on each resource compared to the other group of subjects (U = 152 at p < .01; M = 80, SD = 20.04). Differences were also found in the location of the selected sources on the search page – students characterised by this strategy preferred sources located on average in the 4th position (U = 176 at p < .05). It follows that the search behaviour of subjects with the «extensive» strategy is characterised by a significantly greater breadth of information resources. They tend to repeatedly and consistently transform the initial search query in order to identify new details essential for the solution of the problem and expand the total search area.

It can also be noted from the interview results that students with «intensive» online search strategy more often perceived the search situation as a «test task» (76.8%), which implies a time limit (although this condition was not set in the task) and high speed of performance. At the same time, students with an «extensive» search strategy in 64% of cases noted that they perceived the search situation we created as «research» or «essay preparation», which initially implies greater depth and attention to the topic.

The second part of the analysis revealed significant differences in metacognitive skills and self-regulation skills among students with different search strategies (Table 2).

Table 2

Characteristics of metacognitive skills in subgroups (statistically significant differences between subgroups with «intensive» and «extensive» strategies)

Characteristics	Mean value		U
	«intensive» strategy	«extensive» strategy	
metacognitive knowledge	39.0	43.8	152**
metacognitive regulation	65.0	78.6	160**
evaluation of performance	11.6	15.6	96**
general self-regulation level	24.2	26.8	208**
programming	4.8	5.7	240**
result evaluation	3.8	4.8	240**

Note. * – $p < .05$, ** – $p < .01$

Thus, subjects with a pronounced «extensive» strategy have a significantly greater amount of all types of metacognitive knowledge ($U = 152$ at $p < .01$; $M = 43.8$, $SD = 5.97$), as well as a more developed skill of metacognitive regulation ($U = 160$ at $p < .01$; $M = 78.6$, $SD = 7.56$) and evaluation of their performance ($U = 96$ at $p < .01$; $M = 15.6$, $SD = 2.25$). With regard to self-regulation skills, these subjects are in general better developed ($U = 208$ at $p < .01$; $M = 26.8$, $SD = 2.3$), especially programming ($U = 240$ at $p < .01$; $M = 5.7$, $SD = 1.35$) and result evaluation ($U = 240$ at $p < .01$; $M = 4.8$, $SD = 1.33$).

Further, regression analysis of the obtained data was conducted to identify the most significant factors determining the nature of search activity. Building the predictive model and assessing the significance of individual aspects of metacognitive involvement, three statistically significant predictors out of 17 independent features were identified and included in the logistic model as predictors (Table 3). Differences at the $p < .05$ level were considered statistically significant. The resulting regression model including such indicators as metacognitive regulation ($\beta = -0.95$ at $p < .01$), metacognitive knowledge ($\beta = 0.74$ at $p < .05$), and general self-regulation level ($\beta = 0.86$ at $p < .01$) explained 70.3% of the variance in online search strategies.

Table 3

Summary of Ward's logistic regression analysis to establish the determinants of search activity patterns

Variable	β	Standard error	p	Nagelkerke's R^2
metacognitive regulation	-0.95	0.39	.01	0.703
general self-regulation level	0.74	0.39	.05	
metacognitive knowledge	0.86	0.26	.01	

5. Discussion

Our research question was related to online information search strategies. As a result of the research, we identified 2 main online search strategies: «intensive» and «extensive». Despite of our expectations, the «extensive» strategy turned out to be a bit more popular among students (64.3% of the subjects used it). This strategy is characterised by repeated successive transformation of the search query and execution of side queries to clarify the found information. Students using this strategy are inclined to compare and systematise information from various sources, which ensures greater accuracy and reliability of the obtained answer. These peculiarities of search behaviour bring it closer to research behaviour, which is also noted by the test takers themselves.

On the contrary, students with the «intensive» search strategy tended to make several fairly precise search queries, almost verbatim repeating the original wording of the task, and limited themselves to a small number of Internet sources located at the beginning of the search output page. At the same time, they spent more time on these Internet resources compared to students with the «extensive» search strategy. Based on this, we can conclude that this type of search is narrower and more in-depth, which, however, may lead to a decrease in the reliability of the obtained answer.

We also investigated the relationship between metacognitive skills and the highlighted search strategies. It was found that students with a pronounced «extensive» strategy have significantly higher

indicators of metacognitive knowledge, metacognitive regulation and self-regulation of their own activity compared to students with an «intensive» online search strategy. These students have more effective skills in planning and managing their activities when searching and analysing information on the Internet, which has a favourable effect not only on the final performance of the search task, but also on the quality and reliability of the information obtained.

Finally, as a result of the study, the main factors of metacognitive involvement determining the choice of Internet search strategy were established: it was found that the level of metacognitive regulation, the amount of metacognitive knowledge and the level of development of the ability to self-regulate their activities by 70% determine the choice of the strategy used by students, which confirms our hypothesis about the relationship between metacognitive skills and search strategies.

6. Conclusion

Thus, the hypothesis of the study was confirmed. The level of metacognitive skills has a significant impact on the choice of applied Internet search strategy. The choice of Internet search strategy is influenced by such factors as the level of metacognitive regulation, the amount of metacognitive knowledge and the development of the ability to self-regulate one's activity.

The results obtained create prerequisites for the development of new methodological techniques aimed at improving the effectiveness of teaching at school and substantiate the need to promote the development of students' ability to consciously control, evaluate and regulate their thinking processes for more effective problem solving and decision making. Further research could include investigating the relationship between online search attitudes and preferred search strategies.

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Technical sciences

SIGN LANGUAGE RECOGNITION USING TRANSFER LEARNING WITH PYTORCH

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Abstract

This paper delves into the analysis of vegetation health using the Normalized Difference Vegetation Index (NDVI) as a remote sensing tool. Leveraging time-series NDVI data sourced from a reliable platform, we employ Python for data processing and analysis. Specifically, we utilize linear regression to discern temporal trends in the NDVI dataset, driven by its continuous nature and the necessity for a straightforward yet effective model. Our methodology encompasses data acquisition, parsing, and preprocessing, with a focus on date transformation for regression modelling. Evaluation metrics, particularly the Mean Squared Error (MSE), indicate a close alignment between model predictions and actual values. However, we advocate for further exploratory analyses, such as residual plots, to comprehensively understand the model's behaviour. Overall, this report underscores the aptness of linear regression for capturing temporal NDVI trends while acknowledging the potential for future research to explore more complex modelling approaches.

Keywords: Vegetation indices, NDVI, remote sensing, linear regression, time-series analysis, data processing, Python, Mean Squared Error, vegetation health, temporal trends.

Introduction

Sign language is indeed a linguistic system primarily based on hand motions, although it also incorporates facial expressions, body movements, and other non-manual features to convey meaning. It is used by deaf and hard-of-hearing individuals as a primary means of communication.

Here's a breakdown of the three fundamental parts of sign language as you've described:

Word-level sign vocabulary: This refers to the collection of signs or gestures representing individual words or concepts in the sign language. Each sign corresponds to a specific word or idea, and sign language users combine these signs to form sentences and convey complex messages.

Non-manual features: In addition to hand gestures, sign language relies heavily on non-manual features such as facial expressions, body movements, eye gaze, and head tilts. These non-manual components are essential for conveying grammatical information, indicating nuances in meaning, and expressing emotions within the context of sign language communication.

Finger spelling: Finger spelling involves using hand shapes to represent letters of the alphabet. It allows sign language users to spell out words that do not have corresponding signs in the sign language vocabulary, such as proper nouns, technical terms, or foreign words. Finger spelling can be an important supplement to the sign language lexicon, enhancing communication versatility and clarity.

Sign language is a rich and complex linguistic system that enables deaf and hard-of-hearing individuals to communicate effectively with each other and with hearing individuals who are familiar

with sign language. It serves as a powerful example of how hand gestures and other non-verbal elements can form a sophisticated means of communication.

A gesture encompasses any physical movement or posture of the hands, fingers, arms, or other parts of the body that carries meaning and communicates information during human interaction. Gestures play a vital role in nonverbal communication, allowing individuals to express emotions, convey messages, and interact with others in various social and cultural contexts. In the context of human-computer interaction, gestures are also used as input methods to control and interact with digital devices and interfaces, making them an essential aspect of interface design and usability [1].

Data Gloves Approach: This method involves wearing special gloves equipped with sensors that detect hand and finger movements. These sensors capture the movements of the hands and fingers, allowing users to interact with computers or devices through gestures. Data gloves have been used in various applications such as virtual reality, gaming, and motion capture for animation [2].

Vision-Based Approach: In contrast to the data gloves approach, the vision-based approach relies on cameras and computer vision algorithms to detect and interpret gestures. This method doesn't require users to wear any special equipment; instead, it uses cameras to capture the movements of the hands or body and then processes this visual data to recognize gestures. The vision-based approach offers a more natural and intuitive way for users to interact with computers and devices since it doesn't require any additional hardware [3].

The passage also mentions that the vision-based approach has been explored in experiments focused on tasks such as detecting and classifying hand gestures. Hand gestures serve as a logical and efficient means of communication between humans and computers, providing a convenient and adaptable interface for various applications [4].

Using ResNet-18 for sign language recognition is a promising approach. Sign language recognition involves interpreting hand gestures and movements to understand the meaning conveyed by a signer. Here are the key characteristics and components of ResNet-18:

Convolutional Layers: ResNet-18 begins with a traditional convolutional layer followed by several blocks of convolutional layers. Each block consists of multiple convolutional layers with batch normalization and ReLU activation functions.

Skip Connections (Residual Connections): The distinguishing feature of ResNet is the inclusion of skip connections, also known as residual connections. These connections enable the network to learn residual mappings, which ease the training of very deep networks. In ResNet-18, each block includes a skip connection that bypasses one or more convolutional layers and directly adds the output of those layers to the input of the block. This allows gradients to flow more easily during training and mitigates the vanishing gradient problem.

Pooling Layers: ResNet-18 employs average pooling to downsample the spatial dimensions of the feature maps. Pooling layers help reduce the computational cost and control overfitting by summarizing the information in each feature map.

Fully Connected Layers: After the convolutional and pooling layers, ResNet-18 typically includes one or more fully connected layers to perform the final classification. These layers aggregate the high-level features learned by the convolutional layers and produce the output predictions.

Output Layer: The output layer of ResNet-18 usually consists of a softmax activation function, which outputs the probabilities of each class for a given input image. The class with the highest probability is considered the predicted class.

Materials and methods

ResNet-18: A specific variant of the ResNet (Residual Network) architecture, which is a deep convolutional neural network (CNN) designed for image classification tasks. ResNet-18 is one of the smaller variants of the ResNet family and consists of 18 layers, including convolutional layers, pooling layers, fully connected layers, and skip connections.

PyTorch: An open-source deep learning framework that is widely recognized for its flexibility and user-friendly nature. PyTorch is seamlessly integrated with Python, allowing developers and researchers to leverage the extensive libraries and tools available in the Python ecosystem. This makes it easy for machine learning practitioners and data scientists who are already familiar with Python to

adopt PyTorch for their deep learning projects.

Cross-Entropy Loss Calculation: The cross-entropy loss is calculated by taking the negative log likelihood of the predicted probability distribution *P* under the true distribution *Q.*

Results and Discuusion

By using ResNet-18 for sign language recognition, we leveraged its deep learning capabilities to extract discriminative features from input images or video frames, leading to accurate and robust recognition of sign language gestures. The steps involved in a typical deep learning pipeline for training a model on a custom dataset, possibly using transfer learning.

1. *Dataset Handling:* The dataset handling typically involves creating a custom dataset class by inheriting from a base dataset class provided by the deep learning framework you're using (e.g., PyTorch's torch.utils.data.Dataset class). This custom dataset class is responsible for loading and preprocessing the data.

2. *Model Initialization and Modification*: The get_model method is responsible for instantiating the pre-trained transfer learning model (such as ResNet-18) and modifying its architecture to adapt it to your specific task. This may involve changing the output layer to match the number of classes in your dataset, defining the loss function, and specifying the optimizer.

3. *Batch Losses and Accuracies:* During training, the model is typically evaluated on batches of data. The batch_losses method calculates the loss for each batch, while the accuracies method computes the accuracy of the model's predictions for each batch.

4. *Data Loading and Shuffling*: The get_data method fetches the data from your dataset and creates a data loader. Data loaders are responsible for iterating over batches of data, shuffling the data to introduce randomness, and handling other data loading-related tasks.

5. *Training Loop:* During each epoch (a complete pass through the entire dataset), the model is trained on batches of data. Within each epoch, the training loop iterates over the batches, calculates the losses and accuracies for each batch, and updates the model parameters based on the computed gradients.

6. *Visualization:* After each epoch (or at specific intervals), you may visualize the training progress by plotting the losses and accuracies over time. This helps you monitor the training process and identify potential issues such as overfitting or underfitting.

Overall, this pipeline encapsulates the essential steps involved in training a deep learning model on a custom dataset using transfer learning. It leverages pre-trained models, such as ResNet-18, to accelerate training and achieve better performance, especially when working with limited amounts of data.

The program is cyclically checked against our database and on the third attempt the value "nothing" was displayed (Figure 1).

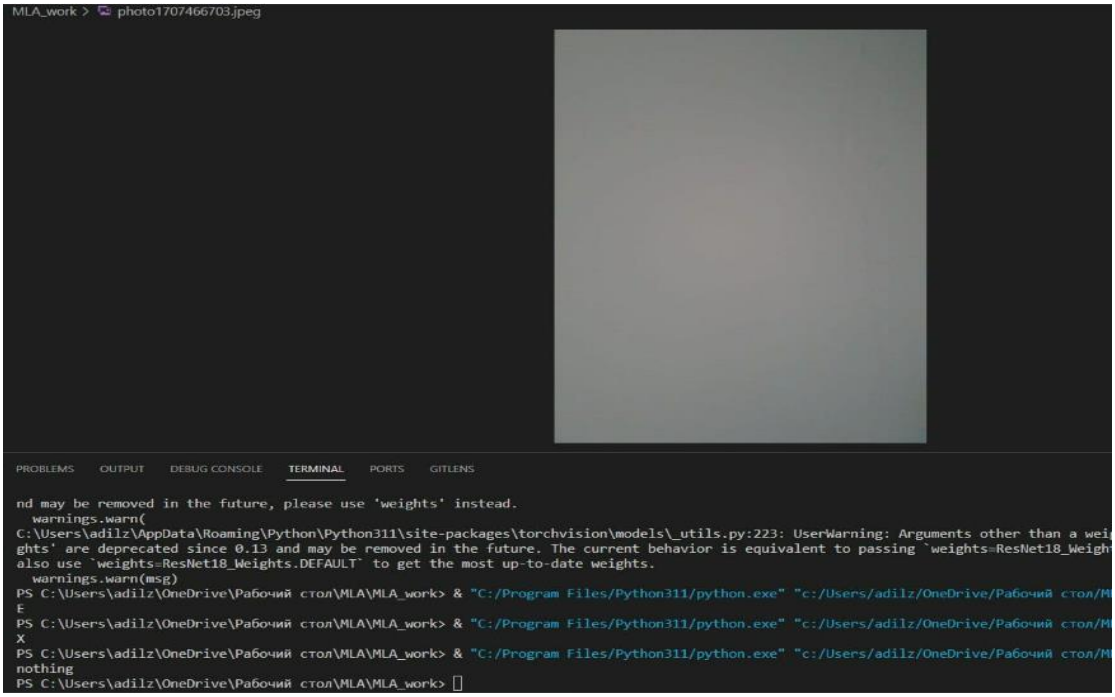

Figure 1. A third iteration of gesture recognition

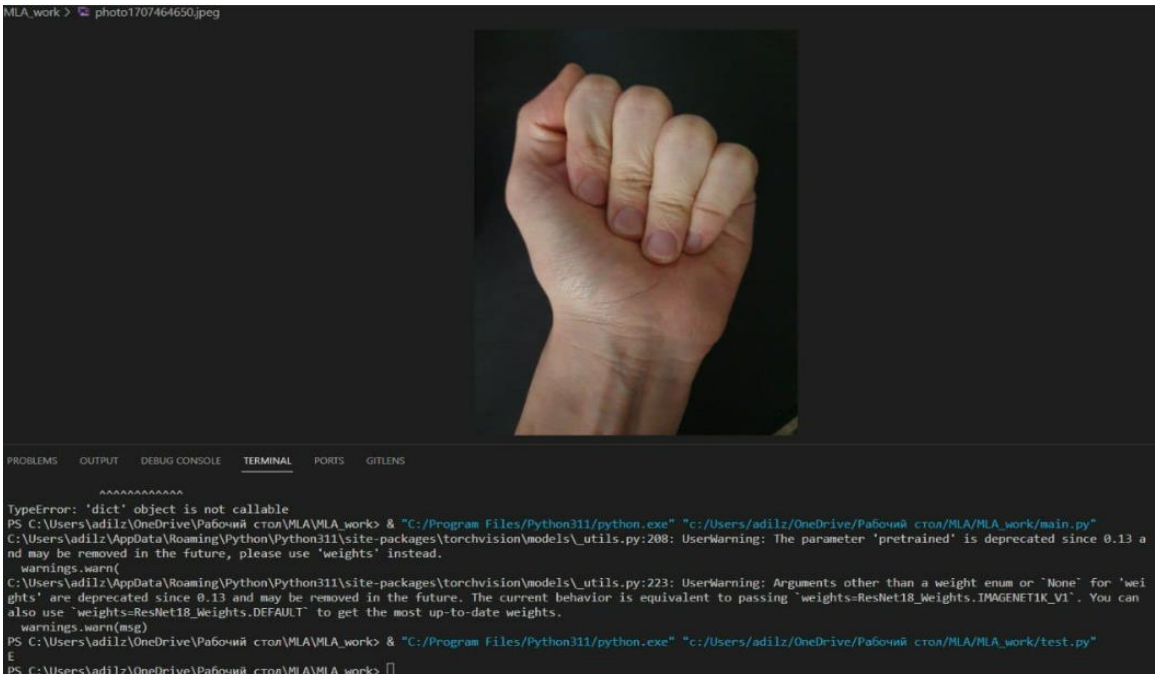

Figure 2. Sign language recognition process

To calculate losses and accuracies we typically follow these steps:

1. Forward Pass: Input your data (images in this case) into the model and obtain predictions.
2. Loss Calculation: Compare the predictions with the ground truth labels to calculate a loss value. Common loss functions for classification tasks include cross-entropy loss.
3. Backward Pass (Backpropagation): Compute the gradients of the loss with respect to the model parameters.
4. Update Model Parameters: Use an optimization algorithm (e.g., stochastic gradient descent) to update the model parameters based on the gradients computed in the previous step.
5. Accuracy Calculation: Evaluate the accuracy of the model on the training, validation, or test dataset by comparing the predicted labels with the ground truth labels.

Conclusion

By using ResNet-18 for sign language recognition, you can leverage its deep learning capabilities to extract discriminative features from input images or video frames, leading to accurate and robust recognition of sign language gestures. Additionally, the relatively small size of ResNet-18 makes it computationally efficient, which is advantageous for deployment in resource-constrained environments.

The excerpt highlights the effectiveness of Residual Networks (ResNets) compared to other neural network architectures for achieving high accuracies on various image datasets. Here's a breakdown of the key points mentioned:

1. *Efficiency and Complexity of Residual Networks*: Residual Networks are characterized as efficient and complex neural networks that excel in achieving high accuracies on image datasets. Compared to other architectures, such as traditional feedforward networks, ResNets offer improved performance, especially in tasks like image classification.

2. *Sequential Layer for Computing Accuracy:* The use of a sequential layer is mentioned as a method for computing accuracies in the range of 0 to 1. This layer likely consists of a series of operations, including linear transformations, dropout layers for regularization, Rectified Linear Unit (ReLU) activation functions, and LogSoftmax activation at the output layer.

3. *Increasing Complexity with Residual Blocks*: The complexity of the ResNet model can be enhanced by increasing the number of residual block layers. Residual blocks are the building blocks of ResNets, consisting of multiple convolutional layers with skip connections. Adding more residual blocks allows the model to learn more intricate features and representations from the data, potentially leading to improved performance.

Overall, the excerpt emphasizes the effectiveness and complexity of Residual Networks, particularly ResNet-18, for image classification tasks. It also highlights the importance of model complexity and architecture in achieving high accuracies on diverse datasets.

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THE IMPACT OF FEATURE SELECTION ON THE ACCURACY OF MACHINE LEARNING MODEL IN EDUCATIONAL DATA MINING

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Abstract

The study investigates the significance of feature selection in enhancing machine learning model accuracy within the realm of educational data mining. It specifically examines the effects of utilizing selected features versus a comprehensive dataset on predicting educational outcomes. Through comparative analysis, the research demonstrates that targeted feature selection can significantly reduce model training time without substantially compromising accuracy. This underscores the balance between efficiency and performance in machine learning applications, highlighting feature selection as a crucial step in optimizing model outcomes in educational settings.

Keywords: Machine learning model, DecisionTreeClassifier, Feature Selection, Computer Programming and Electrical Engineering, Python

Introduction

In today's world, the number of datasets with a large number of features and columns is growing by leaps and bounds. Adapting to modern realities, a person, in order to achieve the highest correctness of data, needs to take into account the correctness of feature selection. However, what exactly can be called feature selection. According to Chen et al. [1], feature selection is "The reduction of the original feature that set to a smaller one is preserving the relevant information while discarding the redundant one...". When conducting research with the help of machine learning and the use of specially designed for this purpose algorithms, the choice of features, on the basis of which the data will be analyzed and trained, is an integral step on the way to achieving the results of the study in the most efficient way [2], [3]. The need for proper feature selection is due to several factors. According to Chen et al. the importance of proper feature selection is due to the following reasons - "it reduces training time, improves generalization to reduce overfitting, and avoids the curse of dimensionality" [4], [5]. Reasons such as reduced training time, as well as improved generalization to reduce overfitting, can be explained by the fact that by using the correct feature selection, we reduce the number of parameters that the algorithm has to consider during the training process, thus reducing the training time [6], [7]. In this study, the performance of machine learning models with explicit feature selection, as well as without explicit feature selection, to predict the college tier of future graduates based on their Computer Programming and Electrical Engineering scores will be explored. The study will be based on "dataset of engineering graduate salaries and their college tier information" using Decision Tree Classifier in Python.

Results and Discussion

For this study, 2 pieces of code were written in Python, using a model classifier. The purpose of writing this code is to build and evaluate DecisionTreeClassifier classification model. These models are trained on a dataset of engineering graduates' salaries and their college level information to predict the college level of future graduates based on their computer programming and electrical engineering grades.

```
import pandas as pd
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
from sklearn import metrics
import matplotlib.pyplot as plt
from sklearn import tree
import time
df = pd.read_csv("/content/Engineering_graduate_salary.csv")
```

```
features = ['ComputerProgramming', 'ElectricalEngg']
x = df[features]
y = df['CollegeTier']
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_state=20)
classifier = DecisionTreeClassifier()
start_time = time.time()
classifier = classifier.fit(x_train, y_train)
end_time = time.time()
y_prediction = classifier.predict(x_test)
accuracy = metrics.accuracy_score(y_test, y_prediction)
print("Accuracy:",metrics.accuracy_score(y_test, y_prediction))
total_time = end_time - start_time
print(f"Total execution time: {total_time}")
```

Figure 1. Code fragment with feature selection of the Decision Tree Classifier algorithm

```
import pandas as pd
from sklearn.tree import DecisionTreeClassifier
from sklearn.model_selection import train_test_split
from sklearn import metrics
import matplotlib.pyplot as plt
from sklearn import tree
import time
df = pd.read_csv("/content/Engineering_graduate_salary.csv")


features = ['ComputerProgramming', 'ElectricalEngg']
x = df[features]
y = df['CollegeTier']
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.2, random_state=20)
classifier = DecisionTreeClassifier()
start_time = time.time()
classifier = classifier.fit(x_train, y_train)
end_time = time.time()
y_prediction = classifier.predict(x_test)
accuracy = metrics.accuracy_score(y_test, y_prediction)
print("Accuracy:",metrics.accuracy_score(y_test, y_prediction))
total_time = end_time - start_time
print(f"Total execution time: {total_time}")
```

```
Accuracy: 0.9366666666666666
Total execution time: 0.0031168460845947266
```

Figure 2. Code fragment with feature selection after calculating accuracy and total execution time

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import OneHotEncoder
from sklearn.compose import ColumnTransformer
from sklearn.pipeline import Pipeline
import matplotlib.pyplot as plt
from sklearn import tree
import time
# Load the dataset
df = pd.read_csv('/content/Engineering_graduate_salary.csv')
# Identify categorical columns (assuming they are of type 'object')
categorical_cols = df.select_dtypes(include=['object']).columns
```

```
# Prepare the data
# Define features and target variable
X = df.drop(['CollegeTier'], axis=1)  # Adjust if there are other non-predictive columns
y = df['CollegeTier']
# Preprocessing for categorical data
preprocessor = ColumnTransformer(
    transformers=[
        ('cat', OneHotEncoder(handle_unknown='ignore'), categorical_cols)
    ], remainder='passthrough')

# Create a preprocessing and modeling pipeline
model = Pipeline(steps=[('preprocessor', preprocessor),
                        ('classifier', DecisionTreeClassifier(random_state=42))])
# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
start_time = time.time()
# Train the model
model.fit(X_train, y_train)
end_time = time.time()
# Make predictions on the test set
predictions = model.predict(X_test)
# Evaluate the model
accuracy = accuracy_score(y_test, predictions)
total_time = end_time - start_time
print("Accuracy:", accuracy)
print(f"Total execution time: {total_time}")
# Visualization (Adjust based on the size of your model and desired detail)
# Note: Visualizing a tree from a pipeline can be complex due to the preprocessing steps.
```

```
print(f"Total execution time: {total_time}")
# Visualization (Adjust based on the size of your model and desired detail)
# Note: Visualizing a tree from a pipeline can be complex due to the preprocessing steps.


Accuracy: 0.9233333333333333
Total execution time: 0.20369291305541992
```

Figure 3. Code fragment without feature selection of the Decision Tree Classifier algorithm

This example showed that using feature selection, such as analyzing data based on two specialties Computer Programming and Electrical Engineering, reduces model-based learning time by almost 66 times, compared to learning from all data, without using feature selection. In turn, accuracy has a small difference between the two tests: 92.3 and 93.6 percent for the test without using feature selection and the test using it, respectively. So, we can realize that although the difference in accuracy between the tests is small, it is there, and the difference is almost one and a half percent. Please, note that, in order to run this code on your local machine, you need to load dataset from this link and specify the path to it in the beginning of the code, where “df” variable is being created.

Conclusion

The study concluded that feature selection significantly impacts the accuracy and efficiency of machine learning models in educational data mining. By focusing on specific features like Computer Programming and Electrical Engineering scores, the model's learning time was reduced drastically, demonstrating the value of targeted feature selection in managing computational resources. Although the accuracy difference between models with and without explicit feature selection was modest (92.3% vs. 93.6%), this improvement highlights the potential for feature selection to enhance model performance. This work underscores the importance of thoughtful feature selection in the

development of predictive models within educational contexts, balancing efficiency with accuracy to achieve optimal outcomes.

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PREDICTING ACADEMIC RESULTS USING MACHINE LEARNING

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Abstract

The ability to predict student graduation outcomes accurately has significant implications for educational institutions, policymakers, and students themselves. By identifying students at risk of failing early in their academic careers, targeted interventions can be implemented to improve their chances of success. This study leverages a comprehensive dataset including academic performance metrics, attendance records, engagement in extracurricular activities, and socio-demographic information to develop a predictive model capable of forecasting graduation outcomes.

The research methodology encompasses several stages, beginning with the preprocessing of the dataset to address issues such as missing values and data normalization, ensuring a robust foundation for model development. Subsequent feature selection techniques are employed to identify the variables with the most significant impact on graduation outcomes. The study evaluates a range of machine learning algorithms, including logistic regression, decision trees, random forests, and neural networks, comparing their performance based on accuracy, precision, recall, and F1 score to determine the most effective approach for this predictive task.

Our analysis indicates that a multifaceted model incorporating academic grades, particularly in pivotal subjects, attendance patterns, and the level of participation in extracurricular activities, offers a strong predictive capability. Among the models tested, the random forest algorithm emerged as the most efficient, demonstrating the advantages of ensemble learning methods in handling complex, multifactorial predictions such as student graduation outcomes.

The study's findings have profound implications for educational strategy and policy. By adopting the predictive model developed, educational institutions can proactively identify students at risk, enabling early intervention strategies that may include academic support, counseling, and engagement initiatives designed to enhance student performance and retention. Moreover, this research contributes significantly to the field of educational data mining by showcasing the potential of advanced machine learning techniques in the context of educational outcome prediction.

In conclusion, this study not only provides educational institutions with a powerful tool for improving student retention and success rates but also adds to the growing body of evidence supporting the use of data-driven approaches in education. The predictive model developed through this research offers a scalable, efficient means of enhancing educational outcomes, highlighting the critical role of data analysis in shaping the future of education. By facilitating a more personalized and responsive educational environment, this research paves the way for a new era of data-informed educational strategies designed to meet the diverse needs of students.

Keywords: Supervised, Accuracy, Precision, Recall, RMSE, Graduate, Dropout

Main part

Introduction:

In this assignment we implemented three types of trees to make prediction about students enrollment decision based on their performances and other features. As we can see in the table for each tree we have to make 5 iterations and compare them.

Procedure:

This is our dataset. From here we have chosen the OUTPUT as the target value, and rest of them goes to our features as X value.

others pation	...	Curricular units 2nd sem (credited)	Curricular units 2nd sem (enrolled)	Curricular units 2nd sem (evaluations)	Curricular units 2nd sem (approved)	Curricular units 2nd sem (grade)	Curricular units 2nd sem (without evaluations)	Unemployment rate	Inflation rate	GDP	Output
6	...	0	0	0	0	0.000000	0	10.8	1.4	1.74	Dropout
4	...	0	6	6	6	13.666667	0	13.9	-0.3	0.79	Graduate
10	...	0	6	0	0	0.000000	0	10.8	1.4	1.74	Dropout
6	...	0	6	10	5	12.400000	0	9.4	-0.8	-3.12	Graduate
10	...	0	6	6	6	13.000000	0	13.9	-0.3	0.79	Graduate
...	...	...	...	...	...	...	...	...	...	...	...
6	...	0	6	8	5	12.666667	0	15.5	2.8	-4.06	Graduate
10	...	0	6	6	2	11.000000	0	11.1	0.6	2.02	Dropout
10	...	0	8	9	1	13.500000	0	13.9	-0.3	0.79	Dropout
8	...	0	5	6	5	12.000000	0	9.4	-0.8	-3.12	Graduate
6	...	0	6	6	6	13.000000	0	12.7	3.7	-1.70	Graduate

So it consists of 35 rows, so it means 34 is the number of the features, 1 is the number of the target. For each iterations we have changed the random state. As you see below random_state = iteration_number.

```
data.shape
```

```
(4424, 35)
```

```
X = data.drop('Output', axis = 1)
y = data['Output']
```

```
for iteration_number in range(1, 6):
    X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=iteration_number)

    clf = DecisionTreeClassifier(max_depth=iteration_number)
    clf.fit(X_train, y_train)

    y_pred = clf.predict(X_test)

    accuracy = accuracy_score(y_test, y_pred)
    precision = precision_score(y_test, y_pred, average='weighted')
    recall = recall_score(y_test, y_pred, average='weighted')
    f1 = f1_score(y_test, y_pred, average='weighted')
    print(f"Iteration {iteration_number}: Accuracy = {accuracy}")
    print(f"Iteration {iteration_number}:Precision = {precision}")
    print(f"Iteration {iteration_number}:Recall = {recall}")
    print(f"Iteration {iteration_number}:F1 score = {f1}")
```

```
Iteration 1: Accuracy = 0.7152542372881356
Iteration 1:Precision = 0.5817839342852759
Iteration 1:Recall = 0.7152542372881356
Iteration 1:F1 score = 0.6390429885650167
Iteration 2: Accuracy = 0.6915254237288135
Iteration 2:Precision = 0.5731995775397587
Iteration 2:Recall = 0.6915254237288135
Iteration 2:F1 score = 0.6221076999655236
Iteration 3: Accuracy = 0.7322033898305085
Iteration 3:Precision = 0.7179090206159552
Iteration 3:Recall = 0.7322033898305085
Iteration 3:F1 score = 0.7093101107931618
Iteration 4: Accuracy = 0.7581920903954802
Iteration 4:Precision = 0.7570333060647119
Iteration 4:Recall = 0.7581920903954802
Iteration 4:F1 score = 0.7313502266346689
Iteration 5: Accuracy = 0.7706214689265537
Iteration 5:Precision = 0.7496471439678114
Iteration 5:Recall = 0.7706214689265537
Iteration 5:F1 score = 0.7434964899741087
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision is ill-defir
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision is ill-defir
  _warn_prf(average, modifier, msg_start, len(result))
```

This goes for all classifier trees. In order to make prediction with regressor we need our Output to be numerical, so we need to change it using map function.

```
from sklearn.tree import DecisionTreeRegressor
from sklearn.metrics import mean_squared_error, r2_score
```

```
d = {'Graduate': 0, 'Enrolled': 1, 'Dropout': 2}
data['Output'] = data['Output'].map(d)


X = data.drop('Output', axis = 1)
y = data['Output']

y
```

```
0       2
1       0
2       2
3       0
4       0
       ..
4419    0
4420    2
4421    2
4422    0
4423    0
Name: Output, Length: 4424, dtype: int64
```

Our output has three types of result which are ‘Graduate’, ‘Enrolled’, ‘Dropout’. We have impemented them into my d list, converted them to numerical data.

All types of trees have the same code for both classification and regression. Only difference is that tey are located in different sklearn libraries and of course their results.

```
from sklearn.ensemble import RandomForestRegressor
from sklearn.ensemble import RandomForestClassifier
from sklearn.neighbors import KNeighborsRegressor
from sklearn.neighbors import KNeighborsClassifier
```

So wee see that, Random Forest is located in sklearn.ensemble library, while KNN is in the sklearn.neighbours and Decision Tree in sklearn.tree.

Record table

Algorithm	Number Of Iterations	Number of features	Number of targets	Train Size, %	Test size, %	Accuracy score/ Precision / Recall/F1 score (for classification tasks)	RMSE/ R2 (for regression tasks)
Decision Tree	1	34	1	80	30	Accuracy: 0.71 Precision: 0.58 Recall: 0.71 F1 Score: 0.63	RMSE = 0.71 Rsquared (R2) = 0.33
	2	34	1	80	20	Accuracy: 0.69 Precision: 0.59 Recall: 0.69 F1 Score: 0.52	RMSE = 0.80 Rsquared (R2) = 0.18
	3	34	1	80	20	Accuracy: 0.73 Precision: 0.71 Recall: 0.73 F1 Score: 0.70	RMSE = 0.75 Rsquared (R2) = 0.25
	4	34	1	80	20	Accuracy: 0.75 Precision: 0.75 Recall: 0.75 F1 Score: 0.73	RMSE = 0.77 Rsquared (R2) = 0.23
	5	34	1	80	20	Accuracy: 0.77 Precision: 0.75 Recall: 0.77 F1 Score: 0.74	RMSE = 0.75 Rsquared (R2) = 0.29
Random Forest	1	34	1	80	20	Accuracy: 0.78 Precision: 0.77 Recall: 0.78 F1 Score: 0.77	RMSE = 0.62 Rsquared (R2) = 0.49
	2	34	1	80	20	Accuracy: 0.77 Precision: 0.76 Recall: 0.77 F1 Score: 0.76	RMSE = 0.68 Rsquared (R2) = 0.40
	3	34	1	80	20	Accuracy: 0.80 Precision: 0.79 Recall: 0.80 F1 Score: 0.79	RMSE = 0.60 Rsquared (R2) = 0.51

	4	34	1	80	20	Accuracy: 0.78 Precision: 0.77 Recall: 0.78 F1 Score: 0.76	RMSE = 0.61 Rsquared (R2) = 0.52
	5	34	1	80	20	Accuracy: 0.80 Precision: 0.78 Recall: 0.80 F1 Score: 0.78	RMSE = 0.59 Rsquared (R2) = 0.56
KNN	1	34	1	80	20	Accuracy: 0.68 Precision: 0.67 Recall: 0.68 F1 Score: 0.65	RMSE = 0.60 Rsquared (R2) = 0.53
	2	34	1	80	20	Accuracy: 0.68 Precision: 0.68 Recall: 0.68 F1 Score: 0.66	RMSE = 0.69 Rsquared (R2) = 0.38
	3	34	1	80	20	Accuracy: 0.69 Precision: 0.67 Recall: 0.69 F1 Score: 0.66	RMSE = 0.61 Rsquared (R2) = 0.51
	4	34	1	80	20	Accuracy: 0.67 Precision: 0.67 Recall: 0.67	RMSE = 0.63
						F1 Score: 0.66	Rsquared (R2) = 0.48
	5	34	1	80	20	Accuracy: 0.70 Precision: 0.70 Recall: 0.70 F1 Score: 0.68	RMSE = 0.60 Rsquared (R2) = 0.55

Conclusion

In evaluating the performance of three distinct machine learning models—Random Forest Classifier, Decision Tree, and K-Nearest Neighbors (KNN)—on predicting student graduation outcomes based on a dataset that includes academic performance, attendance records, and other relevant factors, we conducted a series of experiments. These experiments were designed to assess the models' effectiveness across various metrics, including accuracy, recall, root mean square error (RMSE), and others, with the random state of the dataset being altered in each iteration to explore the consistency and reliability of the models under varying conditions.

The analysis revealed that the Random Forest Classifier consistently outperformed the other two models in terms of accuracy. Its accuracy ranged between 75% to 80%, peaking at 77%, which indicates a strong capability in correctly predicting student graduation outcomes. This superior performance can be attributed to the ensemble learning method employed by the Random Forest

algorithm, which combines multiple decision trees to produce a more accurate and robust model by reducing the risk of overfitting associated with individual trees.

In contrast, the Decision Tree model demonstrated the highest RMSE among the models, reaching up to 0.80. The RMSE is a measure of the average magnitude of the errors between the predicted values and the actual values, with a higher RMSE indicating less accurate predictions. The relatively high RMSE for the Decision Tree model suggests that it was the least efficient at making accurate predictions, likely due to its susceptibility to overfitting, especially when dealing with complex datasets with many features. Decision Trees can capture intricate patterns in the data, but without proper regularization, they can become too tailored to the training data, impairing their generalization to new data.

Regarding the K-Nearest Neighbors (KNN) model, it was observed to be effective for small to moderately sized datasets. KNN's performance is contingent upon its ability to find a balance between similarity and diversity among the nearest neighbors it selects for making predictions. However, as the dimensionality of the dataset increases, KNN's efficiency may decrease due to the curse of dimensionality, which complicates the distance measurement between points in high-dimensional space. Consequently, while KNN is a valuable tool for certain predictive tasks, its utility may be limited in scenarios involving high-dimensional data, where the distance between points becomes less informative.

In conclusion, our comprehensive evaluation of these three machine learning models on the task of predicting student graduation outcomes underscores the importance of selecting the appropriate model based on the specific characteristics of the dataset and the prediction task at hand. The Random Forest Classifier emerged as the most reliable and accurate model for our dataset, offering a robust solution that mitigates the risk of overfitting associated with Decision Trees while outperforming the KNN model in handling high-dimensional data. These findings highlight the critical role of model selection in the development of predictive analytics solutions, emphasizing the need for careful consideration of the model's strengths and limitations relative to the data and the analytical objectives.

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SUBSTANTIATION OF THE MODEL OF THE PROCESSES OF DESTRUCTION OF WATER-BASED EMULSIONS

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СУМҰНАЙЛЫ ЭМУЛЬСИЯЛАРДЫ БҰЗУ ПРОЦЕСТЕРІНІҢ МОДЕЛІН НЕГІЗДЕУ

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Abstract

The dewatering process includes the stages of droplet formation and deposition. The more efficient the drip formation process, the more effective the separation of the emulsion into oil and water. Therefore, it is necessary to know the ways of intensifying this process and the effectiveness of the influence of various technological parameters on the processes of droplet formation.

In this article, a mathematical model for calculating the drop-down process in modeling the processes of field preparation of crude oil, well products, hydrocarbons in oil fields and a modeling system (MS) for calculating the processes of field preparation of crude oil, well products, hydrocarbons were used.

Therefore, the purpose of this article is the processing and analysis of experimental, experimental data on the influence of technological parameters on the process of drip formation during the movement of water - based emulsion through a pipeline and the study of the process using a mathematical model.

Аңдатпа

Сусыздандыру процесі тамшытүзілу және тұндыру кезеңдерін қамтиды. Тамшы түзілу процесі неғұрлым тиімді болса, эмульсияны мұнай мен суға бөлу соғұрлым тиімді болады. Сондықтан да бұл процессті күшейту жолдарын және әртүрлі технологиялық параметрлердің тамшытүзілу процестеріне әсер ету тиімділігін білу қажет.

Бұл мақалада мұнай кен орындарындағы шикімұнайды, ұңғыма өнімдерін, көмірсутектерді кәсіпшілікте дайындау процесстерін модельдеу кезінде тамшытүзілу процесін есептеудің математикалық моделі және шикімұнайды, ұңғыма өнімдерін, көмірсутектерді кәсіпшілікте дайындау процестерін есептеу үшін моделъдеу жүйесі (МС) пайдаланылды.

Сондықтан да бұл мақаланың мақсаты - құбыр арқылы сумұнайлы эмульсияның қозғалысы кезінде тамшытүзілу процессіне технологиялық параметрлердің әсері туралы эксперименттік, тәжірибелік деректерді өңдеу мен талдау және математикалық модельді қолдана отырып процесті зерттеу болып табылады.

Keywords: oil field, water emulsion, mathematical modeling
Кілттік сөздер: мұнай кенорны, сумұнайлы эмульсия, математикалық модельдеу

Мұнайды жинау мен дайындаудың заманауи жүйелері технологиялық өзара байланысты объектілердің күрделі кешені болып табылады. Игеріліп жатқан кен орындарының технологиялық параметрлерінің әртүрлілігі, мұнайдың табиғи-климаттық жағдайлары мен физико-химиялық қасиеттерінің айырмашылығы жаңа мұнай дайындау объектілерін жобалау және қолданыстағы мұнай дайындау объектілерін жайластыру кезінде әртүрлі шешімдерді талап етеді.

Мұнайды, ұңғыма өнімдерін, көмірсутектерді мұнай кенорындарында бастапқы дайындау процестерінің математикалық модельдеуі мұнайды дайындаудың қолданыстағы қондырғыларын талдау, оңтайландыру, тиімділігін арттыру, мұнайды дайындаудың қондырғысын жобалауға арналған автоматтандырылған жобалау жүйелері мен технологиялық регламенттерді әзірлеу мәселелерін шешудің қажетті кезеңі болып табылады.

Шикі мұнайды кәсіпшілікте, мұнай кенорындарында дайындаудың қолданыстағы қондырғыларын талдау, оңтайландыру және тиімділігін арттыру мәселелерін шешудің қажетті кезеңі математикалық модельдеу процесі келтірілген.

Тамшылардың түзілу процесінің математикалық моделі су-мұнайлы эмульсиясының (массалардың алмасуы) және тамшының ыдырау процесстерінің математикалық сипаттамасын қамтиды және ағынында пайда болатын тамшылардның диаметрлерін, беттік керілуді, сызықтық ағын жылдамдығын, құбырлардың диаметрлері мен ұзындығын және басқа көрсеткіштерді есептеуге мүмкіндік береді. Математикалық моделъдегі тамшылардың диаметрі Тронов әдісімен есептеледі:

$$d_{\max} = 43{,}3 \cdot \frac{\sigma^{1,5} + 0{,}7\mu_в \cdot u^{0,7} \cdot \sigma^{0,8}}{u^{2,4} \cdot \mathrm{Re}^{0,1} \cdot \nu_{см}^{0,1} \cdot \rho_н \cdot \mu_н{}^{0,5}} \qquad (1)$$

Модельдеу жүйелеріне мұнайды дайындау процестерінің физика-химиялық мәнін ескеретін сепарациялау (бөлу), тамшы түзілу және тұндыру процестерінің модельдері кіреді, бұл сенімді нақты нәтижелерге қол жеткізуге және қондырғының тиімді жұмыс режимдері бойынша жедел ұсыныстар беруге мүмкіндік береді.

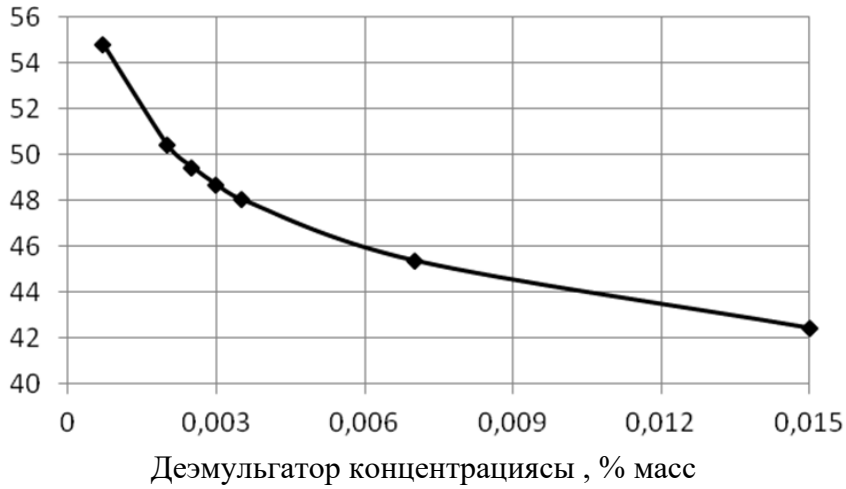
Негізгі процестердің модельдері модельдеу жүйелерінің мұнайды дайындау процестерінің физика-химиялық заңдылықтарына негізделген, сонымен қатар эмпирикалық тәуелділіктерді қамтиды. Тұндыру процесінің математикалық сипаттамасы ауырлық күштерінің әсерінен су тамшыларының тұндыруының белгілі заңдарына негізделген:

$$V_{ос.} = \frac{\rho_в}{18}\frac{D_0^2}{\mu_н}\left(1 - \frac{\rho_н}{\rho_в}\right)g, \qquad (2)$$

Мұнайдың тұтқырлығы температураға, қысымға, мұнайдың химиялық құрамына және қабаттағы көмірсутектердің ерітілген ілеспе газдардың мөлшеріне, көлеміне байланысты болады.

Кенорын мұнайларының тұтқырлығының температураға тәуелділігі мұнайды өңдеу технологиясында жылу алмасу, тұндыру процестерінде дайын мұнайлардың өнімдерін қолдануда пайдаланады. Сұйықтардың арасындағы ішкі әсерлесуді анықтау арқылы (температураны, қысымды, электромагниттік өрісті) мұнайдың өнімдерін дисперсті фазалар ретінде қарастырады.

Мұнайды кәсіпшілікте дайындаудағы маңызды параметр коалесценция процесі жүретін құбырдың ұзындығы болып табылады. Құбырдың коалесцентті және масса алмасу секциясының ұзындығын есептеу деэмульгаторды енгізудің қажетті орнын анықтауға мүмкіндік береді. Суретте 1 реагенттің концентрациясының тиімді тамшытүзілу процесі үшін қажетті құбыр ұзындығына әсерін зерттеу нәтижелері келтірілген.



Сурет 1 - Құбырдың ұзындығының деэмульгатор концентрациясына тәуелділігі

Математикалық модельді қолдана отырып жүргізілген зерттеулер тамшылардың диаметрі, беттік керілу және деэмульгатор концентрациясының жоғарылауымен құбырдың ұзындығы басқалары тең болған кезде азаятындығын көрсетті. Реагенттің концентрациясы массаның 0,0007-ден 0,015% - на дейін болған кезде. тамшылардың диаметрі 210-дан 33 мкм-ге дейін азаяды, беттік керілу 41-ден 11,5 дин/см-ге дейін төмендейді, ал құбырдың ұзындығы 54,8-ден 42,4 м-ге дейін өзгереді.эмульсия ағынының тамшы диаметріне әсер ету нәтижелерін талдау эмульсия ағынының 35000-нан 65000 кг/сағ-қа дейін өсуімен тамшылардың диаметрі 460-тан 98,5мкм-ге дейін төмендейтінін көрсетті. Демек, тамшытүзілу процесінің тиімділігі және одан кейін суды тұндыру процесі төмендейді.

Осылайша, деэмулъгатор концентрациясының беттік керілуге әсерін математикалық моделде есепке алу бізге реагенттің мұнайды кәсіпшілікте дайындаудағы тамшытүзілу процесінің тиімділігіне әсерін болжауға және су-мұнайлы эмульсиясының ыдырау процесінің ең тиімді режимдерін анықтауға мүмкіндік береді.

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COMPARISON OF C++ AND PYTHON. MEMORY USAGE AND EXECUTION TIME

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Abstract

In the current technological era, programming plays a crucial role, with Python and C++ standing out as widely utilized languages. Python, recognized as today's most popular high-level, object-oriented language, contrasts with C++, which, as the backbone of many operating systems, operates at a low-level. This paper presents a comparative analysis of Python and C++, covering their introductions, memory management techniques, and the factors influencing their program execution speed. Additionally, we examine the execution time and memory usage of various algorithms in both languages under best, average, and worst-case scenarios. A comparison of benefits and issues is also provided. Results reveal that C++ exhibits faster execution speed than Python, yet Python proves to be more beginner-friendly due to its simplicity. Ultimately, the choice of language should align with the specific project requirements for optimal results.

Keywords: C++, Python, algorithms, execution speed, comparative analysis.

[I] INTRODUCTION

Software development emerges as an exceptionally demanding field, given its integration into all domains. A multitude of programming languages are in active use, with new languages continually introduced. Each language carries its own set of advantages and drawbacks, serving distinct purposes. In our research paper, we conducted a comparative analysis of two frequently employed languages: Python and C++. Python is favored by novice programmers for its user-friendly nature, while seasoned developers often lean towards C++. Our examination revolves around comparing these languages based on time and space utilization, discerning their significance in various contexts. The comparison involves algorithms, considering best, worst, and average cases. Execution is carried out using Visual Studio for C++ code and PyCharm for Python code. In addition to algorithm execution, we explore memory allocation, background, and time utilization for program execution in both C++ and Python.

In this document, [II] covers related work, [III] provides an overview of Python and C++ along with their brief history. [IV] delves into the memory management techniques of both languages, while performance analysis in terms of execution time is detailed in [V]. Memory and time analysis of algorithms in both languages is presented in [VI]. [VII] discusses the benefits and issues of both C++ and Python, offering recommendations for beginners. [VIII] concludes the paper, and [IX] contains the list of references.

[II] BACKGROUND

As time progresses, numerous programming languages emerge in the field of computer science. Each language holds its significance along with drawbacks. The dilemma of choosing a language for beginners versus selecting one for fast and precise results is a common challenge for developers. Zakaria Alomari, Oualid El Halimi, Kaushik Sivaprasad, and Chitrang Pandit address this issue by comparing C++, PHP, C#, Java, Python, and VB in their paper [1]. The comparison encompasses paradigms, application areas, execution strategy, typing strategy, memory management, and available IDEs. By executing the same algorithm in all languages and comparing the results, they deduced that C++ is the fastest language. Each language excels in specific domains; C# is optimal for GUI, Java and PHP for web development, VB for event-driven programming, Python for rapid prototyping, and C++ for a wide range of software applications development.

Kristijan Stefanoski, Aleksandar Karadimche, and Ile Dimitrievski conducted a performance analysis comparing two languages – the compiled language C++ and the scripting language Javascript

[2]. The focus was on sorting and searching algorithms. The authors compared the time taken by both languages for inserting varying data amounts into arrays for Javascript and vectors for C++ (akin to dynamic arrays). Results indicated that C++ outperformed Javascript, being 7ms faster. The logging time difference was 15 ms and 22 ms, respectively, and this trend persisted across different input quantities. Linear searching algorithms also highlighted C++ as comparatively faster than Javascript. However, the sorting algorithm revealed the efficiency of Dynamic Javascript arrays compared to standard C++ arrays. The paper concluded that C++ is notably faster than Javascript or any scripting language like Python, attributing this to C++ being a compiled language that doesn't require translation time into machine code. In contrast, scripting languages rely on an interpreter for code translation before execution.

In a recent study comparing programming languages, Python and C++, the focus was on efficiency. The authors examined sorting algorithms (Quicksort, Merge Sort, Bubble Sort, and Insertion Sort) to assess the languages' performance. The execution time of each sorting algorithm was calculated in both Python and C++ using two approaches: first, without displaying data in the array, and second, with displaying data in the array. The authors also explored two compilation methods: Command Prompt and Cygwin. Results indicated that Python completed tasks more quickly in Cygwin and took longer in CMD, while C++ exhibited the opposite trend. Notably, both languages demonstrated faster performance when not displaying data in the array [3].

In a study conducted by Muhammad Ateeq, Hina Habib, Adnan Umer, Muzammil Ul Rehman [4], the focus was on the choice of programming languages for beginners. The paper concluded that Python stands out as an easy-to-learn and user-friendly language, akin to English in its syntax. The majority of beginners expressed satisfaction and comfort while learning Python. While languages like C++, Java, and others have their significance, the recommendation is for students or beginners to start with Python. The advice is to avoid learning C++ unless necessary, as C++ entails more syntax rules and programming conventions. However, it is acknowledged that in certain cases, particularly for game development and systems, C++ becomes a suitable choice. The study emphasized Python as the most powerful programming language compared to others.

This paper undertakes a comparative study of Python and C++, focusing on memory allocation, speed, advantages, and disadvantages. The primary objective is to analyze and compare the two languages, particularly addressing the perception that Python is slow. The research questions posed include: Is Python slow, and if so, why? Additionally, the paper aims to determine which language is better suited for beginners.

[III] OVERVIEW OF C++ AND PYTHON

A. Overview of C++

C++, a general-purpose compiled language, was developed by Danish computer scientist Bjarne Stroustrup in 1979. It serves as an extension of the C language, regarded as a superset of C. The initial edition of C++ debuted in 1985 [5]. Over time, C++ underwent updates and introduced new features such as classes, inheritance, static and constant member functions, templates, libraries, and namespaces. Standardized by the International Organization for Standardization (ISO), C++ was published in 2011.

Several programming languages are based on C++. For instance, C# utilizes C++ syntax and incorporates major features like classes. Notably, Java, one of the most popular programming languages, draws inspiration from C++, though it excludes certain features like pointers, operator overloading, and multiple inheritance to maintain simplicity [1].

C++ facilitates both object-oriented and procedure-oriented programming, yet it primarily functions as an Object-Oriented Programming language widely used in real-world applications. Recognized for its efficiency in terms of memory and speed, C++ surpasses other programming languages like Java and Python [6].

B. Overview of Python

In the late 1980s or early 1990s, Guido van Rossum developed Python at the National Research Institute for Mathematics and Computer Science in the Netherlands. Python is derived from various languages, including Modula-3, C, C++, Algol-68, and other scripting languages.

As one of the most popular dynamic programming languages, alongside Perl, Ruby, etc., Python is recognized for its high code readability and employs indentation instead of brackets and semicolons, distinguishing it from languages like C++, C, and Java [1]. Gaining prominence since 2003, Python has consistently ranked high, reaching the top spot in the 2020 PYPL PopularitY of Programming Language Index. Python has two major versions, 2.x and 3.x, and supports various programming paradigms such as functional, procedural, reflective, imperative, and object-oriented approaches [8].

[IV] MEMORY MANAGEMENT

The memory system significantly influences performance [9]. Memory management, encompassing the allocation, deallocation, and effective handling of memory, is crucial in this regard. It involves assigning memory to a program when needed and releasing it when no longer necessary. Since the precise memory requirements for running an application cannot be predetermined, additional code is essential to manage dynamic memory needs. Memory management involves two interrelated tasks:

1) Allocation: This involves assigning memory blocks to the program upon request, with the operating system providing this block. The allocator, a part of the memory manager, performs this task.

2) Recycling: Once allocated memory blocks are no longer needed, they undergo recycling. This can be achieved through manual memory management, where the programmer decides, or automatic memory management, where the memory manager handles this process [10].

A. Memory Management in C++

Managing memory is a critical aspect of programming, serving as a key factor in measuring the efficiency of a programming language. For an effective program, a programmer must be attentive to how memory is utilized. While languages like Java offer their garbage collector to handle memory management, C++ requires the programmer to manually manage memory [11].

Kinds of Memory Management:

1. Stack Allocation (Automatic Management):

The stack in computer memory is where programs store executed values and results. It is maintained throughout the program's execution. When a function is called, its address is pushed onto the stack and popped out when the function completes its execution.In C++ programs, an activation record is generated each time a program runs, allocating memory for local variables and methods. Memory deallocation occurs with the end of a variable's lifetime. The stack's memory management is handled by the compiler, so there's no explicit need to allocate or deallocate memory in the stack for stack objects. However, not all memory requirements are met by the stack; certain objects, such as strings, necessitate additional memory allocation to fulfill their tasks [11].

2. Static Memory Allocation:

Indeed, "static" in programming refers to something fixed or unchanging. Programmers allocate a predetermined size of memory to a specific variable, program, or application during compile time. Once the memory is assigned to a variable, it remains dedicated to that purpose, even if the variable doesn't require most of the allocated memory at a specific moment. This static allocation occurs regardless of the dynamic memory needs of the variable during runtime.

3. Dynamic Memory Allocation (Heap Allocation)

Efficient memory usage is crucial to avoid memory shortages. Dynamic memory allocation, also known as manual memory allocation, is a mechanism where memory is allocated only when the program demands it and is released or deallocated when no longer needed. The released memory becomes available for other purposes, offering control over memory usage during runtime. Dynamic allocation in C++ occurs in the heap memory, a large and powerful area of dynamic storage.

C++ provides a mechanism for dynamic memory allocation using the new and delete keywords for allocation and deallocation, respectively. In C++, where memory management is the programmer's responsibility, once memory is explicitly allocated using new, it cannot be reused until deallocated with delete. Pointers are utilized to handle dynamic allocation, providing programmers with runtime memory control.

B. Memory Management in Python

Python, a high-level programming language implemented in C, operates with everything represented as objects, such as lists, dictionaries, tuples, and integers. These data structures and Python objects are stored in a private heap managed by the Python memory manager.

The Python memory manager involves four key concepts:

1. **Heap**: This encompasses all Python-managed memory.

2. **Arenas**: These are the largest memory chunks, each with a fixed size of 256 KB. Python requests these from the system, and they constitute the objects forming the heap.

3. **Pools**: These are 4 KB memory chunks that compose the arenas. They are essentially arrays due to their fixed sizes.

4. **Blocks**: Python objects are stored in blocks, each adhering to a specific format based on their data types. For efficiency, different block sizes are used; for example, an integer occupies more space than a character, leading to varied block sizes.

Memory can only be returned to the operating system in the form of an arena. Consequently, when an arena becomes empty, it is freed. For this reason, when Python requests memory, a filled arena is provided whenever possible, rather than an empty one. However, when a block is freed, it is not released to the OS but retained for future memory allocation. Python's garbage collector handles this automatic deallocation of memory [13].

Contrary to manual memory management, where the programmer specifies which objects to deallocate, deallocating memory with a garbage collector is an automated process [14]. Python's garbage collector has default thresholds set to 700, 10, and 10 for the three generations of collected objects. It automatically collects when these thresholds are reached. The collector tracks all memory allocations and deallocations. If the difference between allocations and deallocations reaches 700, the object is either deleted if it's unreferenced or moved to the next generation if still referenced. This process repeats for generations 2 and 3 with lower thresholds of 10 [15].

In summary, when a Python program is executed, it compiles into an intermediate code called bytecode, which is then interpreted by the Python Runtime Environment (PRE) to machine code. The garbage collector, managed by the PRE, takes care of memory allocation and deallocation. When a new object is created, the required memory is allocated, and when the object goes out of scope, the memory becomes eligible for Garbage Collection (GC). Eventually, the GC releases the memory [1].

[V] TIME ANALYSIS

Analyzing program execution time is crucial, especially for complex software systems. The runtime of a program is measured from the initiation of providing inputs to the program until its termination and output delivery [16]. Different programming languages exhibit varying speeds in program execution, often influenced by their implementation. Typically, high-level languages tend to be slower than low-level languages. The reasons behind the execution speed in C++ and Python are explored below.

A. *Time Analysis in C++*

Creating code in C++ may present more challenges compared to Python, yet C++ excels in performance. Research indicates that languages such as Python, PHP, Java, and C# fall short in matching C++ regarding speed and memory efficiency. Several factors contribute to C++'s superior performance.

1. *Statically Typed Language:*

C++ employs a static typing approach, where data types such as integer, float, char, and string are fixed. Each variable is stored with its designated data type, allowing the compiler to determine the appropriate process for a specific variable. This eliminates the need for runtime type conversion validation, enhancing C++ performance by streamlining the execution process.

2. C++ is a Compiled Language:

C++ distinguishes itself from interpreted languages like Python, as it directly converts the source code into machine code during compilation, without the intermediate steps of byte code translation and runtime conversion. This compiler-based approach significantly boosts execution speed, providing a notable improvement [1].

3. Dynamic Memory Allocation:

C++ supports dynamic memory allocation, allowing programmers to declare and manage object lifetimes without relying on a garbage collector. This eliminates the pause time required for a Java Virtual Machine or Python interpreter to trace object lifetimes. Consequently, C++ code runs faster, as it avoids the additional overhead [17].

4. Use of Templates:

C++ leverages powerful templates, enhancing runtime performance by conducting computations primarily at compile time. Although this may extend compilation time, the resulting runtime performance surpasses that of Python. Particularly for substantial numerical tasks, expression templates are employed to efficiently handle vectors and matrices. These templates execute many matrix operations, including transposition, without creating intermediate matrices, thus optimizing memory usage and overall performance.

B. *Time Analysis in Python*

Python, being a dynamically typed language with a straightforward syntax and flexibility, requires less effort from the programmer during coding. However, the trade-off is that the interpreter has to perform more identification tasks during program execution, contributing to a slower runtime [18].

1. Reasons behind Slow Execution

Below are the factors contributing to its sluggish execution speed:

- *Dynamically Typed Language*

In a dynamically typed language like Python, where variable types don't need to be explicitly specified, a single variable can hold various data types. Consequently, during program execution, the interpreter checks the variable's data type each time an operation is performed to ensure compatibility. This continuous type-checking process adds overhead, contributing to slower execution [19].

- *Global Interpreter Lock (GIL)*

The Global Interpreter Lock (GIL) is essential in Python to prevent multiple threads from simultaneously modifying memory, thereby avoiding memory corruption. Due to the Python memory manager not being thread-safe, GIL ensures that only one thread executes at a time, preventing memory issues. However, this serialization of thread execution contributes to a slowdown in program execution speed [20].

- *High-level language*

Python's status as a high-level language, closer to human language, eases the coding process due to features like automatic memory management and garbage collection. This characteristic reduces the effort required in code writing, contributing to Python's user-friendly nature [21].

- *Garbage Collection*

Due to Python employing a garbage collector, there is a delay in identifying which memory to release, leading to an extended runtime for the program.

2. Different Kinds of Python Implementation:

Following the aforementioned factors, the speed of your Python code might be influenced by the interpreter uses.

[VI] C++ OR PYTHON: WHAT SHOULD A BEGINNER PREFER?

A. C++, It's significance and issues

As previously mentioned, C++ holds a prominent position among programming languages. Beginners are often eager to identify the most suitable and user-friendly language for their learning journey. It is essential for novices to be aware of the strengths and weaknesses of different languages as they embark on their programming endeavors. Understanding the advantages and challenges of C++ is crucial for beginners in making informed choices about the language they wish to adopt.

1. *Significance*

- Portability

C++ offers portability by allowing users to run the same program on various operating systems.

- Object-Oriented Programming

Given that C++ is an object-oriented language, it incorporates fundamental concepts such as structures, inheritance, classes, polymorphism, and more. This facilitates code reuse and enhances comprehension. Furthermore, C++ empowers programmers to address real-world issues by conceptualizing real-world entities as objects.

- Memory Management

C++ grants complete memory control to the programmer, offering the flexibility to decide whether to clear or retain past memory. The responsibility of managing memory, including garbage collection, rests with the programmer. Dynamic memory allocation, facilitated by pointers, is employed for effective memory management.

- Compatibility with C

C++ exhibits high compatibility with the C language, allowing individuals familiar with C basics to seamlessly transition to C++. Code written in C, devoid of errors, can be effortlessly executed in a C++ compiler.

- Scalability

Scalability, the capacity to handle programs of varying sizes, is a notable feature of C++. Whether it's a small or large program, C++ compilers can execute code of any scale effectively.

- Multi-paradigm

The term 'paradigm' encompasses the logics and structures defining the style of code representation. C++ is deemed a multi-paradigm language as it supports representation in various styles.

2. *Issues*

- Complex Syntax

Compared to languages such as Python, the syntax of C++ is notably more complex and extensive.

- Security Issues

While C++ excels in object-oriented programming with its object-centric approach, security concerns persist due to factors like global variables, pointers, and public specifiers.

- Use of Pointers

Pointers in C++ can be memory-intensive, challenging to implement, and have a steep learning curve. Excessive use of pointers may lead to issues like wild pointers, posing a risk of program crashes.

- Garbage Collection

As previously mentioned, C++ lacks a garbage collector, requiring the programmer to manually manage and clean up unnecessary memory.

- Lack of Rapid prototyping

The size of the code is larger in C++ due to which rapid prototyping cannot take place [8].

B. Python, It's significance and issues

Python has origins in various languages such as C, C++, and Linux. Its widespread popularity is attributed to its distinctive syntax, which differs significantly from C, Java, and C++. In Python, there is no need for semicolons and brackets, and data types like int, float, and string are not explicitly declared.

1. Significance

- Easy to read, write, maintain, and learn

Python stands out with its well-defined syntax and easily comprehensible structure. Novices find it accessible as its keywords are primarily derived from the English language, facilitating quick learning due to its English-like syntax. Python's code is characterized by its minimal size, simplifying the task of maintenance. These factors collectively contribute to the widespread recommendation of Python for beginners.

- Portability

Similar to C++, Python exhibits platform independence. You need to write the code only once, and it can be executed on any desired platform, ensuring that the code is free of errors. This flexibility allows Python developers to run their code seamlessly across various platforms.

- Scalable

Python is scalable, accommodating code of any size, whether it's extensive or concise, spanning from a single line to a large program. This versatility allows Python to execute code efficiently across a broad spectrum of project sizes.

- Vast Standard Library

Python's standard library is vast, encompassing a comprehensive collection of functions that cater to a wide range of user needs. This abundance of built-in functionality proves to be a significant advantage for Python users, as it ensures that a variety of functions are readily available within the language itself.

- Productivity Improvement

Due to Python's ease of understanding, programmers can shift their focus towards productivity rather than constantly checking for syntax errors and managing syntax-related issues. This results in the creation of concise code where more functions can be executed, minimizing complexity and ensuring code manageability. This approach ultimately boosts productivity rates among Python developers.

2. *Issues*

- Gets Slow in Speed

A notable drawback of Python is its reliance on an interpreter rather than a compiler, unlike some other programming languages. This characteristic leads to slower execution times. In time-sensitive projects, Python is often bypassed because its execution involves backend work concurrently, affecting its speed and causing delays in the overall process.

- Weak in Mobile Computing

Python is not frequently employed in the development of mobile applications. This is attributed to Python's suboptimal memory efficiency and time consumption, making it less suitable for mobile computing. Other languages are often preferred in the mobile app development landscape to ensure better performance and efficiency.

- Less Memory Efficient

Python is known to consume a significant amount of memory during compilation. When prioritizing memory optimization, Python is often avoided. Developers sometimes make a trade-off, opting for a language that is simpler to work with despite being more time and memory-consuming. This reflects a balance between developer convenience and the resource demands of the language.

- Issues in Using Other Languages

Due to Python's user-friendly nature, programmers often become accustomed to its simplicity, making it challenging for them to transition to or work with other low-level languages. Users of Python may find tasks such as adding curly braces or semicolons, which are common in languages like C++, C#, etc., to be cumbersome and unfamiliar. This comfort with Python's syntax can create a learning curve when adapting to the conventions of other programming languages.

C. Recommendation of Programming Language

Python outperforms C++ and stands out as the recommended language for beginners. Its easy-to-learn nature and uncomplicated syntax make it a more favorable choice for newcomers. Moreover, Python excels in web design and backend development, offering a user-friendly approach in these areas, unlike C++, which is not well-suited for various web development tasks.

Python takes the lead in data analysis and machine learning, areas where C++ does not prove to be as effective. Python's simplicity is evident across all aspects, and particularly in Artificial Intelligence and Machine Learning, it stands out as the language of choice. Beginners find Python easy to understand, thanks to its syntax resembling English, facilitating a smoother learning process and enabling a better command of the language.

[VII] CONCLUSION

This paper undertakes a comparison between Python and C++, recognizing them as two of the most prevalent languages in the contemporary era. The focus revolves around evaluating the efficiency of these languages concerning time and memory usage.

Notably, C++ is acknowledged for its adept memory management, allowing dynamic memory allocation and granting programmers comprehensive control over memory. Programmers using C++

can allocate and deallocate memory at their discretion. Conversely, Python employs a garbage collector managed by the Python Runtime Environment (PRE), which identifies and collects memory that won't be utilized in the future based on reference count. While this reduces the manual workload for the programmer, it concurrently increases the responsibilities of the interpreter.

Following the discussion on memory management, we delve into the examination of time consumption by both languages. C++, being a statically typed compiled language, is inherently more efficient in terms of performance. In contrast, the Python interpreter introduces an additional step in the process, as it requires time to translate the source code into bytecode and subsequently into machine code. Moreover, Python's reliance on dynamic typing means that it addresses type conversion matters at runtime, contributing to its comparatively slower execution speed.

Furthermore, we showed a comparison of both languages, focusing on sorting, searching, insertion, and deletion algorithms applied to array data structures. The assessment involved evaluating their time and space complexities in best, worst, and average cases. Python code was tested using PyCharm, while C++ was tested with Visual Studio. Graphical representations clearly demonstrated that Python lags behind C++ in terms of both memory efficiency and performance. However, when considering attributes such as simplicity in code writing, understanding, and learning, the conclusion was drawn that Python stands out as a powerful tool for beginners, facilitating efficient coding in less time. For larger projects with a need for swift processing, C++ remains a more suitable option.

In summary, this paper affirms the significance of both languages, each serving distinct purposes. Python is recommended for beginners due to its simple syntax, readability, portability, and scalability. In contrast, C++ is advised against for beginners, being perceived as a complex and challenging language to learn. However, for projects requiring speed and superior performance, such as operating systems and gaming applications, C++ is considered a more suitable choice.

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THE USE OF INFOGRAPHICS IN THE HIGHER EDUCATION EDUCATIONAL PROCESS

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Infographics is a tool for presenting information in a more concise form

Infographics are a relatively new means of presenting and explaining information. This technology is just beginning to conquer the educational space. Therefore, we consider it necessary to focus on this technology in more detail. Thus, the very concept of "infographics" implies a visual, artistic, drawn presentation of text or any information. Scientifically, the term "infographics" is deciphered as a tool for presenting information in a more concise form. This is one of the types of presentation of certain information by means of creating artistic sketches, graphs, diagrams and other graphic objects on paper and in electronic form.

Educational infographics

Educational infographics are a visual presentation of educational material, new knowledge that does not require additional comments.

On a sheet of paper or a slide (if it is a computer infographic), the material is collected in such a way that not only everything is clear, but also the student can find additional meaning in such an infographics, analyze it, and draw his own conclusions.

The feasibility of using infographics in lessons lies in the following aspects:

• clarity is perceived more easily than printed text;
• concise presentation of a large amount of information;
• development of visual thinking.

Infographics can be used at different stages of the lesson. For example, when learning new material, in particular the work of composers, systematization and generalization of knowledge.

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So, infographics can be used at different stages of the lesson. For example, when learning new material, in particular the work of composers, systematization and generalization of knowledge [1].

A scoping review

The process of creating infographics is also related to the use of digital tools in higher education. Whenever technology is utilized just for the sake of transmission of what others know and execution of simple tasks or operations, such cases illustrate a mere increase of learners' productivity. However, considering the integration of infographics in higher education, practitioners and researchers indicate that the use of such teaching and learning tools is not very common or only in the initial stage. It is showed that infographics can be meaningfully integrated across various subjects in higher education. In this section, we summarize the educational practices reviewed.

Thus, a common practice among educators was to assess infographics based on the criteria presented in advance, usually provided in the form of either rubrics or checklists, To engage students

in the creation of infographics you should make students more skilled in the creation of infographics and as well as to increase the value of such practices [2].

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APPLICATION OF THREE-DIMENSIONAL SURFACE LASER SCANNER TECHNOLOGY IN ENGINEERING INFRASTRUCTURE FACILITIES BUILT IN AZERBAIJAN

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Abstract

Infrastructural buildings include a single system of interrelated government institutions that continuously provide various spheres of life. Modern infrastructure buildings make an unparalleled contribution to the country's development and increase its production capacity. The construction of infrastructure facilities reflects the level of development of the country's economy.

The laser scanning process is the fastest and most effective way to obtain large-scale street and building site plans, profiles and cross-sections of road surfaces. Laser scanning is the most up-to-date, efficient and useful technology for obtaining more accurate and comprehensive digital information about the terrain, creating digital models of the earth's surface relief (RRM).

Keywords: Laser scanner, oil and gas industry, marker works, three-dimensional models.

Taking into account the advantages of three-dimensional surface laser technology, it is of great scientific and practical interest to consider the possibility of using this technology, geodetic support for the construction and operation of various objects, primarily engineering infrastructure, in the Republic of Azerbaijan.

Analyzes show that this technology can be applied mainly in the following areas in our country.

Mining industry. Combining the models created in different years, it can be concluded that the magnitude and direction of the deformation can be calculated at almost any point on the surface. Many objects of the mining industry and construction sites, starting with stone flows and ending with road construction, require the determination of volumes. It is possible to calculate the volume of even the most inaccessible object in less than one or several hours.

Markshader works. Markshader works The high effectiveness and efficiency of the laser scanner process, along with the operational monitoring capabilities of field measurements, allow solving various types of accident prevention problems. A separate field of application of laser scanner technology is the control and reporting function, for example, by obtaining a three-dimensional digital model of the quarry, the problems of calculating the volume of mineral production are solved.

According to the data obtained from the laser scanner, it is possible to obtain the model of the quarry each time after each blasting of the next block or stone - ore mining. Many scanners allow obtaining a model of the object with a very large - centimeter and less accuracy for the slopes of stone quarries that do not have a simple shape.

Oil and gas industry. The results of laser scanning of oil and gas objects can be used to solve a number of tasks: recovery of documents, inventory of equipment, detection of design inconsistencies, design of additional objects, monitoring of deformations in objects, determination of actual volume, monitoring of air passages, construction of digital models of objects, enables multiple tasks performed in the field of deformation management, fuel and lubricant storage, offshore rig and roll control, and the use of specialized equipment to support construction and engineering work at service sites and other facilities.

There are facilities for oil and gas production that consist of a large number of pipelines, cable bridges, industrial buildings, reservoirs, etc. Using traditional survey methods for large-scale mapping, at the same time, it takes a lot of time to create three-dimensional models of oil and gas production facilities. To solve these problems, surface laser scanning technology is more effective.

Theoretical studies and practical experiences in conducting scanner surveys of objects in the oil and gas industry have made it possible to formulate requirements for creating large-scale topographic plans and creating three-dimensional vector models for surface laser scanners.

Practical experience shows that the use of underground laser scanner technology for the purpose of large-scale mapping of oil and gas regions allows to reduce the time of field work by 4 to 4.5 times. However, two-dimensional topographic plans allow obtaining less initial information for the purpose of reworking technological objects of oil and gas production compared to three-dimensional models.

A large number of welded cylindrical tanks (SCC) used for storage and protection of oil products operate in the facilities of the oil and gas production complex. These tanks have a volume of 100 m3 to 50,000 m3 and require periodic technical diagnostics and inspection. According to the current method, for this purpose, various parameters are measured for individual points of the tank and intermediate values are obtained by interpolation.

Table 1.

Requirements for the technical characteristics of YLS for the creation of digital topographic plans and three-dimensional models of oil and gas industry facilities

Technical characteristics of YLS	Issues resolved	
	creation of digital three-dimensional models	creation of digital topographic plans
Maximum movement distance, m	>50	>100
Distance measurement accuracy, mm	≤15	≤50
Spread of laser rays, mrad	≤0,25	≤2
Speed of performing measurements, point/sec	≥4000	≥4000
Minimum angular step of scanning, degrees	≤0,06	≤0,1
Angle of the field of vision on a horizontal surface, degrees	≥80	≥80
Minimum working temperature, °C	≥0	≥-10
Protective class	Not less than IP42	Not less than IP42
Safety class of the laser	Not less than 3R	Not less than 3R

Road construction. Planning for the project, calculating the amount of work, monitoring the deformations of bridges, aqueducts, crossings, piers, railways and cars, calculating the amount of work, checking the compliance of the actual work with the plan, it is planned to establish communication for the presence of obstacles before the start of work.

Terrestrial laser scanners can be successfully used in land management, geology and archeology and other fields.

At all times, terrain mapping in two-dimensional space has been one of the main areas of topography and geodetic production. Therefore, the first area where ground laser scanners were used was topography. The main advantage of laser scanning is its very high productivity compared to traditional tacheometric methods and even satellite imagery. Experience shows that YLS can also be used for less developed areas and areas with high levels of congestion. The indisputable advantage is that the center of gravity is transferred to camera work during large-scale mapping due to ground laser scanning data. At the same time, the field measurement process is reduced several times.

However, for areas with high grass cover (more than 40 cm), ground laser scanning technology is practically useless for mapping the area. Tacheometric and satellite surveys are indispensable methods in such areas. Experience shows that the use of surface laser scanners in the execution of works during the creation of large-scale topographic plans provides a more flexible approach to the selection of technology and significantly increases the productivity of the work. Thus, if in three months two teams of three people manage to conduct surveys with an area of more than 500 hectares to prepare a topographic plan on a scale of 1: 500 in the third category area, and for an underdeveloped area - an area of more than 1000 hectares is required.

The assessment of the accuracy of the created topographic plans was carried out on the basis of measurements from control pickets and rigid fixed contours. It showed that the accuracy applied to the obtained product meets the regulatory requirements and the completeness of the data provided

and the results of the full-scale survey of the detailed areas are fully consistent. All received cartographic materials are fully transferred to customers.

Areas of application of laser scanner technology in Azerbaijan and the work done

By connecting the laser scanner data with a total station, in 2017, the laser scanner specialist of Trimetari Consulting LLC created a 3D model for the executive of Diamond Park, the largest water park in Gabala, Azerbaijan, which is conducting construction work for clients (Figure 1).

During the execution request, the construction of the concrete monolith was completed, some of the equipment and communications were installed. Laser scanning was required to analyze the deviations of the actual location of the concrete structures built from the project. Laser scanning will provide a better design of the metal structures supporting the glass facade and roof, knowing the actual dimensions.

Figure 1. Application of laser technology in Diamond Park, the largest water park in Gabala

The work was processed with Stonex X300, FARO Focus3D laser scanners. In order to connect the scanner data to the coordinate system of the construction, FlexLine total stations from the Leica series were used to perform a series of control measurements. All the field work was done within 2 days, and later, at the camera stage, the processing of laser scanner data, that is, the construction of a 3D model based on a set of points, was carried out. The 3D model of concrete structures reflects the geometric representation of wall surfaces, covers, supports, stairs, and other structural elements. The 3D model is built using laser scanners, so it corresponds to the original with great accuracy, depending on the configuration and dimensions of the objects. Laser scanners model, as well as other factors, the error of the 3D model can be from 1 to 20 mm. The accuracy of the 3D model in the project carried out in Diamond Park, which is a water park, was 6mm.

The result. The purpose of using modern technologies for geodetic assurance of engineering infrastructure facilities construction is to investigate the application of space, satellite images, GIS technology and satellite geodetic measurements, such as remote sensing data. For this purpose, information on the current state of construction of engineering infrastructure facilities and development prospects was collected, analyzed and systematized. The role of modern technologies in this field has been investigated. In order to ensure the construction and operation of engineering infrastructure facilities, the theoretical basis of three-dimensional surface laser scanning technology has been developed and studied.

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ANALYSIS OF VEGETATION DATA USING LINEAR REGRESSION

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Abstract

This paper delves into the analysis of vegetation health using the Normalized Difference Vegetation Index (NDVI) as a remote sensing tool. Leveraging time-series NDVI data sourced from a reliable platform, we employ Python for data processing and analysis. Specifically, we utilize linear regression to discern temporal trends in the NDVI dataset, driven by its continuous nature and the necessity for a straightforward yet effective model. Our methodology encompasses data acquisition, parsing, and preprocessing, with a focus on date transformation for regression modelling. Evaluation metrics, particularly the Mean Squared Error (MSE), indicate a close alignment between model predictions and actual values. However, we advocate for further exploratory analyses, such as residual plots, to comprehensively understand the model's behaviour. Overall, this report underscores the aptness of linear regression for capturing temporal NDVI trends while acknowledging the potential for future research to explore more complex modelling approaches.

Keywords: Vegetation indices, NDVI, remote sensing, linear regression, time-series analysis, data processing, Python, Mean Squared Error, vegetation health, temporal trends.

Introduction

Vegetation indices, like NDVI, are key indicators of vegetative health and vigour. They play a pivotal role in remote sensing and provide an objective and quantifiable measure of vegetation status and dynamics. In this report, we endeavour to analyse the time-series NDVI data and discern any underlying trends or patterns [1].

Normalized Difference Vegetation Index (NDVI) is a valuable tool for determining changes in plant health and for quantifying the greenness of vegetation. It may also be used to determine vegetation density. The usual method of calculating NDVI is to divide the red (R) value by the near infrared (NIR) value. NIR minus R / NIR plus R [2].

The decision to employ linear regression in this analysis was informed by several key considerations. Firstly, its suitability for modeling continuous variables aligns well with the nature of NDVI values. Moreover, the time-series nature of NDVI datasets lends itself naturally to linear regression analysis, allowing for the identification of trends and patterns in vegetation dynamics over time. Additionally, the simplicity and effectiveness of linear regression make it an attractive choice for this task, offering a straightforward yet powerful tool for analyzing NDVI data. This algorithm, known for its high predictive performance in vegetation health forecasting models, was implemented using Python programming language tools such as Colab notebook, along with essential libraries like pandas, scikit-learn, and Matplotlib for analysis [3].

The efficacy of this algorithm is meticulously assessed using metrics like Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and accuracy [4]. Machine learning amalgamates data from diverse origins to generate predictive outputs, discerns patterns within datasets, and subsequently identifies relationships among these patterns through a training dataset. It autonomously learns and adapts to test or validation data without requiring human intervention [5].

In this paper, we delve into the utilization of linear regression and nearest neighbor methods to analyze NDVI data, aiming to uncover insights into vegetative health and dynamics. By leveraging these methodologies, we seek to enhance our understanding of vegetation trends and contribute to the advancement of environmental monitoring and management practices [6].

Materials and methods

Libraries

Pandas: A powerful library in Python offering data structures and functions essential for efficient data manipulation and analysis. Its functionalities made it apt for handling and preprocessing the dataset.

Scikit-learn: An indispensable library for machine learning in Python. Scikit-learn provides simple and efficient tools for data mining and data analysis. For our analysis, we utilized its Linear Regression module to build and evaluate our model.

Linear regression

A fundamental statistical and machine learning method used to model and analyse the relationships between a dependent and one or more independent variables. The basic principle behind linear regression is to fit a straight line to the data that best captures the underlying trend [7].

Choice of Linear Regression

The decision to utilize linear regression for this analysis was based on several key considerations:

- Continuous Nature of NDVI Values: Linear regression is well-suited for modelling continuous variables, making it an appropriate choice for analysing the NDVI data, which represents a continuous scale of vegetative health [7].
- Inherent Time-Series Structure: The NDVI dataset exhibits a time-series structure, with observations collected at regular intervals over time. Linear regression is adept at capturing trends in time-series data, making it particularly suitable for analysing temporal patterns in vegetation dynamics.
- Need for Simplicity and Effectiveness: Linear regression offers a simple yet effective approach to modelling linear relationships between variables. Given the aim of capturing linear trends in NDVI values over time, a straightforward modelling technique was preferred to avoid unnecessary complexity.

A method for solving classification and regression problems based on the search for the nearest objects with known values of the target variable [8].

This algorithm was chosen for the task as they have been used in other vegetation health forecasting models and have shown high predictive performance, they were implemented in python programming language using Colabatory notepad and various libraries including pandas, ski-learn and Matplot library were imported for analysis.

Results and Discuusion

Data Acquistion

The data was sourced from https://eos.com/landviewer and Astana, Kazakhstan was chosen as a location of vegetation health dataset (Figure 1). The data is processed using python. We are considering the attributes and their summary for the prediction [8].

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	scene_id	view_id	date	cloud	notes	min	max	average	std	variance	q1	q3	median	p10	p90
2	S2A_tile_2	S2/42/U/X	4/9/2022	0		-1	1	0.0898	0.0921	0.0085	0.0412	0.1443	0.093	-0.0105	0.1915
3	S2B_tile_2	S2/42/U/X	9/21/2022	0		-0.4783	1	0.2147	0.146	0.0213	0.1131	0.3053	0.2078	0.0419	0.4064
4	S2B_tile_2	S2/42/U/X	10/14/2022	0		-0.6231	0.8498	0.1605	0.1287	0.0166	0.079	0.2375	0.161	0.0075	0.3182
5	S2B_tile_2	S2/42/U/X	4/29/2023	0		-0.4212	0.9855	0.1061	0.075	0.0056	0.0642	0.1502	0.106	0.0239	0.1932
6	S2A_tile_2	S2/42/U/X	6/13/2023	0		-0.4985	1	0.2404	0.1589	0.0253	0.1238	0.3366	0.2168	0.0638	0.4631
7	S2A_tile_2	S2/42/U/X	10/1/2023	0		-0.569	1	0.2375	0.1723	0.0297	0.1109	0.3583	0.2275	0.0296	0.4714

Figure 1. "Astana, Kazakhstan" NDVI initial dataset

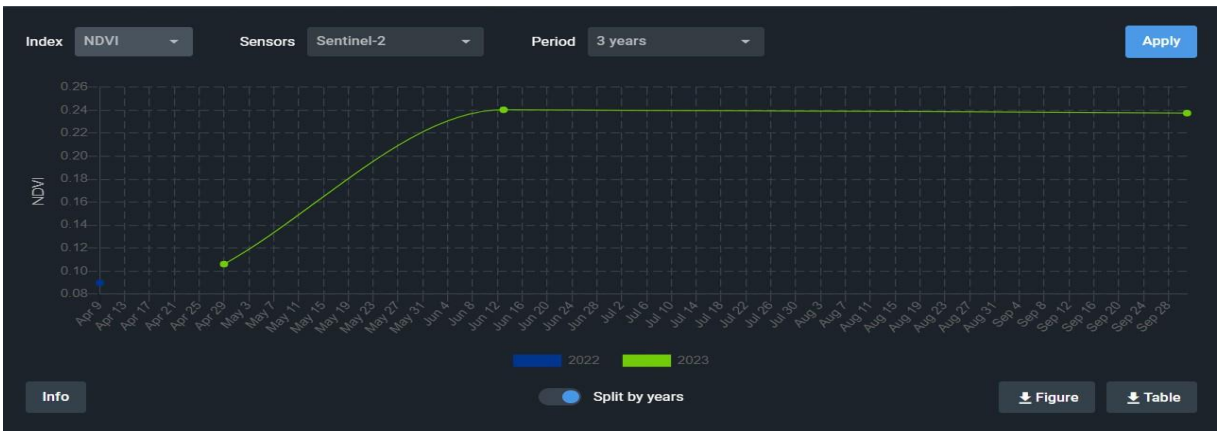


Figure 2. NDVI Time Series Analysis

The NDVI time series analysis tool is used to transform multispectral data into a single image band representing vegetation distribution (Figure 2).

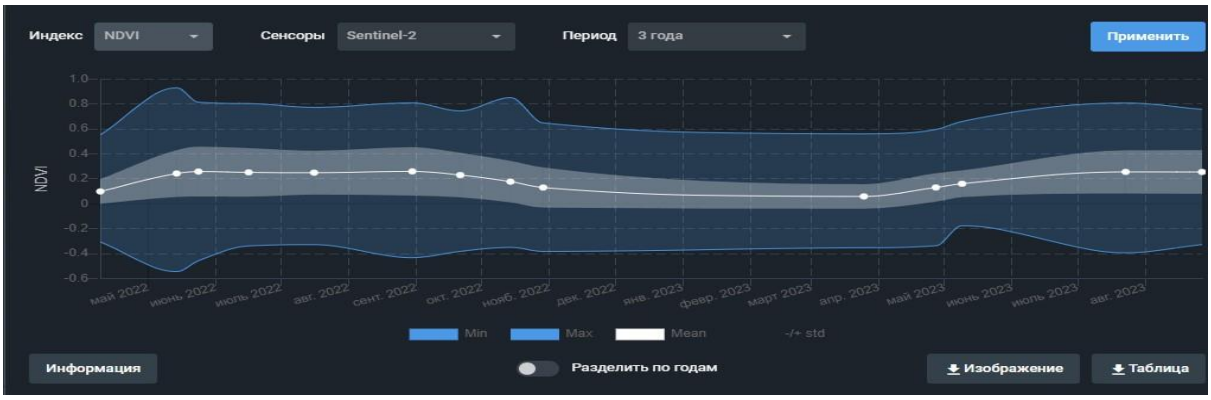


Figure 3. NDVI Distribution Analysis

The minimum NDVI value shows areas with sparse vegetation or bare ground, while the maximum NDVI value is regions with dense vegetation cover. The mean NDVI value supplies insight into the overall vegetative health and distribution across the landscape (Figure 3, 4).

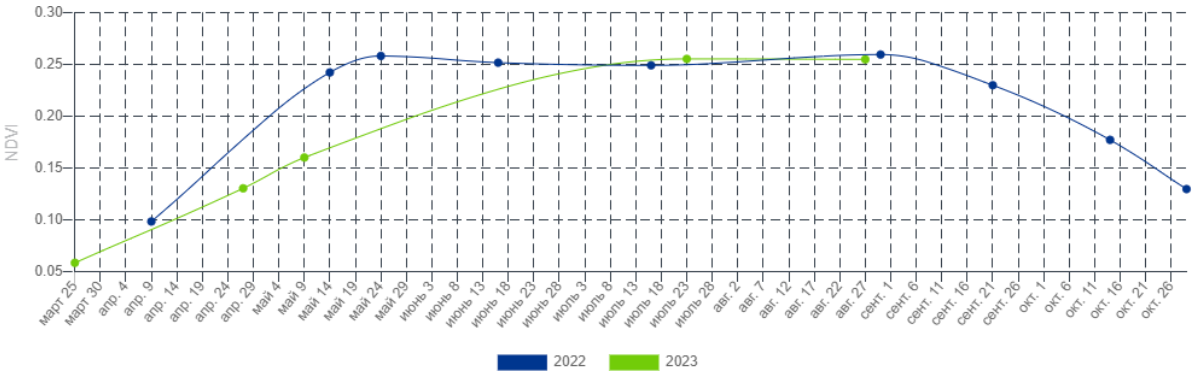
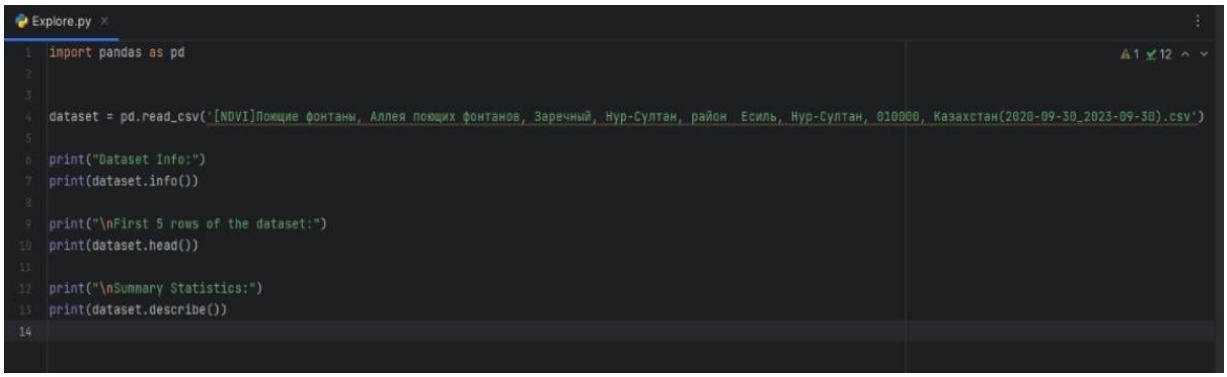


Figure 4. NDVI Comparison between 2022 and 2023

Data Preparation and Exploration

First, we checked for missing or erroneous values in the vegetation indices dataset. Any missing or erroneous values were handled through imputation or removal. Subsequently, we visualized the distribution of the vegetation indices and performed statistical analysis to gain insights into their characteristics (Figure 5-9).



```python
import pandas as pd


dataset = pd.read_csv('[NDVI]Поющие фонтаны, Аллея поющих фонтанов, Заречный, Нур-Султан, район  Есиль, Нур-Султан, 010000, Казахстан(2020-09-30_2023-09-30).csv')

print("Dataset Info:")
print(dataset.info())

print("\nFirst 5 rows of the dataset:")
print(dataset.head())

print("\nSummary Statistics:")
print(dataset.describe())

```

Figure 5. Python program checking dataset

```
Dataset Info:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 14 entries, 0 to 13
Data columns (total 15 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   scene_id  14 non-null     object
 1   view_id   14 non-null     object
 2   date      14 non-null     object
 3   cloud     14 non-null     int64
 4   notes     0 non-null      float64
 5   min       14 non-null     float64
 6   max       14 non-null     float64
 7   average   14 non-null     float64
 8   std       14 non-null     float64
 9   variance  14 non-null     float64
 10  q1        14 non-null     float64
 11  q3        14 non-null     float64
 12  median    14 non-null     float64
 13  p10       14 non-null     float64
 14  p90       14 non-null     float64
dtypes: float64(11), int64(1), object(3)
memory usage: 1.8+ KB
None

First 5 rows of the dataset:
                   scene_id                 view_id  ...     p10     p90
0  S2A_tile_20220409_42UXB_0   S2/42/U/XB/2022/4/9/0  ... -0.0224  0.2185
1  S2B_tile_20220514_42UXB_0  S2/42/U/XB/2022/5/14/0  ...  0.0321  0.5088
2  S2B_tile_20220524_42UXB_0  S2/42/U/XB/2022/5/24/0  ...  0.0323  0.5408
3  S2B_tile_20220616_42UXB_0  S2/42/U/XB/2022/6/16/0  ...  0.0206  0.5204
4  S2B_tile_20220716_42UXB_0  S2/42/U/XB/2022/7/16/0  ...  0.0468  0.4906
```

Figure 6. Python program output

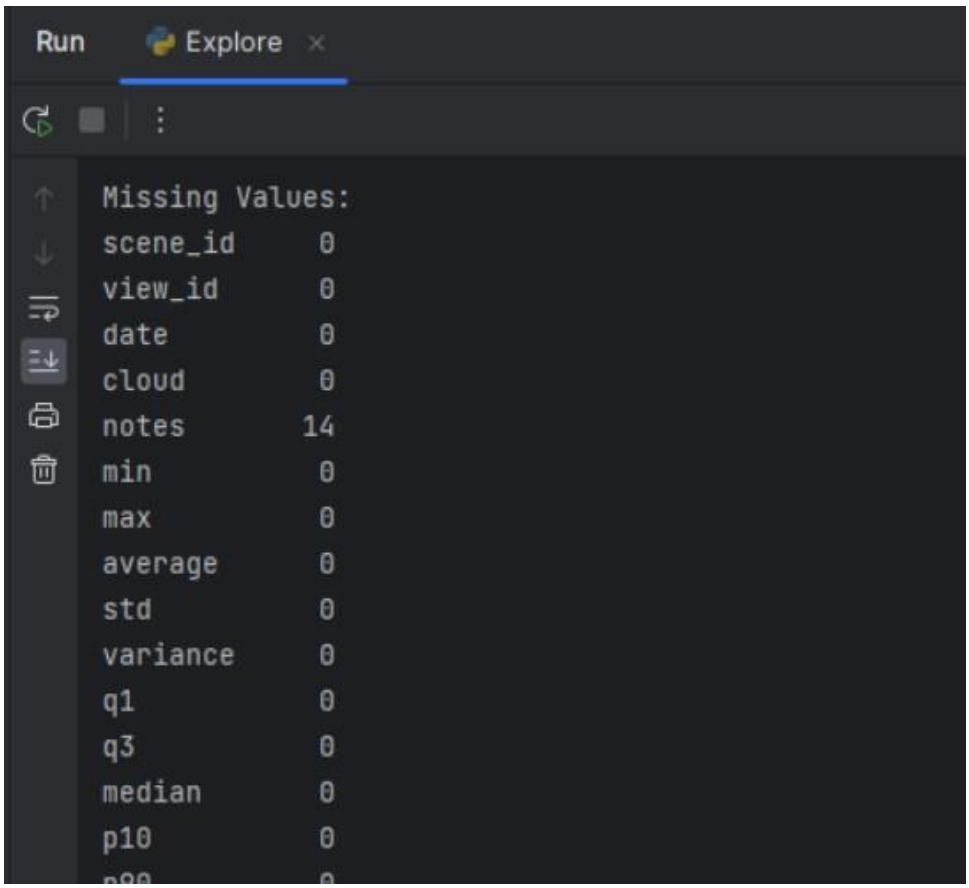


Figure 7. Checking for Missing Values

```
plt.hist(dataset['average'], bins=20, color='skyblue', edgecolor='black')
plt.xlabel('Vegetation Index')
plt.ylabel('Frequency')
plt.title('Distribution of Vegetation Index')
plt.show()


index_mean = dataset['average'].mean()
index_std = dataset['average'].std()
print("\nStatistics for Vegetation Index:")
print(f"Mean: {index_mean}")
print(f"Standard Deviation: {index_std}")
```

Figure 8. Code for visualization of the distribution of NDVI

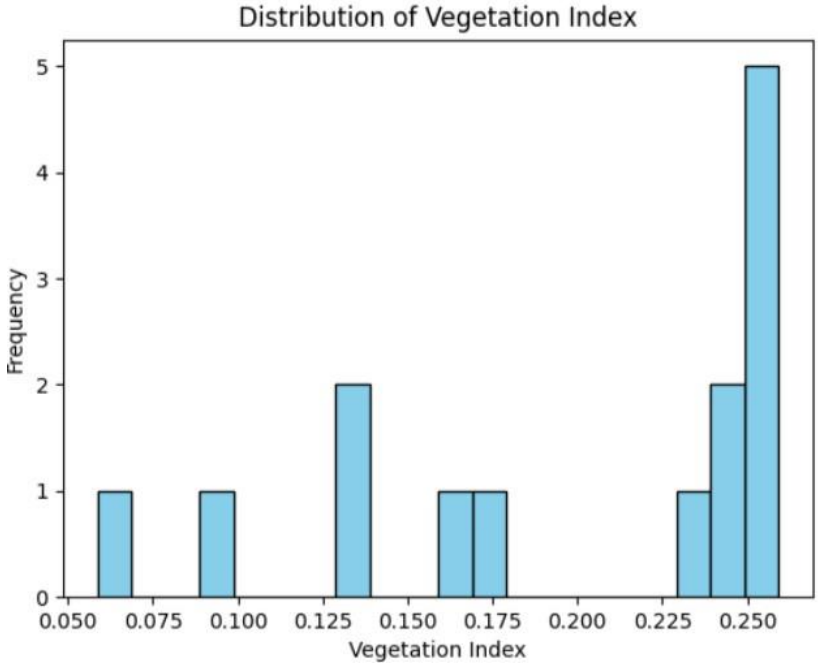


Figure 9. Histogram of Distribution of NDVI

Data Wrangling

To prepare the data for analysis, we handled missing or erroneous values through appropriate methods such as imputation or removal. Additionally, we normalized or standardized the numerical features as necessary for machine learning models. Feature engineering was conducted based on domain knowledge, which involved extracting additional features from the 'date' column (Figure 10).

```
data['date'] = pd.to_datetime(data['date'])
data['month'] = data['date'].dt.month
data['day'] = data['date'].dt.day
data['year'] = data['date'].dt.year

print("Updated Dataset:")
print(data.head())
```

```
Run    Explore
C:\Users\soc\AppData\Local\Programs\Python\Python39\python.exe C:\Users
Updated Dataset:
                    scene_id                 view_id  ... day  year
0  S2A_tile_20220409_42UXB_0   S2/42/U/XB/2022/4/9/0  ...   9  2022
1  S2B_tile_20220514_42UXB_0  S2/42/U/XB/2022/5/14/0  ...  14  2022
2  S2B_tile_20220524_42UXB_0  S2/42/U/XB/2022/5/24/0  ...  24  2022
3  S2B_tile_20220616_42UXB_0  S2/42/U/XB/2022/6/16/0  ...  16  2022
4  S2B_tile_20220716_42UXB_0  S2/42/U/XB/2022/7/16/0  ...  16  2022

[5 rows x 18 columns]

Process finished with exit code 0
```

Figure 10. Normalising the data

Machine Learning Model Building

For analysing the data, we chose a regression analysis approach to predict a numerical target based on the features. Initially, we split the dataset into training and testing sets, separating the features (X) from the target variable (y). Next, we trained a machine learning model, specifically a simple linear regression model, as a demonstration. We also explored hyperparameter tuning for the linear regression model using GridSearchCV from scikit-learn to optimize its performance.

Model Evaluation

To assess the performance of the machine learning model, we evaluated it using regression evaluation metrics such as Mean Absolute Error (MAE), Mean Squared Error (MSE), and R- squared (R2) Score (Figure 11). This evaluation was conducted for both the original model and the model after hyperparameter tuning. The evaluation metrics were calculated using the test set and its corresponding true target values, allowing for a comprehensive comparison of model performance.

```
Best Hyperparameters: {'fit_intercept': True, 'positive': False}
Evaluation Metrics for the Original Model:
Mean Absolute Error: 0.0027161245314286536
Mean Squared Error: 1.3297936156408561e-05
R-squared (R2) Score: 0.9923736664329551

Evaluation Metrics for the Best Model (with hyperparameter tuning):
Mean Absolute Error (Best Model): 0.0027161245314286536
Mean Squared Error (Best Model): 1.3297936156408561e-05
R-squared (R2) Score (Best Model): 0.9923736664329551

Process finished with exit code 0
```

Figure 11. Mean Squared Error (MSE) and R-squared (R2) Score results

The MSE indicates that the model's predictions are close to the actual values. However, further graphical analyses, such as residual plots and quantile-quantile plots, would provide deeper insights into the model's behaviour.

Linear regression proves effective in understanding temporal trends in NDVI data, with a low Mean Squared Error (MSE) indicating a good fit. Despite an unsuccessful attempt to analyse feature importance, linear regression achieved an impressive R-squared (R2) score of approximately 0.99, indicating a strong correlation between features and the predicted 'average' vegetation index. Insights from feature importance analysis revealed significant factors influencing the vegetation index prediction, although computation limitations hindered comprehensive analysis.

Conclusion

This paper presents an analysis of vegetation health utilizing the Normalized Difference Vegetation Index (NDVI) as a remote sensing tool. Leveraging time-series NDVI data obtained from a reliable platform, Python is employed for data processing and analysis. The methodology involves the application of linear regression to identify temporal trends in the NDVI dataset, given its continuous nature and the need for a straightforward yet effective model. Our approach encompasses data acquisition, parsing, and preprocessing, with particular emphasis on date transformation for regression modeling.

The high R-squared (R2) score validates linear regression's efficacy in predicting vegetation indices. However, challenges in feature importance analysis underscore the need for robust methodologies. Nonetheless, these findings emphasize the potential of linear regression in accurately forecasting vegetation indices, offering valuable insights for future research.

Opportunities exist for improvement through exploring more sophisticated models like polynomial regression or time-series models to capture nuanced patterns. This study lays the groundwork for further research to enhance our understanding of vegetation dynamics and distribution.

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FIRE SAFETY WHEN TRANSPORTING ELECTRIC VEHICLES BY RO-RO SHIPS

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Abstract

More that 80% of world trade is transported by sea. Ships are the primary means of transporting cars around the world as well. Most often, this is done with specialized ships called Ro-Ro (Roll on-Roll off), and sometimes, when it comes to individual units, in containers. One of the main concerns during such transportation is the fire safety of the ships. At the same time automotive technology is changing, electric powered vehicles are increasingly displacing internal combustion engines. In the last decade, the production of electric and hybrid cars has grown significantly, which has also led to an increase in the volume of their transportation. However, this also brought a new challenge - the risk of fire caused by their batteries malfunctioning. The danger of fire associated with lithium-ion batteries is well known and there have been quite a few such cases in recent years. The idea of this study is to highlight the conditions of carriage, the fire safety measures on board the ships, as well as the ways of fighting a possible fire.

Keywords: electric vehicles, Ro-Ro ships, maritime transportation, fire safety, fire fighting

Introduction

The global electric vehicle market worldwide was valued at USD 388.1 billion in 2023 and is expected to reach USD 951.9 billion by 2030 [1]. Most of these vehicles are shipped by sea. The increasing popularity of electric vehicles (EVs) has transformed the automotive industry and, consequently, the logistics of transporting these vehicles across the seas. Roll-on/Roll-off (Ro-Ro) ships are a common choice for shipping large numbers of vehicles, including electric ones [3].

Transporting battery-powered electric vehicles (BEVs) by Ro-Ro ships requires careful consideration of fire safety measures due to the presence of lithium-ion batteries. These batteries are commonly used in EVs due to their high energy density, but they can pose unique fire safety challenges and safety concerns if mishandled or damaged.

Basically the likelihood of fires for BEV, as well as the combustion temperatures or the heat release rate are not higher than for conventional vehicles with internal combustion engines, however, the consequences of a BEV fire can be higher. There are some risks associated with BEVs fires onboard: high voltage shocks, direct jet flames, fires develop in intensity quickly and rapidly reach their maximum intensity (typically within 2-3 minutes), gas explosion (if the released gas accumulates for a while before being ignited), once established fires are difficult to stop/extinguish [2]. Unfortunately such fires lead to very serious consequences and even to total loss of ship (Fig. 1).

Fig. 1: Fire on m/v "Fremantle Highway"

One of the main risks of breaking out a fire is when a battery cell goes into thermal runaway. This is a phenomenon that can occur in certain types of batteries, including lithium-ion batteries, and refers to an uncontrolled, self-accelerating increase in temperature within the battery cell or pack. It is a highly critical condition that can lead to overheating, release of flammable gases, and, in extreme

cases, fire or explosion. Thermal runaway typically begins with a localized thermal event, such as a short circuit or a failure within the battery cell which can be caused by physical damage, manufacturing defects, overcharging, over-discharging, exposure to high temperatures, or other factors that disrupt the normal operation of the battery.

Fire precautions when transporting EVs

Pre-loading inspection: Inspection of intended cargo at port should begin preferably before the loading process because vehicles in movement represent a hazard. The total identification of all fire hazards is not possible at this stage. Electric vehicles which are damaged in any way that may impact on the battery system should not be accepted for loading. Where a lithium battery installed in a vehicle is damaged or defective, the battery shall be removed. If the battery is not removed, the vehicle should not be accepted for transport.

Stowing and securing: EVs are expected to be on average 25% heavier than conventional vehicles, therefore appropriate considerations should be made in relation to loading limitations and stability calculations [4] Some battery powered vehicles have a lower ground clearance than internal combustion engine vehicles. This means they are more susceptible to damage from ramps during boarding. Care should be taken in identifying these vehicles before boarding to ensure damage is not sustained to the battery. Physical damage of the battery can lead to thermal runaway; a damaged high-voltage battery can create rapid heating of the battery cells as well. BEVs which have been damaged should not be loaded. [2]

Stowage of BEVs should ensure that electric vehicles are securely stored and properly contained to prevent movement and collisions during transport, allowing the crews direct access to the vehicles so they can respond quickly and effectively in an emergency. Extreme temperatures can affect the performance and safety of lithium-ion batteries. During transportation, efforts should be made to avoid exposing BEVs to temperature extremes. The cars should be stowed in designated areas that are away from machinery spaces, emergency equipment, dangerous goods, and passengers including escape routes and muster points for passengers.

The intended cargo areas shall be with fire containment features to prevent the spread of a fire from one vehicle to another with installed fire-resistant barriers and materials to isolate potential fire hazards. In enclosed or partially enclosed vehicle decks should consider stowage of BEVs taking into account the risks of toxic and potentially explosive gases released during fires.

Charging (DC or AC) of BEVs on board: Charging the battery while onboard a vessel can increase the likelihood of a thermal runaway fire, therefore charging of BEVs while onboard should be avoided, unless a comprehensive risk assessment is carried out and the relevant risk control measures are implemented. Appropriate control measures should be in place, charging stations for BEVs while enroute should be installed in compliance with the SOLAS regulations II-1/45 and II-2/20.3. [5] There are further guidance and detailed recommendations for charging stations on board ships in different international documents [6, 7].

Fire patrols: The fire patrols frequency and procedures can vary significantly from one shipping operator procedure to another. First fire patrol has to be executed preferably directly after departure, then every hour for a RoPax ship (transporting passengers as well) or every watch for RoRo ships. More frequent patrols shall be carried out on decks loaded with more potential hazardous cargo as EVs. Crew members who conduct safety patrols of the vehicle decks should be made familiar with the early signs of thermal runaway and if possible equipped with thermal handheld detectors. They have to wear proper personal safety equipment and “press to talk” type of portable VHF/UHF radios that leaves both hands free.

Fire patrols should pay special attention and look for evidence of battery coolant leakage, smoke or heat from the areas of vehicles where a battery is normally located, for example, the underside. They should also listen for “popping sounds” which may be indicative of a potential thermal runaway event. On periodically intervals, specified by company regulations, the crew shall inspect the cargo for lashing arrangements failure (especially with bad weather forecast) and take corrective measures, if necessary.

Fixed fire-detection system: Fixed fire detection systems provide continuous monitoring of the vehicle deck and play a crucial role in mitigating the risks of fires. By providing early and accurate detection of potential fire threats, these systems contribute to the overall safety of maritime operations. The control panel of these systems is positioned on the ship's Bridge and is integrated with automated alert systems (Fig. 2).

Fig. 2: Bridge Fire alarm control panel

There are different types of sensors fitted to fixed fire detection systems:

a. Infrared (thermal): Infrared sensors detect changes in temperature that may indicate a thermal anomaly. These sensors provide early warning signs of potential fires before they become visible.

b. Smoke: Advanced smoke detection systems use sensitive detectors to identify smoke particles associated with smoldering fires. These systems are effective in enclosed spaces where traditional smoke detection may be challenging.

c. Flame: based on UV detectors that can quickly detect a flame's weak UV emission from a distance. Flame detectors utilize optical technologies to detect flames as they emit electromagnetic radiation in the infrared (IR), visible light, and ultraviolet (UV) wavelengths depending on the fuel source.

d. Gas: Gas detection systems can identify gases released during a thermal runaway event. Early detection of specific gases associated with battery fires enables rapid response.

Some of sensors are connected to suppression fire fighting systems to automatically activate them.

When transporting BEVs, the fixed detection systems have some drawbacks: smoke detectors on the vehicle decks may take some time to activate as the smoke flow from the thermal runaway can be prevented from reaching detectors due to the physical design of the vehicle decks and the airflow created by ventilation systems; flame detectors are designed to detect the infrared radiation of fires, so they are activated by the presence of flames.

A principle of utmost importance is all fire-detection system alarms to be treated seriously and assumed to be real until they are verified as false.

3. Fire-fighting EVs fire

Establishing a comprehensive emergency response plan is essential in the event of an incident involving thermal runaway during transportation. Emergency responders should be equipped with the knowledge and tools to handle potential battery-related incidents, including fires or overheating.

Once the fire has spread to the battery, the fire becomes difficult to extinguish because it is sealed, generates oxygen on its own and also it is difficult to direct extinguishing agent to the generated flame as it is the underside of the car. An adequate step would be breaking the burning vehicle glass and spraying water onto its floor and same for the adjacent vehicles (to prevent spreading the fire). At same time practice has shown that allowing the battery to burn itself out has shown to be an effective means to handle the situation. Due to the longer duration of the fire and, especially when

round cells are used in the battery modules causing risk of burning battery parts flying away, there is a higher risk of the fire spreading.

Common means for fire fighting on ships are:

Fire extinguishers – for BEV fire it is preferably using dry chemical powder or CO_2 types.

Fire Blankets or Shields: large sizes fire-resistant blankets, designed to be placed above vehicles in order to limit the oxygen supply to a fire. Deployment fire-resistant blankets or shields to contain and isolate the affected BEV can help prevent the spread of flames and protect nearby vehicles or equipment from heat exposure. These fire blankets may be best suited as a precautionary measure deployed where a vehicle has been identified as being at increased fire risk e.g., if battery coolant is found leaking during routine fire patrol. While vehicle fire blankets will contain flame, the thermal runaway event will continue. [8].

Main fire system (Low pressure system) – The system is using sea water and consists of fire pump, fire lines with hydrants, hoses and nozzles. When fighting a lithium-ion battery vehicle fire with water, substantially higher quantities of water are required in comparison to an internal combustion vehicle fire and the water must also be applied for a longer period. It is not possible to stop a thermal runaway in a single battery cell, but with a large amount of water it is possible to stop the propagation to adjacent cells [9]. Without intervention (cooling) the internal battery temperature will continue to rise and with this the potential for a fire to spread and an explosion to occur if the resultant gases are allowed to build-up in the space. The only way to cool the battery is to use large amounts of water, sprinkler systems can help to contain the spread of fire, but have no cooling effect on the battery, which is usually installed in the underbody of the vehicle. In the event that a BEV connected to charging station becomes involved in fire, the incident shall be treated as an energized electrical fire; therefore the electrical supply of charging unit shall be turned off before attacking with water.

When using a copious amount of water for extinguishing BEVs fire or for cooling-down a special attention should be paid to ship's stability affected by additional weight and free surface influence. The stability needs to be continuously assessed, especially taking in consideration the amount of water on lower decks, where there are no drainage facilities to allow the free flow of water off the hull.

Fixed fire systems: Typically Ro-Ro ships rely on carbon dioxide (CO_2) systems to extinguish fires on their vehicle decks, but with the significantly increased risk of re-ignition with BEV fires, the CO_2 systems do not remove the heat generated from a fire nor extract the highly flammable gasses emitted from a BEV fire. Therefore for transportation of BEVs the ships should be fitted with different fixed systems, such as **Fire suppression systems**. Upon detection of a potential fire, these systems can trigger appropriate suppression measures, such as water mist or specialized agents. Water mist systems can be effective in cooling overheated batteries and suppressing fires. These systems release a fine mist of water, which evaporates quickly and absorbs heat, helping to cool the battery and prevent further thermal runaway. As specialized agents suppression systems use high-fog system, high-expansion foam, Nitrogen, exhaust gases (inert gas system), Halon, Freon, HFC-227ea, FM 200 (HFC 227), Novec 1230, aerosols. Fire suppression extinguishing systems if applied quickly after the detection and verification/confirmation of a fire have worked successfully to fight fires on board Ro-Ro ships. Upon discovery of fire in a cargo deck, immediate preparation for using ready the fixed fire extinguishing system must be. If the fire has already spread upon discovery and/or cannot be contained or controlled with continuous cooling, then this system must be immediately activated (released).

Water mist: can be used to scrub smoke and fire gases and reduce the amount of toxic substance in the air either through an overhead discharge (mist sprinkler) or portable devices that can be connected to fire hoses ("mist nail"). It can also lower the temperature, thus improving accessibility to the fire. (Fig. 3)

Fig. 3: Water mist in action; "Mist nail" (Lance)

Very important point in initial firefighting is ventilation control and creating a "Positive Pressure Ventilation". Control of air supply (intake of outside air) and exhaust (discharge of combustion products to overboard) has some major advantages – will clear toxic gases, protect emergency team from heat and smoke, etc. In order ventilation to be properly managed, team leader should inform the Bridge about accumulated smoke escape direction. [10]. The master should maneuver the vessel to control the flow of smoke and gases from the BEV fire away from passengers and crew as the smoke and gases are both toxic and potentially flammable.

In BEVs fires there is also an elevated risk of re-ignition until the chemical chain reaction exhausts itself, even hours after apparently put out of the fire. A fully-equipped fire-fighting team should be monitoring the fire site and be able to respond immediately until the vehicle is removed from the ship.

Carriage of Electric Vehicles (EVs) in Containers: The growing trend to prevent global warming has led to carriage of BEVs in containers as well, which may present additional risks to the vessel. These risks should always be properly identified, evaluated, and mitigated to being as low as reasonably possible. The current IMO regulations do not specify any additional requirements for the carriage of EVs in containers, treating them as a general IMDG cargo (the International Maritime Dangerous Goods (IMDG) Code classifies an EV under battery powered vehicles or battery powered equipment as Class 9, UN no. 3171). As the BEVs are loaded as general cargo, this may propose serious threats if they are placed next to IMDG cargo. A key concern with the containerized shipment of EVs is the inability of the ship's crew to verify the condition of the EVs within the containers. This issue arises from the shipper being responsible for loading and securing the EVs in the containers, an activity over which the "carrier" (shipowner) has no control. The ship's crews are also unable to monitor the EV unit itself during the voyage. The carriage of second hand EVs has a potentially higher risk as the quality of the vehicle itself and safety checks on its condition may not be of a standard equivalent to those applied to the shipment of new vehicles. Stowage and segregation should meet the requirements of the IMDG Code and the vessels Document of Compliance (DoC) for the Carriage of Dangerous Goods. Additionally, where possible, consideration should be given to the following: stowing containers carrying EVs away from the accommodation block, so that toxic gasses, if released, do not enter crew accommodation; on easily accessible lower tiers on deck and at easily accessible outboard slots. A fire onboard a container ship can have catastrophic outcomes, endangering safety of life, causing serious environmental pollution and resulting in significant financial losses. Therefore the crew need to additional precautions: **Physical monitoring** patrols (weather permitting) of containers carrying BEVs, and additional and special equipment such as hydro pen, thermal imaging cameras and water lancing equipment. [11]

Crew training: It is very important the crews are aware that fighting a BEV fire requires a different technique to that employed in fighting a conventional fire onboard. Directly attacking the fire with water hoses and breaking open the battery requires extensive training and practice. Additionally to common fire-fighting trainings and drills, for transporting BEVs all responsible personnel on board should receive specialized training on handling electric vehicles, with a focus on the safe transport of lithium-ion batteries. Training should cover which hazards are connected with these cars, proper loading and unloading procedures, securing the vehicle during transport, and

responding to emergencies. One of the scenarios should be joint actions with a coastal fire brigade. Well planned drills and training exercises that cover a full range of scenarios and situations are valuable in ensuring crew members are aware of their responsibilities and will ensure familiarity with all equipment on board. Drills should be as realistic as possible and various scenarios should be allowed to play out from detection onwards and cover both successful outcomes and non-successful scenarios (abandoning the ship) (Fig. 4).

Fig. 4: Fire and sinking of m/v "Felicity Ace"

4. Conclusions

Currently there are no requirements from the International Maritime Organization (IMO) for transportation of electric vehicles on Ro-Ro vessels. It is expected that IMO will announce new safety standards for transporting electric vehicles in 2024. The guidelines could include specifications on how fully a battery can be charged. The IMO said that chemicals for extinguishing fires, special fire blankets, equipment such as battery-penetrating jet extinguishers and bigger gaps left between electric vehicles on ships could also become mandatory.

Overall, ensuring the safe transport of electric vehicles involves a combination of engineering safeguards, compliance with regulations, proper training, and effective emergency response planning. By implementing proper fire safety measures, Ro-Ro ship operators can enhance the safety of transporting electric vehicles and mitigate the risks associated with lithium-ion battery fires.

In the case of an accident or damage to an EV during transport, it is crucial to follow proper procedures for handling damaged vehicles. This may involve isolating the damaged vehicle, consulting with emergency responders, and taking measures to prevent further damage to the battery.

After any fire incident a thorough analysis shall be conducted to understand the root causes, evaluate the effectiveness of the fire extinguishing activities and identify opportunities for improvement in both fire systems design and emergency response procedures.

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GEODYNAMIC STRESS STUDY BASED ON GRAVIMETRIC STUDIES AND ECOGEO-PHYSICAL RISK ASSESSMENT (IN THE CASE OF THE KARADAG GAS RESERVOIR)

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Abstract

The President of the Republic of Azerbaijan, Mr. Ilham Aliyev, instructed SOCAR to increase the volume of the Garadag and Galmaz gas reservoirs to 6 billion cubic meters. Currently, scientific and practical research is being conducted in this direction. In order not to be ecologically dangerous in the future, the activity of gas storage facilities that have been expanded and increased in volume, the work done in the seismic risk and seismic zone, and the activity of tectonic faults should be regularly monitored. Underestimation of environmental risks and investigation of the necessary factors to avoid the danger of abnormal geodynamic stress of energy growth in layers with gas reserves is one of the most urgent problems of today.

Keywords: seismic activity, geodynamic stress, gravimetric studies.

Garadag gas reservoir is located 30 km southwest of Baku. There are mud volcanoes such as Korgoz (396 m), Baku Gulag (383 m), Garagush (389 m) and Osmanbozdag (392 m), which are sometimes active. The Garadag gas reservoir is located in a region of high seismic activity, where there are some important deep faults [1,2].

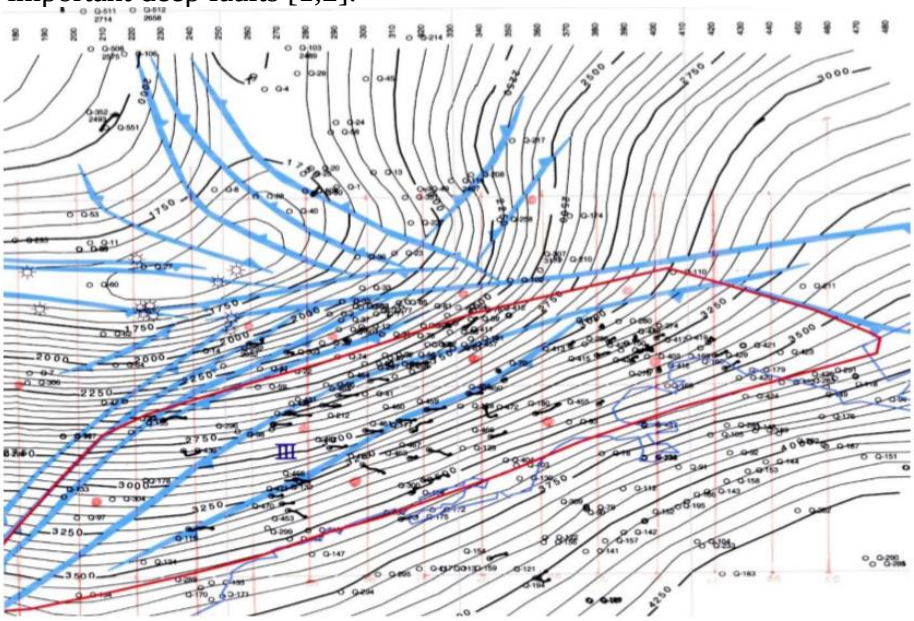

Figure 1. Location scheme of gravimetric profile

The seismic activity map of recent years shows that activity has increased in these areas (Figure 1.). Strong earthquakes in Achichay-Alat, Kura, Palmir-Absheron deep faults create a high voltage seismic hazard for Garadag and Galmaz gas fields [4,5]. The earthquake that occurred in Baku on November 25, 2000 consisted of two seismic tremors (magnitudes 5.8 and 6.2) and was accompanied by numerous aftershocks. The earthquake in the territory of the Garadag gas reservoir had a magnitude of 6-7 on the CEC-64 scale. Taking into account the above, the increase in the volume of the reservoir should be regulated, and thus it was determined that the geodynamic-tectonic changes in the depth do not cause abnormal activation of the mentioned mud volcanoes, and also do not activate these tectonic depth fractures. The maximum magnitude of earthquakes that are likely to occur in potentially strong earthquake foci located in the regions of the depth fault in the Garadag gas reservoir

area is 6.6 ÷ 7.4, the depth is H = 15-30 km, and their seismic impact on the earth's surface is calculated in the I=8-9 range depending on the depth of the foci. It is clear from the analysis that the study of the manifestation characteristics of numerous strong earthquakes of shallow depth and high magnitude occurring on the Earth's surface results in the formation of faults on the surface of Pleistocene regions. Earthquakes with a magnitude of 6.5 and a depth of 10÷15 km and stronger (M≥7.5) earthquakes occur at relatively greater depths (25÷35 km).

The reclassification of the geotectonic structure of underground gas reservoirs, which is of special importance in the development of the oil and gas industry of the Republic, is one of the main problems and is always in the focus of geologists and geophysicists. In 1986, a gas reservoir was put into operation for the first time in the Garadag field (VII Horizon). This horizon covers the southern flank of the field and is known to have had large gas reserves in the past. Therefore, regular geophysical (gravimagnometric) research is very important in this field, depending on the volume of gas injected into the reservoir [3,6].

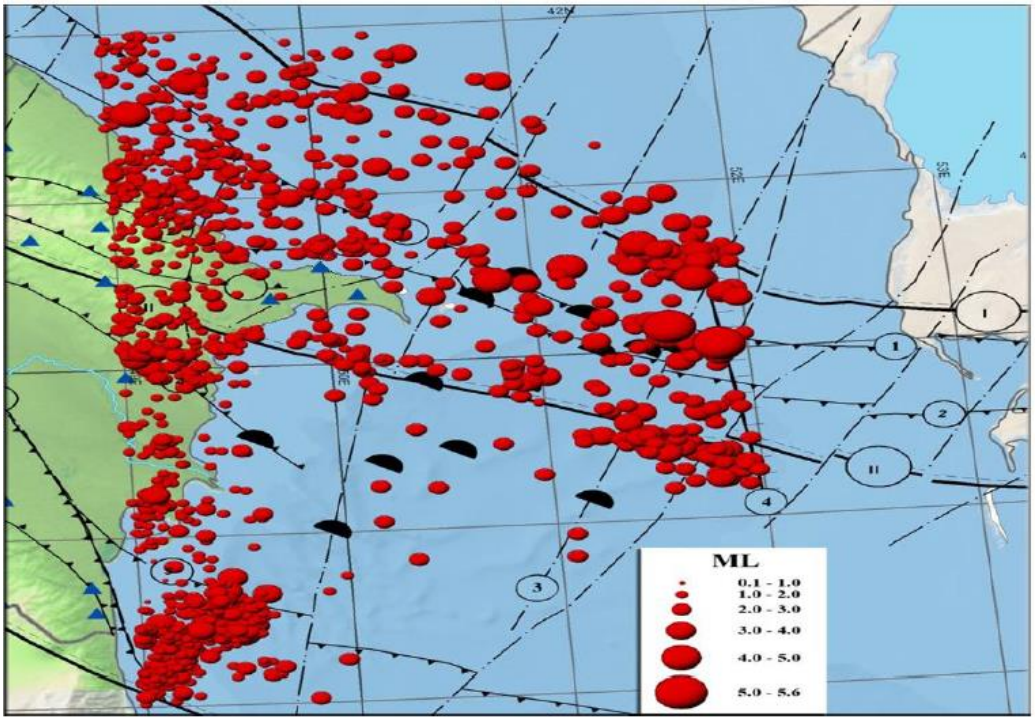

Figure 2. Epicenter map of earthquakes that occurred in the Caspian Sea and nearby regions in 2014-2016

Expanded and enlarged gas reservoirs should be regularly monitored to avoid unavoidable seismic hazards during future environmental activities. One of the most pressing issues is to pre-empt the threat that may arise from the increase of abnormal geodynamic stress energy. The territory of Azerbaijan is one of the regions with high seismic activity and there are some major deep faults that are seismically active. In recent years, there has been a sharp increase in seismic activity in the areas of the seismic activity maps. Strong earthquakes in Achichay-Alat, Kura, Palmir-Absheron fault zones create a high voltage seismic hazard for gas reservoirs.

The result. From the results and research analysis of the effects of many strong earthquake mechanisms and parameters on the Earth's surface, it is known that earthquakes have great power and their depth is relatively small, which leads to the formation of cracks at different levels in the Pleistocene zones. At this time, the hermeticity of the gas reservoir may be broken and the process of gas flowing to the surface (leakage) may occur. In order to prevent an environmental disaster, the potential impact of earthquakes that may occur in the research areas and in the areas near the gas reservoir should be investigated in detail. Taking into account the geological and tectonic structure of the gas tank, gravimetric observation should be carried out in the area and adjacent areas. Based on the seismic and gravimetric data, it is necessary to create 10-12 observation points for the purpose of conducting gravimetric experiments, taking into account the shortcomings and blocks in the research

area. In order to solve geological and technical issues in the reservoir and adjacent areas, carrying out gravimetric profiling works in parallel with magnetometric observation works (Figure 2), creating local anomaly (tension) maps for different levels, taking into account the change of density effect, increasing the volume of injected and extracted gas and or mitigation as well as environmental risk assessment is recommended.

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CORROSION OF UNDERGROUND EQUIPMENT IN OIL PRODUCTION WELLS

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КОРРОЗИЯ ПОДЗЕМНОГО ОБОРУДОВАНИЯ НЕФТЕДОБЫВАЮЩИХ СКВАЖИН

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Abstract

Equipment corrosion is one of the problems encountered in oil production wells today. As the concentration of corrosive substances in water increases, the corrosion rate increases. The concentration of CO2 and H2S in water depends on pressure, temperature and salinity of water. Among them, the problem of corrosion of components of submersible pumping units in production wells, characterized by a significant amount of highly mineralized formation water in the fields, is becoming more acute. However, in recent years, this problem has led to the failure of the ESP in the well, as well as the formation of salt deposits on the surface layers of well pipes, which led to a decrease in well productivity and increased costs. When considering the hydrochemical characteristics of formation waters in the Caspian basin, it was established that the corrosion rate of oil production equipment in the fields is high. Accordingly, there is a need to use anti-corrosion methods to reduce the rate of corrosion of well equipment when developing these fields.

Аннотация

Коррозия оборудования – одна из проблем, возникающих сегодня на нефтедобывающих скважинах. С увеличением концентрации коррозионно-активных веществ в воде скорость коррозии увеличивается. Концентрация CO2 и H2S в воде зависит от давления, температуры и минерализации воды. Среди них обостряется проблема коррозии компонентов погружных насосных агрегатов в добывающих скважинах, характеризующихся значительным количеством высокоминерализованных пластовых вод на месторождениях. Однако в последние годы данная проблема привела к выходу из строя УЭЦН в скважине, а также образованию отложений солей на поверхностных слоях скважинных труб, что привело к снижению продуктивности скважин и увеличению затрат. При рассмотрении гидрохимических особенностей пластовых вод Прикаспийского бассейна установлено, что скорость коррозии нефтедобывающего оборудования на месторождениях высока. Соответственно, возникает необходимость использования антикоррозионных методов для снижения скорости коррозии скважинного оборудования при разработке этих месторождений.

Keywords: corrosion, operation, equipment, formation water, mineralization.

Ключесвые слова: коррозия, эксплуатация, оборудование, пластовая вода, минерализация.

В мире коррозия ежегодно приводит к колоссальным убыткам, причем основной ущерб, причиняемый ею, заключается не в потере металла как такового (в мире до 20 % металла в год «уходит» именно в коррозионные отходы), а в разрушении дорогостоящих изделий и

оборудования. Еще больший ущерб наносят косвенные потери при простоях оборудования при замене прокорродировавших деталей и узлов, утечке нефти и газа, нарушении технологических процессов. В нашей стране нет официальной статистики, которая отражала бы экономический ущерб от коррозии, но, по некоторым оценкам, он составляет не менее 5 % от ВВП [1].

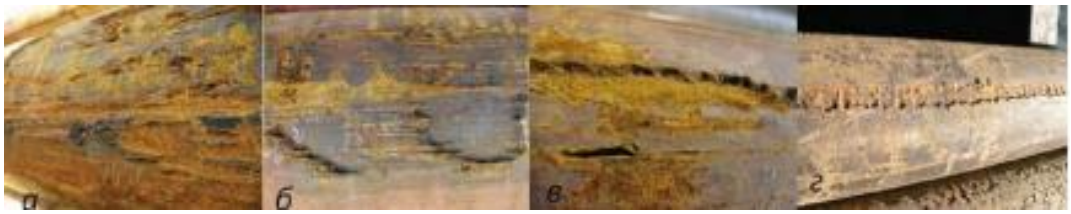
Коррозионные процессы отличаются широким распространением и разнообразием условий и сред, в которых они протекают. Поэтому пока нет единой и всеобъемлющей классификации встречающихся случаев коррозии, хотя многие научные школы и различные фирмы используют различные классификаторы коррозионных поражений. В частности, по типу агрессивных сред, в которых протекает процесс разрушения, коррозию можно отнести к следующим типам: газовая коррозия, атмосферная коррозия, коррозия в неэлектролитах, коррозия в электролитах, подземная коррозия, биокоррозия, коррозия блуждающим током [1].

При контакте добываемой нефтегазоводяной смеси со скважинным оборудованием возможно, как отмечалось ранее, проявление следующих видов коррозионного разрушения: общая (неравномерная) коррозия; локальная.

Основными видами локальной (местной) коррозии скважинного оборудования являются: питтинговая (язвенная) коррозия; коррозия пятнами; коррозия в виде бороздок (канавок); коррозия в виде плато; мейза-коррозия; контактная коррозия; подпленочная коррозия; гальваническая коррозия.

а) общая коррозия; б) питинговая коррозия; в) коррозия пятнами

Рис. 1. Внешний вид деталей, пораженных различными видами коррозии [2].



а) коррозия бороздками; б) коррозия в виде плато; в) мейза-коррозия; г) контактная коррозия

Рис. 2. Внешний вид деталей, пораженных различными видами коррозии [2]

Контактная коррозия – это процесс, протекающий между двумя разнородными по электрохимическим характеристикам металлами, например между броней кабеля и корпусом ЭЦН или телом НКТ. Результатом процесса могут быть локальные коррозионные повреждения как корпуса ЭЦН в виде язв, расположенных цепочкой, или язв, слитых воедино, так и брони кабеля [2].

Проблема коррозии составных частей погружного насосного агрегата в наших эксплуатационных скважинах, характеризующихся значительным содержанием высокоминерализованной пластовой воды, существует уже давно. Однако в последние годы она встала особенно остро, когда средняя наработка УЭЦН в скважине достигла, а затем превысила 1000 суток. Если раньше, при существенно меньших наработках, основными факторами приводящими к отказу УЭЦН были солеотложение и засорение механическими примесями, то с ростом наработки доля отказов УЭЦН по причине коррозии насосного

оборудования неуклонно возрастает. При анализе базы подъемов подземного оборудования ШГН и ЭЦН за 2000–2015 гг. Было замечено, что в 12 % случаев на различных частях оборудования присутствовала коррозия в той или иной степени. Коррозия оборудования связана с воздействием сразу нескольких факторов: – повышением обводненности продукции скважин; – увеличением выноса солей и механических примесей; – повышением скорости движения откачиваемой жидкости; – увеличением токов и напряжений в кабельных линиях и погружных электродвигателях [3].

Проблема коррозии металлических труб остро стоит в области бурения и эксплуатации нефтедобывающих скважин. Технический прогресс тормозится из-за ряда нерешенных проблем с коррозией. В результате коррозии ежегодно теряются десятки миллионов тонн металлов, приходит в негодность огромное количество аппаратуры, оборудования, приборов, инструментов.

Самыми распространенными факторами, влияющими на техническое состояние и срок службы стальных труб, являются коррозионно-агрессивное влияние скважинной среды и циклические нагрузки, которые испытывают трубы в процессе эксплуатации. Химический состав пластовых вод нефтяных и газовых месторождении разнороден и классифицируется по характерным признакам. Состав и свойства пластовых вод в процессе разработки месторождений изменяются и зависят от снижения давления и температуры, а также от контакта с другими пластовыми водами, что приводит к дегазации и нарушению ионного обмена. Природная пластовая вода содержит в себе множество различных солей и их соединений. Эти соли могут оседать на стенках труб, иными словами-солеобразование прдставляет собой отложения, закупоривающие перфорационные каналы, обсадные и эксплуатационные колонные НКТ, клапаны, засоряя, таким образом скважину и препятствуя потоку жидкости [4].

При рассмотрении гидрохимических особенностей пластовых вод подсолевого комплекса Прикаспия многие исследователи отмечают наличие в разрезе комплекса инверсионной зональности . Наиболее минерализованные воды (с минерализацией свыше 300 г/л) выявлены в кунгурских отложениях. Они были вскрыты и опробованы единичными скважинами, поскольку залегают в виде отдельных линз и не формируют единого водоносного горизонта. Притоки воды получены из невыдержанных по простиранию и в разрезе гипсоангидритовых и карбонатных пропластков, встречающихся на глубинах до 4500 м, а также из самой верхней части разреза над сводами соляных куполов из отложений кепрока. Они могут быть отнесены как к подошве надсолевых отложений, так и к кровле подсолевого комплекса [5].

На Карачаганаком месторождении водоносность кепрока установлена в скважинах 2-рк и 9-ртк, пробуренных для технологических нужд под строительство подземных хранилищ нефтепродуктов в толще каменной соли. В скважине 2-рк из интервала 321–325 м получен приток крепких рассолов с минерализацией 308 г/л, хлоркальциевого (ХК) типа, плотностью 1,198 г/см3 . В скважине 9-ртк с глубины 953,5 м получен переливающий приток дебитом 144 м3 /сутки при минерализации 344,6 г/л. Плотность рассола составила 1,244 г/см3 , а избыточное давление превысило 5,0 МПа [6].

Мы заметили, что высокая минерализация пластовой воды и большое количество солей в ней приводят к коррозии скважинного оборудования при разработке скважин. Коррозионная активность пластовых вод месторождений Прикаспия обусловлена содержанием в ней агрессивных веществ (Cl, H_2S и CO_2), каждое из которых по отдельности способствует ускорению коррозии. Именно поэтому при разработке месторождений, расположенных в Прикаспийском бассейне, необходимо использовать методы предотвращения и борьбы с коррозией оборудования.

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COMPARISON OF EXISTING MANAGEMENT METHODS AND STRUCTURES OF ENTERPRISE MANAGEMENT WITH OPTIMAL AGGREGATION

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Abstract

Currently, there are many management models for enterprises. Some of them focus solely on personnel, while others deal with the management processes of production. In this paper, we aim to compare existing models with the one that we believe has an advantage over them. This is the model of optimal aggregation, which can dynamically adjust to changes in models in real-time.

Keywords: Optimal aggregation, model, competition, variability, analysis.

Introduction

Every manager faces the challenge of choosing the levers to control the process, namely how to use management strategies and utilization technologies. The tool that allows this is a management model. The concept of a management model allows us to uncover and manage the main features of the management system.

The necessity of modeling a management situation arises from the complexity of most management problems, as well as the difficulties or impossibility of conducting experiments in real conditions. The main characteristic of a model is simplifying the real situation by removing details that are not essential to solving the problem. Thus, the use of models contributes to increasing managers' ability to perceive management situations and problems adequately[1].

A model (from Latin modulus - measure) is a conditional representation of the object of study, which replaces the original and reproduces it in a form that allows for obtaining new knowledge. The model is developed to reflect the characteristics of the object (elements, relationships, structural and functional properties) that are essential for conducting research. Therefore, modeling is associated with simplifying the prototype and abstracting from certain properties and features.

1.There are several types of models:

Problem model, developed by V. Franchuk, sets the goals of the organization depending on the problems that arise. The type of management structure is determined by the nature of these problems, and the model itself is responsible for the adaptive response to disturbances and the development of the organization aimed at solving problems[2].

Process model views the organization as a flow of production processes linked to cycles of development and degradation. The development of the organization occurs as constant transformations, taking into account the relationship between the internal and external environment.

Conflict model, proposed by Robert Hill, aims to reduce the intensity of conflicts. The organization operates in conditions of conflicting interests of its members and has conflicting goals.

The modern organizational model (by Khyschenko) envisages autonomy, freedom, and responsibility, where the system transitions to a state of self-development.

International model, as proposed by C. Bernard, views the organization as a system of interaction between employees bringing their values and expectations into the organization.

Organizational potential model (by I. Ansoff) is based on the idea of a matrix and the pursuit of economic resource utilization and constant innovation.

Situational model, known from P. Drucker, envisages the synthesis of mechanistic and organic approaches.

Socio-technical model reveals the links between intra-group dependencies and production technology.

Cybernetic model is based on building a mathematical model of the organization taking into account feedback.

Human relations model views the organization as a community, where the main role is given to informal organization.

Natural model of the organization is considered as an objective process that self-improves, while management and control are absent.

Each of these models considers the economic entity from different perspectives. Most researchers believe that the basis for creating a generalized management model should be the concept of an organization as a systemic integrator, which combines various socio-economic processes and achieves effects through systemic multiplicative effects.

2.Analysis of production management structures and methods under conditions of primary resource depletion and demand saturation

The first global problem of today is that global food production has, for the first time in human history, exceeded global needs as a whole. There is also a saturation of demand for mobile phones, automobiles, liners, and other products. The fundamental classes of past centuries – workers and peasants – now constitute only 10-15% of the population, a drastic change compared to 100 years ago when this figure was 80-90%. Large cities are generating a new, urbanized society characterized by instability in the level and content of education across generations and other aspects[3].

The second global production problem is the saturation of demand and overproduction (not to be confused with falling incomes). An analysis of the evolution of global production over the past decade has revealed a new problem: the depletion of natural resources. Coal, oil, iron ore, and rare metals such as lithium are becoming more needed and less accessible. It is now cheaper to use recycled lithium than to produce it from ore. There is also a third alternative: finding another design and technology that does not require scarce components. Radical solutions are possible based on computer-integrated systems and technologies[4].

Logical-mathematical methods of modeling and analysis have evolved over the years, changing spontaneously according to changes in technologies and mathematical methods of production, either leading or lagging behind production systems from the level of computer systems – from pre-computer to computer-integrated technologies. New tasks and programs are presented in light of these current developments. The choice of methodology for optimal aggregation is based on the absence of alternatives. Satisfactory solutions to the problem of optimal retail management are currently unknown. Figure 1 presents a functional diagram of the "production, development ,retail ,recycling "system.

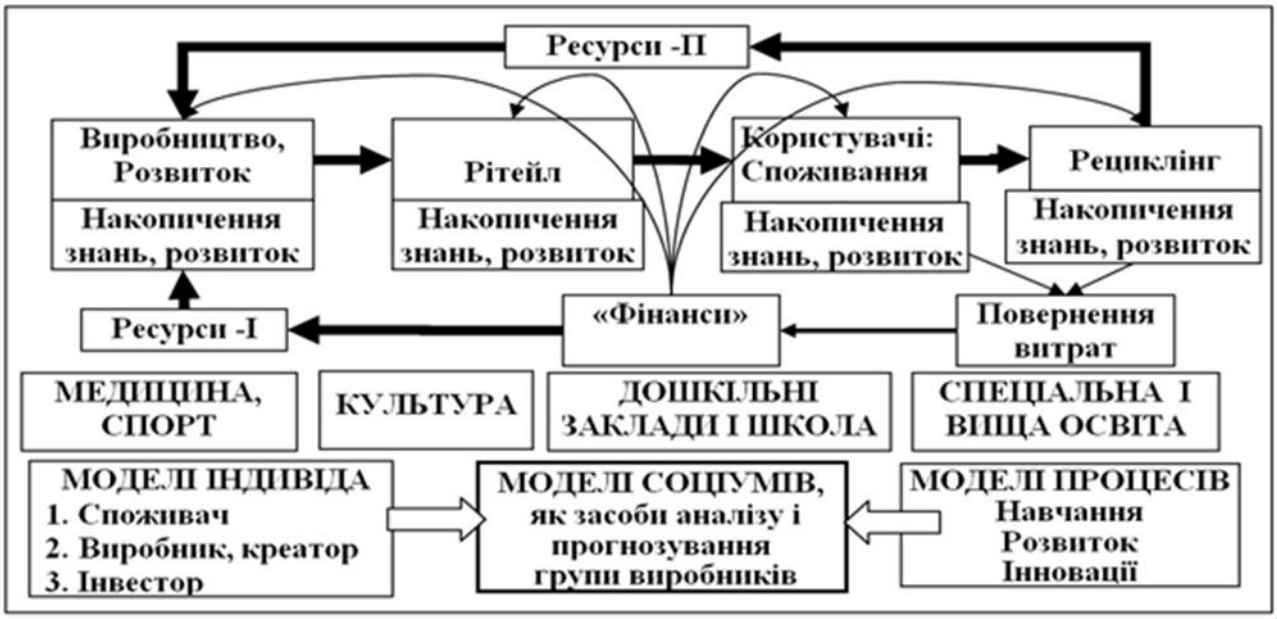

Fig.1. The object of the study is the functional diagram of the production circuit.

Conclusions

Based on the conducted research and comparisons, we can conclude that optimal aggregation effectively describes and models production processes. With optimal aggregation, we can consider both internal processes such as procurement of raw materials, tools for manufacturing goods, and personnel management, as well as external indicators such as staff training, procurement of components, and changes in product pricing policies.

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MACHINE LEARNING FOR DIABETES PREDICTION: STATISTICAL ANALYSIS AND LOGISTIC REGRESSION MODELING

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Abstract

The escalating global diabetes epidemic presents an urgent challenge for healthcare systems worldwide. With 537 million adults affected in 2021 and projections indicating a rise to 783 million by 2045, the need for early detection and effective management of diabetes mellitus (DM) has never been more critical. This paper explores the potential of machine learning (ML) to improve diabetes prediction by analyzing various patient attributes through statistical, correlation, and logistic regression modeling. The advent of these technologies has provided unprecedented opportunities for analyzing vast amounts of medical data, leading to more precise and early detection of diabetes; it highlights the effectiveness of machine learning algorithms in predicting diabetes, thereby significantly contributing to improved healthcare outcomes.

Keywords: Diabetes Prediction, Machine Learning, Statistical Analysis, Logistic Regression Health Data, R.

Introduction

In 2021, the global prevalence of diabetes among adults aged 20 to 79 reached 537 million, equating to one in every ten individuals. This figure is anticipated to climb to 643 million by 2030 and further to 783 million by 2045. A significant portion, over three-quarters of adults living with diabetes, are found in low- and middle-income countries. The disease was responsible for 6.7 million fatalities in 2021, translating to one death every five seconds, and led to healthcare costs exceeding USD 966 billion, marking a 316% increase within the past decade and a half. Furthermore, 541 million adults are identified with Impaired Glucose Tolerance (IGT), significantly increasing their risk of developing type 2 diabetes [1]. Early prediction and management are critical for preventing complications associated with the disease. Recent advancements in big data analytics and machine learning have shown promising results in improving the prediction accuracy of diabetes, leveraging complex algorithms and comprehensive data analysis to identify at-risk individuals more effectively than traditional methods.

Data Description. For the study, I used a dataset hosted on Kaggle[2]. This dataset is primarily aimed at predicting diabetes based on various patient attributes.

Table 1: Overview of the variables included in the dataset

Attributes	Definition
Gender	The gender of the individual (e.g., Female, Male)
Age	The age of the individual, in years.
Hypertension	Indicates whether the individual has hypertension (1 for yes, 0 for no).
Heart Disease	Indicates whether the individual has any heart disease (1 for yes, 0 for no).
Smoking History	Describe the smoking habits of the individual (e.g., never, current smoker).
BMI	Body Mass Index of the individual.
HbA1c Level	Hemoglobin A1c level is a blood test that measures the average level of blood glucose over the past 2 to 3 months.
Blood Glucose Level	Blood glucose level of the individual at the time of testing.
Diabetes	Indicates whether the individual has diabetes (1 for yes, 0 for no), which is the target variable for prediction.

Statistical Analysis. The dataset consists of 100,000 records. Summary statistics for the numerical variables to understand their central tendency, dispersion, and shape. This includes measures like mean, median, standard deviation, and range.

Table 2: Summary of the numerical variables

Attributes	Summary
Age	Ranges from 0.08 (likely in years, indicating infants) to 80 years, with a mean age of approximately 41.89 years.
Hypertension	7.485% of the individuals have hypertension (1 for yes, 0 for no).
Heart Disease	3.942% of the individuals have heart disease.
BMI	Varies from 10.01 to 95.69, with a mean of approximately 27.32, indicating a mix of underweight, normal, overweight, and obese individuals.
HbA1c Level	Ranges from 80 to 300 mg/dL, with a mean of approximately 138.06 mg/dL.
Blood Glucose Level	Body Mass Index of the individual.
Diabetes	8.5% of the individuals have diabetes (1 for yes, 0 for no).

Correlation Analysis. To understand the relationships between numerical variables, particularly how certain factors correlate with the target variable (diabetes), I calculated the correlation coefficients. This exploration of potential relationships helps us comprehend the linkage of these factors to diabetes, thereby identifying the features most strongly associated with the risk of diabetes. Utilizing the R programming language, I built a correlation matrix, the results of which are displayed in Figure 1.

```
> cor_matrix <- cor(data[, sapply(data, is.numeric)], use = "complete.obs")
> corrplot(cor_matrix, method = "circle", type = "lower", tl.col = "black", tl.cex = 0.6, order = "hclust",   addCoef.col = "black",  tl.srt = 45,    diag = FALSE )
```

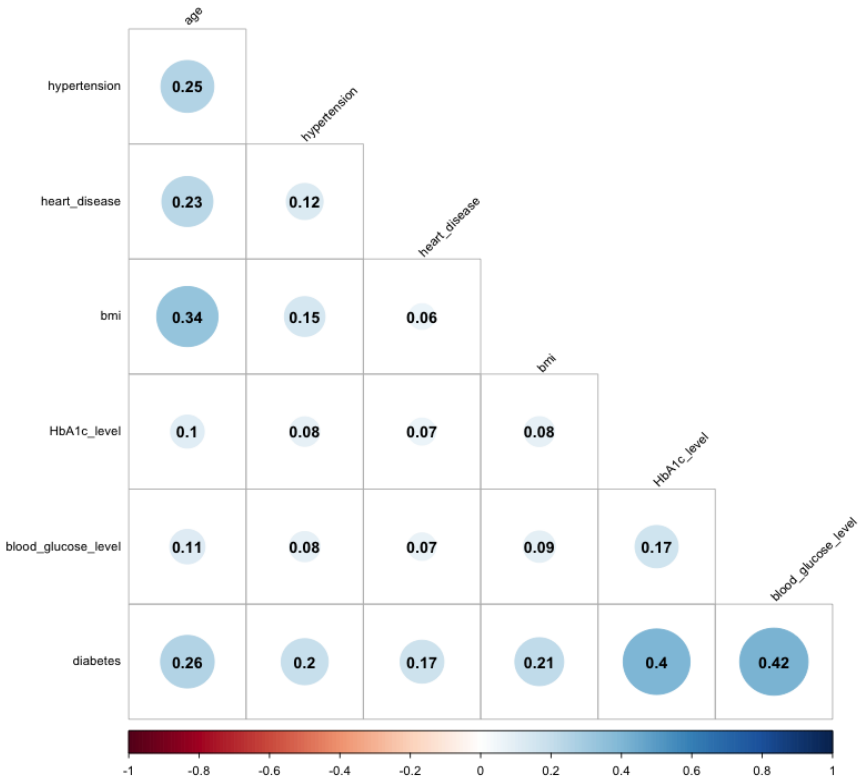

Figure 1. Correlation chart

The correlation matrix reveals several noteworthy associations:
- Age shows a positive correlation with diabetes (0.26), hypertension (0.25), and heart disease (0.23), suggesting that older individuals have higher risks.
- BMI is moderately associated with diabetes (0.21), indicating that a higher BMI might be linked to increased diabetes risk.
- Blood Glucose Level and HbA1c Level have the strongest correlations with diabetes (0.42 and 0.4, respectively), underscoring their importance in diabetes prediction.

Logistic Regression. Logistic regression, a foundational model for binary classification, was utilized in this analysis to assess the impact of various factors on the prediction of diabetes. This method is apt for scenarios with binary outcomes, such as the diagnosis of 'has diabetes' or 'does not have diabetes.' The dataset was prepared for the model by converting the 'gender', 'smoking_history', and 'diabetes' variables into categorical factors, a requisite step for their correct interpretation by logistic regression. A random seed was set to ensure the reproducibility of the results, a crucial aspect of scientific research. The data was divided into an 80% training set and a 20% testing set. This division is important for validating the model, as it is trained on one subset and tested on an unseen subset to evaluate its performance.

```
> data$gender <- as.factor(data$gender)
> data$smoking_history <- as.factor(data$smoking_history)
> data$diabetes <- as.factor(data$diabetes)
> set.seed(123) # for reproducibility
> indexes <- createDataPartition(data$diabetes, p=0.8, list=FALSE)
> trainData <- data[indexes,]
> testData <- data[-indexes,]
```

The logistic regression model was trained using the training data, with 'diabetes' as the outcome variable and all others as predictors. The model was used for predictions on the testing set following the training. These predictions, given as probabilities, were converted into binary outcomes with a 0.5 threshold—the interpretation being that probabilities above 0.5 suggest the presence of diabetes (coded as "1"), and those below indicate its absence (coded as "0"). The model's performance was then assessed through a confusion matrix, juxtaposing the predicted and actual outcomes from the testing set. A confusion matrix comprehensively evaluates a classification model's effectiveness, yielding metrics like accuracy, recall, precision, and the F1 score, each providing distinct insights into the model's efficacy.

```
> # Train a logistic regression model
> model <- glm(diabetes ~ ., data = trainData, family = "binomial")
> # Make predictions
> predictions<-predict(model, newdata = testData, type = "response")
> predictedClass <- ifelse(predictions > 0.5, "1", "0")
> # Convert predictions to a factor for accuracy calculation
> predictedClass <- as.factor(predictedClass)
> # Evaluate the model
> confusionMatrix(predictedClass, testData$diabetes)
```

As a result, the Logistic Regression model has been trained and evaluated on the dataset, yielding the following performance metrics:

```
               Accuracy : 0.9601
                 95% CI : (0.9573, 0.9628)
    No Information Rate : 0.915
    P-Value [Acc > NIR] : < 2.2e-16

                  Kappa : 0.7079
```

```
            Sensitivity : 0.9908
            Specificity : 0.6300
         Pos Pred Value : 0.9665
         Neg Pred Value : 0.8644
             Prevalence : 0.9150
         Detection Rate : 0.9066
   Detection Prevalence : 0.9381
      Balanced Accuracy : 0.8104
```

The confusion matrix and statistical analysis reveal that the logistic regression model demonstrates a high level of accuracy in predicting diabetes, with **a 96.01% accuracy rate.** The model exhibits excellent sensitivity, successfully identifying 99.08% of true positive cases (diabetes presence), and has a positive predictive value of 96.65%, indicating that positive test results are reliable. Nonetheless, specificity and negative predictive value, at 63% and 86.44% respectively, suggest there is room for improvement in correctly identifying individuals without diabetes.

Conclusion

The deployment of logistic regression for diabetes prediction within this study has presented an effective model for binary classification, showcasing a commendable accuracy rate of 96.01%. This accuracy, alongside the model's high sensitivity and positive predictive value, emphasizes its capability to detect the presence of diabetes among individuals reliably. However, the specificity and negative predictive value indicate potential areas for refinement, especially in reducing false positives and improving the identification of non-diabetic individuals. The study's findings point towards the viability of logistic regression as a tool in the medical field for early diabetes detection. However, they also highlight the need for ongoing model optimization to enhance its predictive precision further. Overall, integrating machine learning techniques such as logistic regression in healthcare can significantly contribute to the early diagnosis and treatment of diabetes, potentially reducing the disease's burden on individuals and healthcare systems globally.

Machine learning represents a paradigm shift in the prediction and management of diabetes. The ability to analyze large datasets and apply complex algorithms has led to significant improvements in the accuracy of diabetes prediction, offering a promising avenue for early detection and better patient outcomes. Ongoing research and development in this field are essential to fully realize the potential of these technologies in transforming healthcare, particularly in the realm of chronic diseases like diabetes.

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THE RESULTS OF USING THE HYDRAULIC SHOCK METHOD OF WATER LIFTING FROM WATERCOURSES

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Abstract

The developed new types of hydraulic ram pumping units powered by an energy-saving and environmentally friendly water source of energy in watercourses, their design and technological schemes for lifting water from watercourses for watering pastures and irrigation of land plots, a brief device, principle of operation, novelty, distinctive features and advantages compared with analogues are considered.

The following research methods were used: patent with a review of works, theoretical and experimental.

The theoretical prerequisites of the hydraulic shock method of water lifting are given to determine the dependencies: supply, pressure and efficiency on the total water flow and experimental studies to confirm the reliability of the proposed formulas.

Positive results of laboratory tests and economic verification of two developed variants of hydraulic ram pumping units are given.

The research results have shown that the proposed hydraulic ram pumping units have significant advantages compared to their analogues: an increase in feed by 1.8-3.5 times and efficiency by 1.9 times.

Keywords. Hydraulic shock method of water lifting, hydraulic ram pumping unit, unconventional energy sources, water intake, watercourse, experimental study, laboratory test, economic inspection.

Introduction. Currently, in Kazakhstan and foreign countries, due to the shortage of a traditional energy source (fuel) in the fuel and energy system and in order to save it, as well as reduce the rate of environmental degradation, they are coming to use renewable energy sources (wind, water and solar), including in the agricultural water supply system, mainly for the use of water energy in watercourses [1-10].

However, due to the lack of alternative pumping units on the market for lifting water from watercourses, agricultural and other consumers located in watercourse areas are forced to use traditional centrifugal pumping units powered by internal combustion engines, which require high operating costs, including expensive fuel.

The problem of effective water supply using natural energy resources of water in modern conditions is promising and relevant, the solution of which is rationally carried out from watercourses by pumping units using, under certain conditions, a hydraulic shock method of water lifting, the designs of which, according to the technical solution, are simple and reliable in operation and do not worsen the ecology of the environment.

A hydraulic ram pumping unit refers to a type of installation in which the kinetic energy of moving water is used to create pressure and supply. The principle of operation is based on the creation of a hydraulic shock in the water lifting system from the periodic closing and opening of the shock

valve in the feed pipeline, from which the pressure in it increases cyclically, and water is pumped through the discharge valve into the air cap container and supplied to the consumer through the water lifting pipeline [11-17].

Method. The following research methods were used: patent with a review of works, theoretical and experimental.

Patent research with a review of the work was carried out according to existing methods: identification of close analogues, analysis of existing works and their use in development.

Theoretical studies were carried out using the law of continuity of the flow of movement of raised water in feed and water lifting pipes, the law of the hydraulic shock process in feed pipes, as well as the use of the Bernoulli equation in the technological process of water lifting, as a result, theoretical prerequisites for the technological process of the hydraulic shock method of water lifting from watercourses are given [1, 18-20].

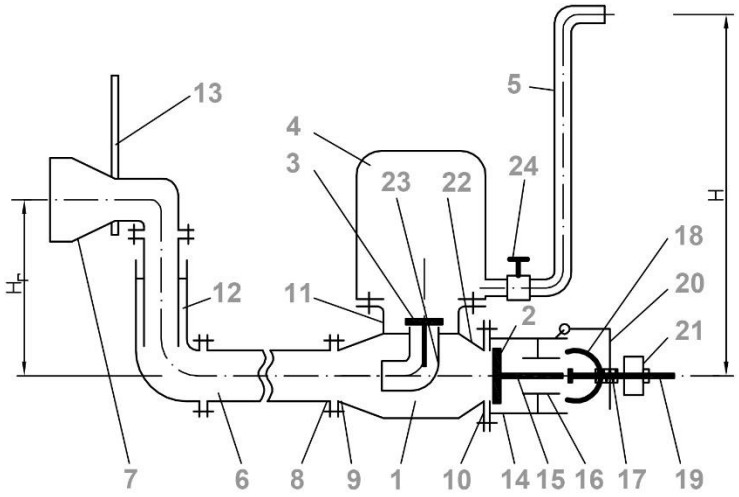
Experimental studies were conducted to study the technological process of the hydraulic shock method of water lifting and to verify the reliability of the theoretical assumptions obtained with a discrepancy within 5%.

Results and discussion. According to applied research, work on the development of pumping units powered by watercourse hydropower was carried out at KazNARU (2012-2020), as a result of which two structural and technical schemes of a hydraulic ram pumping unit were developed: one (option 1) according to the pre-patent for the invention KZ No. 17789 [21] and according to patent KZ No. 29911 [22] (Pic. 1), another (option 2) under the patent for the invention KZ No. 34027 "Hydraulic ram pumping unit" [23] (Pic. 2), the patent holder of which is KazNARU.

The hydraulic ram pumping unit (option 1) (see Pic. 1) consists of a housing 1 with shock 2 and discharge 3 valves, an air cap 4 with a water supply pipeline 5 and a feed pipe 6, a receiving part 7, which is connected to the watercourse, an outlet part 8 with an inlet pipe 9 of the housing 1, and at the outlet 10 and shock 2 and discharge 3 valves are installed in 11 nozzles of the housing. The nozzle 11 of the discharge valve 3 is connected to the air cap 4 [1,21,22].

The receiving part 7 is made adjustable in height and width by means of a telescopic connection of the pipeline 12 and has a shield frame 13 to increase the support, and the main part consists of sections of pressure pipes. The impact valve 2 includes a cylindrical body 14, inside which there is a poppet-type valve with a guide 15 coaxially mounted in the opening of the seat 16 and reciprocated by the force of a counterweight 17 widely suspended on the body 14, consisting of a hemispherical disk 18, a rod 19, a bracket 20 and a load 21.

The housing 1 with inlet 9 and outlet 10 nozzles is made in the form of an expansion diffuser-confuser nozzle 22 with a knee 23 connected to the through section of the check valve 3 of the air cap 4.



1 – impact valve body; 2,3- impact and discharge valves; 4 – air cap; 5 – water supply pipeline; 6 – feed line; 7 – reception area; 8 – outlet part of the feed line; 9, 10, 11 – inlet, outlet and middle pipes; 12 – telescopic connection; 13 –frame is a shield; 14– impact valve body; 15 – impact valve guide; 16 – shock valve seat; 17 – counterweight; 18 – hemispherical disk; 19,20,21 – counterweight rod, bracket and load; 22 – expansion diffuser-confuser nozzle; 23 – the knee of the body; 24 – the valve; H, Hг – height of the water lift, geometric pressure.

Pic. 1. Structural and technical diagram of a hydraulic ram pumping unit of the KazNARU design (option 1)

The technological process of a hydraulic ram pumping unit (option 1) (see Pic. 1) is carried out by starting the shock valve 2 by lifting and lowering the counterweight 17, while the optimal mode (frequency of the shock valve), depending on the initial parameters of the watercourse (geometric and velocity heads), is regulated by adjusting the counterweight 17, moving the rod 19, disc 18 and load 21.

To stop the hydraulic ram pumping unit, the valve 24 of the water supply pipeline 7 is closed and the movement of the shock valve 2 is turned off by lifting the counterweight 17 to a vertical position. When the pumping unit is restarted: the counterweight 17 of the shock valve is lowered again, the valve 24 is opened and the pumping unit operation process is repeated. In general, the developed design and technical scheme of a hydraulic ram pumping unit for lifting water from watercourses has novelty and advantages in comparison with analogues [1,21,22].

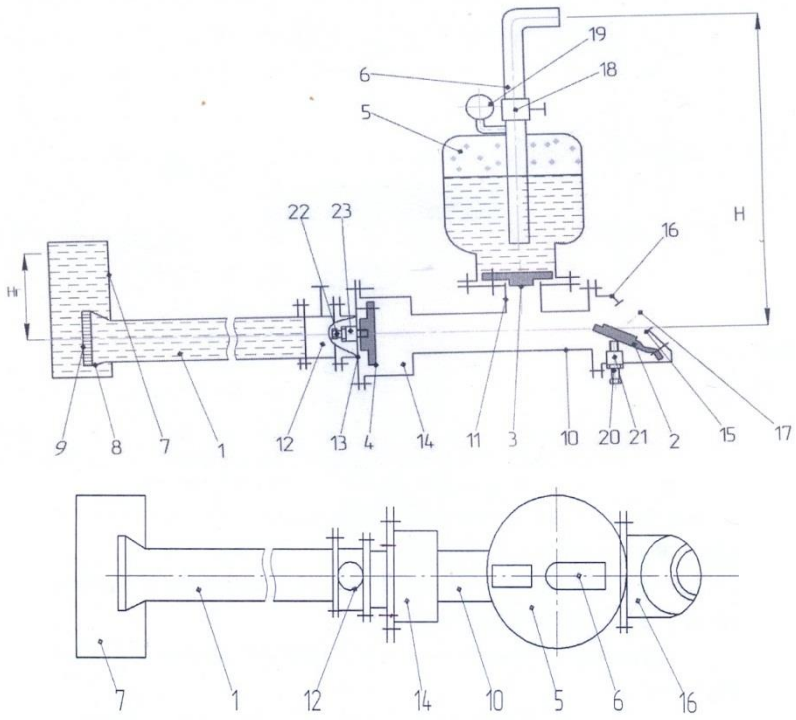
The receiving part of the hydraulic ram pumping unit is made in the form of a Z-shaped feed pipe with a telescopic connection and adjustable in height and width by means of grooved holes in the flange mounts, and is equipped with a shield frame to create additional water support at the inlet of the receiving part and keep the pumping unit in the watercourse. The inlet of the feed pipe is connected to the watercourse, and the outlet is connected to the inlet pipe of the shock valve body, the central part of which is connected through a discharge valve with an air cap, and an impact valve is installed on the outlet pipe of the body, creating a hydraulic shock when it is closed, with the possibility of return movement under the action of a pivotally suspended counterweight and regulation in the axial direction to the optimal mode its operation (switching frequency) [21,22].

According to the manufactured laboratory and experimental samples of a hydraulic ram pumping unit (Pic. 3), laboratory and economic tests were carried out (Pic. 4) with positive results, the main parameters of which were: pumping units supply -3...5 m3/h, head -10...17 m, water flow rate of the watercourse to the drive -0.01...0.04 m3/s, supplied the water pressure to the receiving part of pumping units is 0.5...3.0 m, the efficiency of pumping units is 0.5...0.55, which were the basis for further implementation of the development in the agricultural water supply system of the agro–industrial complex of the Republic of Kazakhstan.

Pic. 2. General view of the GNU - 5-15 hydraulic ram pumping unit of the KazNARU design (option 1)

Pic. 3. Fragment of tests of the GNU - 5-15 hydraulic ram pumping unit of the KazNARU design (option 1)

The hydraulic ram pumping unit (option 2) (see Pic. 4) consists of a supply pipeline 1 with shock 2, discharge 3 and return 4 elastic valves, an air cap 5 with a water supply pipeline 6 and a feeding jumper 7 on the receiving part 8 with a mesh grid 9 of the supply pipeline, creating a hydraulic differential [11,23].



1 – supply pipeline; 2,3,4 - shock, discharge and non-return elastic valves; 5 - air cap; 6 - water supply pipeline; 7 - feeding jumper; 8 - the receiving part of the supply pipeline; 9 - lattice grid; 10 – the chamber of the supply pipeline; 11 - pressure valve support seat; 12 - device for starting and stopping the hydraulic shock process (gate valve); 13 – check valve seat; 14 – check valve body; 15 - shock valve seat; 16 – impact valve body; 17 - through hole of the shock valve seat; 18 - the valve; 19 – manometer; 20,22 - thrust screw; 21,23 - bushing; $H_Г$,H - creating a hydraulic drop and the height of the water lift.

Pic. 4. Design and technological scheme of a hydraulic ram pumping unit of the KazNARU design (option 2)

In this case, the impact valve 2 is located in the housing 16 connected to the chamber 10 at the outlet of the supply pipeline, the discharge valve 3 is located on top of the chamber on a flat support seat 11 inside a centrically located and hermetically connected air cap 5 with a water supply pipeline 6, and the check valve 4 is on the supply pipeline.

The supply pipeline 1 is equipped with a device 12 for starting and stopping the hydraulic shock process in the form of a valve installed at the inlet of the chamber 10 of the supply pipeline 1. The check valve 4 of the supply pipeline is installed at the outlet of the valve 12 and is made in the form of an axial vertically suspended elastic flat valve 4 in contact with the seat 13, hermetically connected to the supply pipeline 1, and located inside the housing 14, hermetically connected to the supply pipeline 1 and its chamber 10.

In this case, the check valve 4 is equipped with an adjustable limiter for its closing stroke, made in the form of two thrust screws 22 in contact with the inner surface of the check valve and moved by means of a threaded connection in the bushings 23, rigidly connected to the flange of the housing 14, and locking with lock nuts.

The impact valve 2 is made in a housing 16, flanged and hermetically connected to the chamber 10 of the supply pipeline 1, in the form of an elastic flat valve 2 suspended at an angle in a horizontal plane, in contact with the seat 15 of the housing 16. In this case, the stroke of the impact valve is made adjustable to the optimal mode of its operation by supplying the body 16 of the impact valve 2 with a thrust screw 20, in contact with the outer surface of the valve 2 and moved by means of a threaded connection in the sleeve 21 and a locking lock nut.

The through hole 17 of the seat 15 is cylindrical or rectangular in shape with an area equal to the through section of the chamber 10 of the impact valve 2, and is connected to the atmosphere. The

receiving part 8 of the supply pipeline 1 is equipped with a lattice grid 9, and the water supply pipeline 6 of the air cap 5 is made inside the cap with its hermetic design and is equipped with a valve 18 and a pressure gauge 19 [23] .

The technological process of a hydraulic ram pumping unit (option 2) (see Pic. 2) is carried out as follows.

The water of the watercourse through the receiving part 8 with a mesh grid 9 of the supply pipeline 1, immersed in the watercourse with the valve 12 closed, fills the supply pipeline due to the geometric head (from the height difference of immersion), creating additional water backflow in the Ng watercourse from the hydraulic drop of the feeding jumper 7 and the high-speed head (from the speed of water movement) through the supply pipeline 1, and when the valve 12 of the device for starting and stopping the hydraulic shock process is opened, water rushes at an increased speed into the chamber 10 of the supply pipeline and flows out at an increasing speed through the cylindrical or rectangular hole 17 of the seat 15 of the housing 16 to the outside of the watercourse, dragging the elastic shock valve 2 and creating a vacuum.

As a result, the impact valve 2 closes quickly, creating a hydraulic shock in the body 16 of the impact valve and in the chamber 10, the pressure in which becomes greater than in the air cap 5, the discharge valve 3 opens and water enters the air cap 5. At the same time, the check valve 4 closes to the screw stops 22 from the action of the water hammer, increasing the duration of water injection into the air cap at increased pressure.

When the water pressure drops in the chamber 10 of the supply pipeline 1 and the shock wave acts in the opposite direction, a vacuum is created and the shock valve 2 opens due to its own weight and vacuum, and the discharge valve 3 closes.

Water from the air cap 5 under the pressure of compressed air in its upper part will flow when the valve 18 is opened through the water supply pipeline 6 to the consumer, which is controlled by a pressure gauge 20.

In the future, the technological process will be repeated automatically, while the hydraulic ram pumping unit will operate at the optimal frequency of closing and opening the shock valve, which is set automatically depending on the initial parameters of the watercourse (geometric and velocity heads) and stroke control of the impact valve with a thrust screw 20.

To stop the hydraulic shock process, the valve 12 is closed, and to completely stop the hydraulic ram pumping unit, the valve 18 of the water supply pipeline 6 is closed.

When the hydraulic ram pumping unit is restarted, the valve 12 opens again, thereby starting the hydraulic shock process, and by opening the valve 18 of the water supply pipeline 6, water is supplied to the consumer at a height of H and the process of operation of the hydraulic ram pumping unit is repeated [23].

The hydraulic ram pumping unit (option 2) of the KazNARU design in comparison with analogues, including a pumping unit (option 1) has a novelty and significant differences:

The supply pipeline is equipped with a device for starting and stopping the hydraulic shock process, the non-return valve of the supply pipeline is installed at the outlet of the device for starting and stopping the hydraulic shock process, and the impact valve is made in the form of an elastic flat valve suspended at an angle in a horizontal plane in contact with the seat of the housing, hermetically connected to the chamber of the supply pipeline and is made with an adjustable stroke of closing the shock valves,

The non-return valve of the supply pipeline is made in the form of an axial vertically suspended elastic flat valve in contact with the seat, hermetically connected to the supply pipeline, and located inside the housing, hermetically connected to the supply pipeline and its chamber and equipped with an adjustable limiter for its closure.

The device for starting and stopping the hydraulic shock process is made in the form of a gate valve installed at the inlet of the chamber of the supply pipeline.

Stroke control of the impact valve is performed by supplying the body of the impact valve with a thrust screw in contact with the outer surface of the valve and moved by means of a threaded connection in a sleeve rigidly connected to the body and locking with a lock nut.

The adjustable stop of the closing stroke of the check valve of the supply pipeline is made in the form of two thrust screws in contact with the inner surface of the check valve and moved by means of a threaded connection in bushings rigidly connected to the flange of the housing and locking with lock nuts.

The through hole of the shock valve seat, having a cylindrical or rectangular shape, is made in an area equal to the through section of the shock valve chamber and is connected to the atmosphere.

The receiving part of the supply pipeline is equipped with a lattice grid.

The water supply pipeline of the air cap is made inside the cap with its hermetic design and is equipped with a valve**.**

The main advantage of the design and technological scheme of a hydraulic ram pumping unit (option 2) in comparison with analogues is to increase the reliability of the pumping unit, create convenience and ease of maintenance and increase the energy performance of a hydraulic ram pumping unit: hydraulic shock pressure, supply, head and efficiency [23].

A fragment of the tests of a hydraulic ram pumping unit (option 2) is shown in Pic. 6.

Pic. 5. Fragment of tests of a hydraulic ram pumping unit of the KazNARU design (option 2)

Based on theoretical studies, formulas are given for determining the main technological parameters of a hydraulic ram pumping unit [1,11].

Supply$Q_{\text{ну}}$ it is determined by the formula:

$$Q_{\text{ну}} = Q\left(1 - \frac{t_{\text{сб}}}{t_{\text{ц}}}\right), \text{ m}^3/\text{s} \quad (1)$$

$$t_{\text{сб}} = t_{\text{ц}} - t_{\text{н}} \text{ , s} \quad (2)$$

The pressure created H $_{\text{ну}}$ it is determined by the formula:

$$H_{\text{ну}} = H_{\text{н}} + \frac{1}{g} \cdot \left(\frac{4Q}{\pi \cdot {D_{\text{птр}}}^2} - v_3\right) \frac{2L_{\text{тр}}}{t_{\text{зф}}} \cdot t_{\text{ц}}, \quad (3)$$

$H_{\text{н}}$– own head of the hydraulic ram pumping unit, m:

$$H_{\text{н}} = H_{\text{г}} + \frac{1}{2g} \cdot \left({\upsilon_{\text{птр}}}^2 - v_{\text{п}}^2\right) + h_{\text{vп}} \text{ , m} \quad (4)$$

$$t_{\text{ц}} = \frac{60}{n} \text{ ,} \quad (5)$$

n - switching frequency of the shock valve, min $^{-1}$;

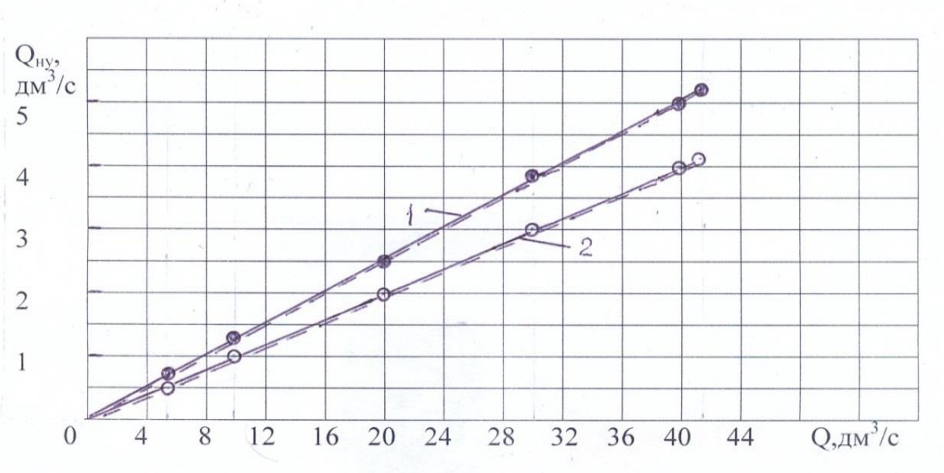
$L_{\text{тр}}$– pressure pipe length, m.

Power consumed $N_{\text{ну}}$ and efficiency $\eta_{\text{ну}}$ the hydraulic ram pumping unit is determined by the formulas:

$$N_{\text{ну}} = 9{,}81 \cdot Q \cdot (H_{\text{г}} + \frac{v_{\text{п}}^2}{2g}), \text{ kW,} \quad (6)$$

$$\eta_{\text{ну}} = \frac{Q_{\text{ну}} \cdot H_{\text{ну}}}{Q \cdot (H_{\text{г}} + \frac{v_{\text{п}}^2}{2g})} \text{ .} \quad (7)$$

The results of theoretical and experimental studies of the technological process of a hydraulic ram pumping unit with dependency graphs are presented $Q_{\text{ну}}$, $H_{\text{ну}}$, $\eta_{\text{ну}}$= f(Q) (Pic. 6,7,8). The reliability of the theoretical formulas (1), (3) and (7) have been confirmed experimentally (the discrepancy does not exceed 3-5%).

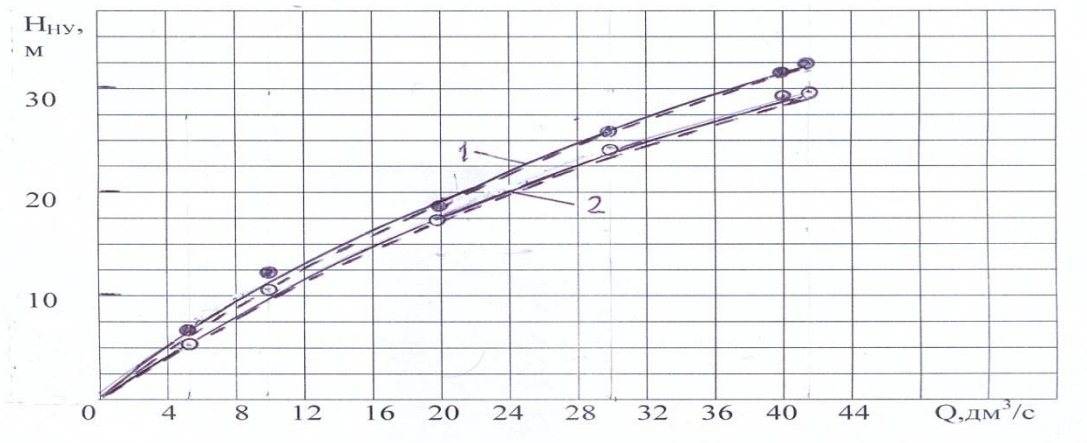


theoretical; ----- experimental

●1 – at the head of the watercourse H_H = 3,42 m;

●2 - at the head of the watercourse H_H = 5,08 m

Pic. 6. Dependence of the supply of a hydraulic ram pumping unit on the total flow rate of the watercourse to its drive



theoretical; ----- experimental

●1 – at the head of the watercourse H_H = 3,42 m;

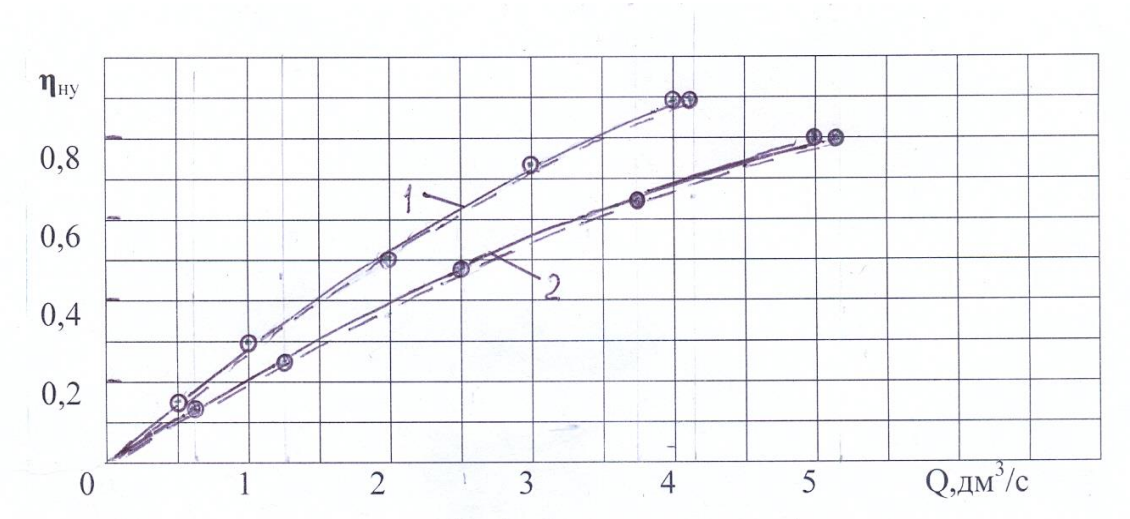
●2 - at the head of the watercourse H_H = 5,08 m

Pic. 7. Dependence of the pressure of a hydraulic ram pumping unit from the total flow rate of the watercourse to its drive

The results of theoretical studies have been tested on an experimental stand simulating a watercourse.

The graph (see Pic. 8) shows that the supply of a hydraulic ram pumping unit under different modes of the watercourse increases with an increase in its total water flow and varies in a curvilinear dependence from 0.5- 0.62 dm3/s to 4.14 – 5.19 dm3/s with a water flow rate from 5 to 41.4 dm3/s.

It follows from the graph (see Pic. 9) that the head of a hydraulic ram pumping unit under different modes of the watercourse increases with an increase in its total water flow and varies in a curvilinear dependence from 5- 6.7 m to 31- 32 m with a water flow rate from 5 to 41.4 dm3/s.



theoretical; ----- experimental

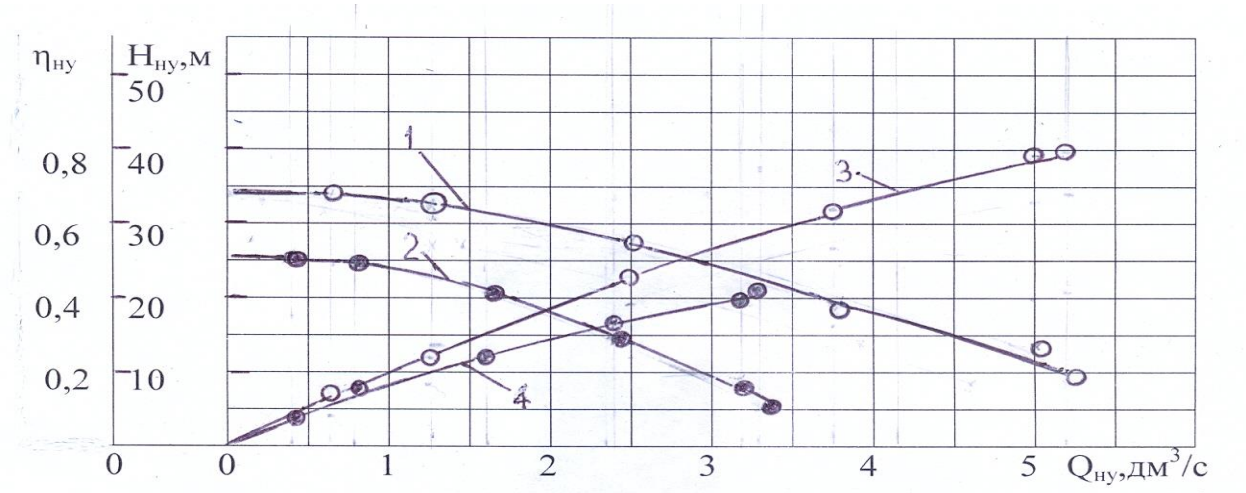
●1 – at the head of the watercourse H_H = 3,42 m;

●2 - at the head of the watercourse H_H = 5,08 m

Pic. 8. Dependence of the efficiency of a hydraulic ram pumping unit on the total flow rate of the watercourse to its drive

The graph (see Pic. 8) shows that the efficiency of a hydraulic ram pumping unit under different modes of a watercourse increases with an increase in its total water flow and varies in a curved dependence from 0.132- 0.146 to 0.778– 0.871 with a water flow rate from 5 to 41.4 dm3/s.

The graph (Pic. 9) shows the results of comparative laboratory tests of two variants of a hydraulic ram pumping unit according to the dependence of pressure and efficiency on supply at a head of a watercourse of 5.08 m.



●1 – head of the hydraulic ram pumping unit (option 2);

●2 – head of the hydraulic ram pumping unit (option 1);

●3 – efficiency of a hydraulic ram pumping unit (option 2);

●4 - efficiency of a hydraulic ram pumping unit (option 1)

Pic. 9. Results of laboratory tests of two variants of a hydraulic ram pumping unit according to the dependence of pressure and efficiency on supply at a head of a watercourse of 5.08 m

Based on the completed research on the review of works and patent research on the technology of lifting water from watercourses and technical solutions for its implementation, two variants of structural and technological schemes of a hydraulic ram pumping unit have been developed, which are protected: option 1 by pre-patent KZ No. 17789 [21] and patent for invention KZ No. 29911 [22], and option 2 by patent for the invention KZ No. 34027 [23], which, compared with analogues, have better energy performance in terms of basic parameters: hydraulic shock pressure, flow , pressure and efficiency and were adopted for the development of experimental and pilot samples for agricultural

and pasture water supply at the facilities of the agro-industrial complex of the Republic of Kazakhstan.

Conclusion.

1. Based on the results of patent research, a review of work and own research at KazNARU, two design and technological schemes of a hydraulic ram pumping unit have been developed, one of which (option 2), compared with analogues (and option 1), provides increased reliability of its operation, convenience and ease of maintenance, increased energy performance: hydraulic shock pressure, feed, pressure and efficiency.

2. The design and technological schemes of two variants of a hydraulic ram pumping unit are given with a description of the device, technological process, distinctive features and novelty in comparison with analogues, the designs of which are protected by pre–patent KZ No. 17789 and two patents for invention KZ No. 29911 and KZ No. 34027, one of them under patent KZ No. 34027 was adopted for the development of prototypes for pasture water supply at the facilities of the agro-industrial complex of the Republic of Kazakhstan.

3. The conducted experimental studies have studied the technological process of the hydraulic shock method of water lifting from watercourses and confirmed the reliability of the obtained basic formulas for determining the supply, required head and efficiency of a hydraulic ram pumping unit at a head of 3.42 m and 5.08 m watercourse.

4. Based on a comparative analysis, a hydraulic ram pumping unit (option 2) has a significant advantage compared to a hydraulic ram pumping unit (option 1): the supply increases at a head of 25 m from 0.8 dm3/s to 2.8 dm3/s (3.5 times), and at a head of 10m from 2.9 dm3/s to 5.2 dm3/s (1.8 times); maximum efficiency increases from 0.41 to 0.78 (1.9 times).

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Veterinary sciences

INCIDENCE OF CYSTOISOSPOROSIS ON DOGS AND CATS

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Investigations were carried out during March 2021- September 2022 on a total of 153 dogs and 54 cats of different breeds and ages. The animals had diarrhoeic syndrome and were examined by coproscopy with MiniFlotac method. The incidence of infestations with Cystoisospora sp. in puppies was 49,5%, of wich 88,1% was recorded in puppies aged 1-3 months and 11,8% in puppies aged in 4-6 months.On cats the frequency of infestations with Cystoisospora was 30,4%,of wich 71,4% in kittens aged 1-3 months and 28,5% in kittens aged 4-6 months

Introduction

The diarrhoeic syndrome has quite a high frequency in the pet carnivores, manly in the young pets aged few months. The classical therapy with antibiotics associated with rehydration, general stimulants and a specific diet is not successfulin all patients because of the polyfactorial aetiology. The determination of the pathogens involved in the aetiology of enteritis requires specific laboratory tests.

Mitchell S.M. et al. (5) proved that the infestation with *Isospora sp*. in puppies and adult dogs with immunodepression can start the diarrhoeic syndrome.The authors conducted experiments with *Isospora canis* of Beagle female puppies aged 6-8 weeks. The prepatent period was of 9-11 days and the patent period of 7- 18 days. The diarrhoeic syndrome started 2-3 days before the presence of oocysts in faeces in all infected female puppies. No bacteria or viruses were isolated, the diarrhoea being caused by *Isospora canis*. Heusinger A. (4) conducted a study on the incidence of infestation with *Giardia*, on its cycle of evolution and on the diagnostic methods in dogs and humans. Diagnosis was done by ELISA on coprology samples and showed 21% infestation in puppies.

Papazahariadou M. et al. (6) investigated the incidence of parasite infestation in dogs on 281 coprologic samples and observed a prevalence of 4.3% for *Giardia sp.* and 3.9% for *Isospora sp.* mainly in the young animals. Diaz et al. (3) observed a 21.9% incidence of Giardia infestation in puppies aged few months and 10.8% in adult dogs. Barr S.C. et al. (1) showed experimentally that the administration of Fenbendazol in dose of 50 mg/kg body mass controls the infestation with nematoda species, also being efficient in giardiosis control in dogs.

Material and metod

Mini-FLOTAC is a multivalent technique (i.e., it permits the contemporaneous diagnosis of oocysts and cysts of protozoa, eggs and larvae of nematodes, eggs of trematodes, and cestodes) . For this reason, the Mini-FLOTAC are able to reduce time and costs of analysis and compared to other fecal flotation methods showed an overall higher specificity, sensitivity, accuracy, precision, reproducibility, and repeatability for egg identification and incidency . In addition, the Mini-FLOTAC and Fill-FLOTAC are user-friendly devices (i.e., no special equipment such as a centrifuge, or trained technicians are required), so they can be used directly by veterinarians or farmers in the field (pen-side use)

The investigations were conducted during March 2021- September 2022 on atotal of 153 dogs and 23 cats of different breeds and age. The animals displayedweakness, capricious appetite, inappetence, dehydration and persisting diarrhoea even after the antibiotics therapy

Species	Nr. of animals	Positive identification	Percent	Young animals		Adults	
				Nr.	%	Nr.	%
Dogs	**153**	**76**	**49.6**	**76**	**100**	-	-
Cats	**23**	**7**	**30.4**	**7**	**100**	-	-
total	**176**	**83**	**47.1**	**83**	**100**	-	-

Tab. 1 Incidence of *Cystosospora sp.* infestation by species

Tables 1 and 2 show that in dogs, the *Cytosospora sp.* infestations occurred onlyin puppies, 88.1% being recorded in puppies aged 1-3 months and 11.8% in puppies aged 4-6 months. In the examined cats the frequency of infestation was 30.4 % of which 71.4 % in kittens aged 1-3 months and 28.5 % in kittens aged 4-6months.

Species	Positive identification	Age 1-3 months		Age 4-6 months	
		Nr.	%	Nr.	%
Dogs	**76**	**67**	**88.1**	**9**	**11.8**
Cats	**7**	**5**	**71.4**	**2**	**28.5**
total	**83**	**72**	**86.5**	**11**	**13.2**

Tab. 2 Incidence of *Cystosospora sp.* infestation by age categories

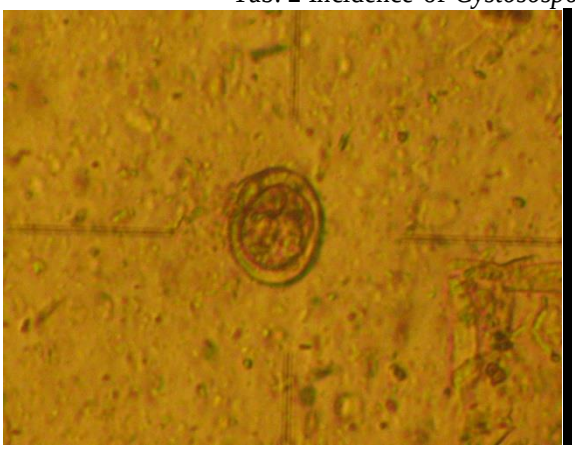

Fig.1 Cystoisospora ohioensis- unsporulated oocyst

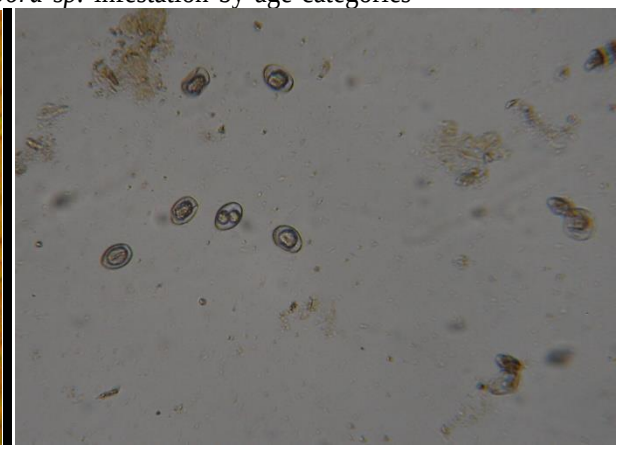

Fig. 2 Cystoisospora sp. in cat- sporulated oocyst

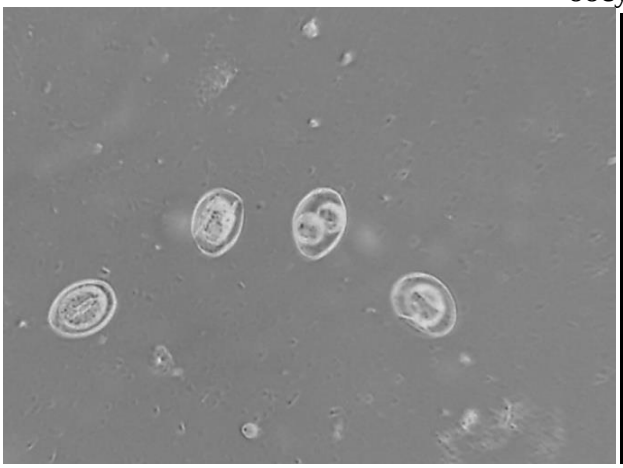

Fig. 3 Cystoisospora sp. in cat- sporulated oocyst

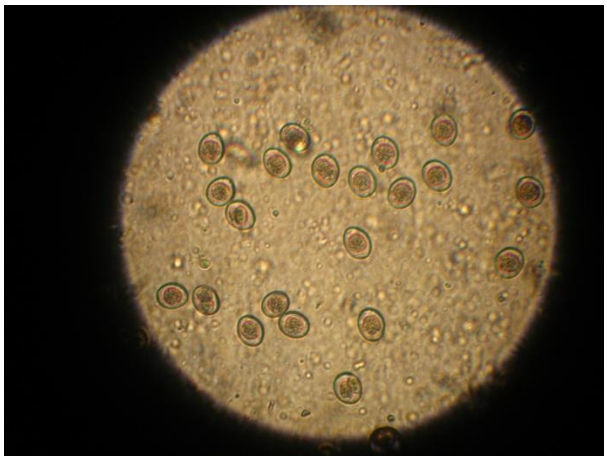

Fig. 4 Cystoisospora sp.(burowsi) in cat- unsporulated oocyst

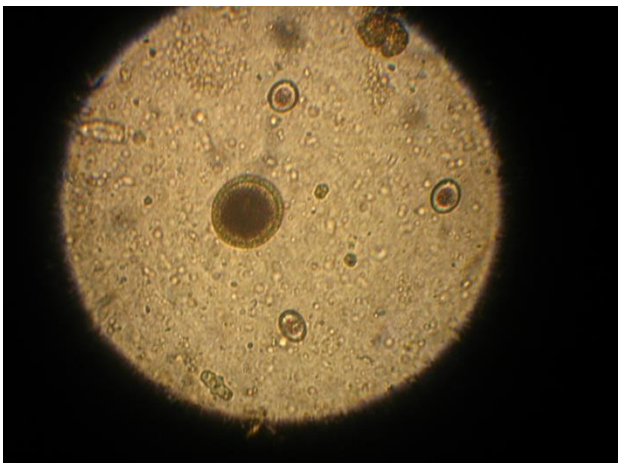

Fig. 5 Mixed endoparasitism in dog- *Cystoisospora* . and *Toxocara canis*

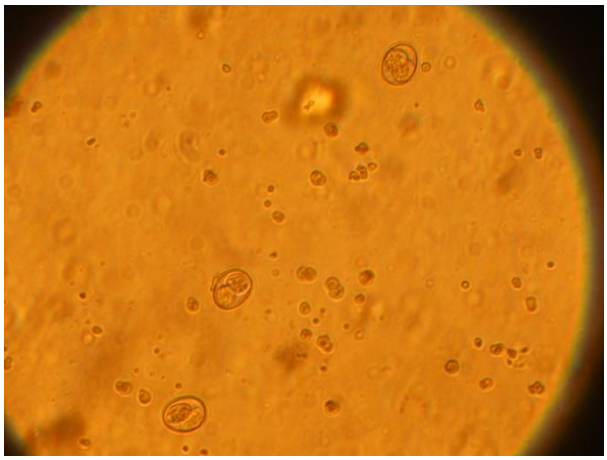

Fig. 6 Mixed endoparasitism in cat- *Cystoisospora and Giardia*

The aetiology of the diarrhoeic syndrome in the puppies and kittens also involved parasitic agents, namely sporozoa and flagellate species. 49.6% of the puppies with diarrhoeic syndrome and 30.4% of the kittens with diarrhoeic syndrome were infested with *Cystoisospora (*fig.1, fig,2,fig.3*). Giardia* infestations were detected in 15.6% of the puppies with diarrhoeic syndrome and in26.08% of the kittens with diarrhoeic syndrome.(fig, 5,fig.6) Because the control of the diarrhoeic syndrome in puppies and kittens is done by antibiotics therapy associated to general stimulants, rehydration etc., we recommend laboratory investigations to reveal the parasitic infestations followed by the specific therapy with coccidiostatics and drugs for flagellate infections

Conclusions

1. The incidence of *Isospora sp.* infestations in puppies was 49.6%, of which 88.1% were recorded in puppies aged 1-3 months and 11.8% in puppies aged 4-6months.
2. The incidence of *Isospora sp.* infestations in kittens was 30.4 %, of which 71.4 % in kittens aged 1-3 months and 28.5 % in kittens aged 4-6 months.
3. The efficacy of Toltrazuril in controlling *Isospora sp.* infestations was 96 %.

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ANALYSIS OF DEVELOPMENT TRENDS AND REGULATORY AND LEGISLATIVE REGULATION OF THE CREDIT UNION MARKET OF UKRAINE

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АНАЛІЗ ТЕНДЕНЦІЙ РОЗВИТКУ ТА НОРМАТИВНО-ЗАКОНОДАВЧЕ РЕГУЛЮВАННЯ РИНКУ КРЕДИТНИХ СПІЛОК УКРАЇНИ

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Abstract

The large-scale military aggression of the Russian against Ukraine and the introduction of martial law could not but affect the work of credit unions. Today, more than ever, Ukraine needs to improve the economic situation, which directly depends both on the state and on other factors that directly affect the development of the Ukrainian economy. An important role is played by the credit union as a non-bank financial and credit institution that helps to meet the needs of the population and small businesses.

The study is aimed at determining the essence and significance of credit unions for the development of the country's economy, determining trends and prospects for their development in Ukraine. The purpose of this scientific study is to determine the quantitative and qualitative changes that occurred in the process of creation and functioning of credit unions of Ukraine and to determine the prospects for their development.

The realization of the set goal caused the need to solve the following tasks in the work: definition of the theoretical foundations of the functioning of credit unions, analysis of the activity of credit unions in our country; approaches of the National Bank of Ukraine (hereinafter the NBU) in the application of influence measures to credit unions in the conditions of martial law; the current legislation of Ukraine on the activities of credit unions in the direction of expanding the range of services provided by them is substantiated.

Анотація

Широкомасштабна воєнна агресія рф проти України та запровадження воєнного стану не могли не позначитися і на роботу кредитних спілок. Сьогодні Україна, як ніколи, потребує покращення економічної ситуації, що напряму залежить як від держави, так і від інших чинників, які безпосередньо впливають на розвиток економіки України. Важливу роль відіграє

кредитна спілка, як небанківська фінансово-кредитна установа, що допомагає врегулювати потреби населення та малого бізнесу.

Дослідження спрямоване на визначення сутності та значення кредитних спілок для розвитку економіки країни, визначення тенденцій та перспектив їх розвитку в Україні. Метою даного наукового дослідження є визначення кількісних та якісних змін, що відбулися в процесі створення та функціонування кредитних спілок України та визначення перспектив їх розвитку.

Реалізація поставленої мети обумовила необхідність вирішення в роботі таких завдань: визначення теоретичних засад функціонування кредитних спілок, аналіз діяльності кредитних спілок в нашій країні; підходи Національного банку України (далі НБУ) у застосуванні заходів впливу до кредитних спілок в умовах воєнного стану; обґрунтовано чинне законодавство України з питань діяльності кредитних спілок у напрямі розширення спектру послуг, що ними надаються.

Keywords: credit union, market concept, analysis, legislation, regulator
Ключові слова: кредитна спілка, концепція ринку, аналіз, законодавство, регулятор

Вступ

Під впливом війни в Україні багато людей змінили місце проживання через небезпеку чи втратили житло. Придбання нового часто супроводжується потребою в кредитних коштах. Державні програми в цьому є обмежені або взагалі в окремі періоди не діють.

З цієї причини кредитні спілки пропонують своїм клієнтам широкий перелік послуг, завдяки яким останні можуть швидко повернути втрачену фінансову стабільність і наблизитися до цілей, що раніше здавалися такими далекими.

Кредитні спілки – це фінансові установи, діяльність яких полягає в задоволенні потреб їх членів у взаємному кредитуванні та наданні інших фінансових послуг за рахунок їх об'єднаних грошових внесків. Кредитна спілка діє на кооперативних засадах, що забезпечує рівні права усіх її членів щодо впливу на управління установою та отримання усіх переваги від її діяльності. Для кредитних спілок порівняно з іншими фінансовими установами отримання прибутку не є метою діяльності.

У свою чергу, НБУ, на період дії воєнного стану врегулював діяльність кредитних спілок. Регулятор надав право кредитним спілкам не видавати: внески (вклади) за договорами про залучення строкового внеску (вкладу) та нараховані проценти за цими внескам (вкладами) до закінчення строку їх дії; додаткові пайові внески членам кредитної спілки в разі звернення про їх видачу.

Крім того, кредитні спілки обмежують видачу готівкових грошових коштів у національній валюті України в обсязі не більше 100 тисяч гривень на добу на одного члена кредитної спілки. Водночас кредитні спілки мають право встановлювати граничну суму видачі готівкових грошових коштів у національній валюті України на добу на кожного члена кредитної спілки за умови дотримання обмеження у 100 тисяч гривень. Такі зміни в роботі кредитних спілок затверджені постановою Правління НБУ від 26 лютого 2022 року № 24 «Про врегулювання діяльності фінансових установ» [1]. Постанова набрала чинності 26 лютого 2022 року та діє на період дії Указу Президента України від 24 лютого 2022 року № 64/2022 «Про введення воєнного стану в Україні» [2].

Для того, щоб точно знати, де можна вигідно взяти кредит в Україні, в банках або кредитних спілках, варто звернути увагу на переваги та недоліки останніх.

Плюси кредитних спілок: просте і швидке отримання кредитів; для отримання кредиту не потрібно багато довідок, поручителі чи застава (таких зараз немає); кожен учасник, незалежно від суми і наявності вкладу має рівний з іншими голос в управлінні; можна не платити пеню, якщо це обумовлено з засновниками

Мінуси кредитних спілок: отримати кредит може тільки учасник кредитної спілки; відсоток за кредитами вище, ніж в банках [3].

Актуальність та значення проблематики.

Питання регулювання кредитних спілок у підвищенні рівня ефективності функціонування національної економіки та добробуту суспільства завжди були в полі зору дослідників. Теоретико-методологічні та практичні засади регулювання кредитних спілок відображені в працях таких вітчизняних дослідників, як: О.Василика, Н.Внукової, Б.Івасіва, В.Корнєєва, М.Крупки, Б.Луціва, І.Лютого, І.Малого, С.Науменкової, А.Пересади, О. Скаска, В.Ходаківської, В.Шелудько та інших.

Значну увагу питанням розвитку кредитних спілок та підходів до їх регулювання приділяють у своїх працях зарубіжні дослідники такі як: Д. Адамі, Б. Бухвальд, А. Дежарден, Е. Делан, М. Лурьє, Ж. Матука, М. Сарджент, У. Стеджер, Х. Шульце Деліч та інші. Зокрема, особливої уваги потребують проблеми регулювання кредитних спілок та удосконалення регулювання їх діяльності.

Однак, незважаючи на таку велику кількість публікацій науковців дане питання потребує поглибленого вивчення, оскільки невизначено основні перспективи діяльності кредитних спілок та їх особливості в умовах війни в Україні.

Виклад основного матеріалу

Завдяки своїй філософії кредитні спілки в усьому світі відіграють важливу роль у підвищенні доступності фінансових послуг для широкої громадськості та рівня їхньої фінансової грамотності, а також є ефективним інструментом підвищення економічного добробуту населення.

За даними Всесвітньої ради кредитних спілок, у 2021 році у світі було 87,9 тис. кредитних спілок із майже 393,9 млн членів (враховуються 118 країн-членів ради). Середньосвітовий рівень проникнення (відношення кількості членів кредитних спілок до економічно активного населення) склав 12,69% у порівнянні з лише 1,21% в Україні. У Європі та США кредитні спілки значно поширеніші, ніж в Україні. Наприклад, рівень проникнення у США в 2021 році становив 61%, у Польщі – 5,5%, у Литві – 9,5% [4].

В Україні ринок кредитних спілок зародився у 1992 році і досяг найбільшого свого розвитку у 2008 році: кількість кредитних спілок становила 829, а їхніх членів - 2,7 млн осіб, активи - понад 6 млрд грн. Після фінансової кризи 2008 - 2009 років показники діяльності кредитних спілок почали погіршуватися: відбулося суттєве зменшення як активів, так і членства в кредитних спілках. Ринок повернувся до відновлення у 2010 - 2013 роках, однак агресія росії і, як наслідок, економічний спад у 2014 році згубно вплинули на діяльність кредитних спілок.

Останні сім років ринок продовжував стагнувати: скорочувались як кількість кредитних спілок та їхніх учасників, так і розмір активів. У цілому, на кінець першого півріччя 2023 року кількість кредитних спілок становила лише 18% від кількості пікового 2008 року, а їхні активи становили трохи менше 1,4 млрд грн на противагу більше 6 млрд грн у 2008 році.

Різке падіння показників ринку кредитних спілок відбулося у 2022 році із початком повномасштабного вторгнення росії (див. рис. 1).

Частина спілок вимушено призупинила або припинила свою діяльність у зв'язку з окупацією території, де вони працюють, падінням економічної активності населення та неготовності до роботи в умовах операційних ризиків, що справдилися.

Зокрема, у І кварталі 2022 року обсяг нових кредитів скоротився у 1,5 рази у порівнянні з І кварталом 2021 року, за даними НБУ. Кількість суб'єктів знизилася на 40%, а залишок обсягу виданих кредитів членам кредитних спілок на кінець 2022 року зменшився на 36%, у порівнянні з кінцем 2021 року (таке зниження обсягу кредитів відбулося через вихід спілок з ринку та скорочення кредитування тими, що залишилися).

У ІІІ кварталі 2022 року кількість кредитних спілок, що звітують, надалі скорочувалася. Обсяги активів за квартал скоротилися на понад третину, обсяг кредитного портфеля зменшився на 8%. Навіть помірне збільшення витрат на резервування призвело до збитковості сегмента за квартал і до зменшення прибутку за результатами дев’яти місяців 2022 року до 18.5

млн грн. Також тривало скорочення обсягів депозитів та додаткових пайових внесків на 13% та 18% за квартал відповідно [5].

Початок повномасштабної війни негативно вплинув також на динаміку банківського кредитування. Зокрема, населення скоротило попит на кредитні ресурси одразу після вторгнення, однак розмір скорочення був меншим у порівнянні з ринком кредитних спілок.

Так, за даними НБУ, обсяг банківських кредитів, що надані фізичним особам, на початку 2023 року був на 13% менше, у порівнянні з початком 2022 року.

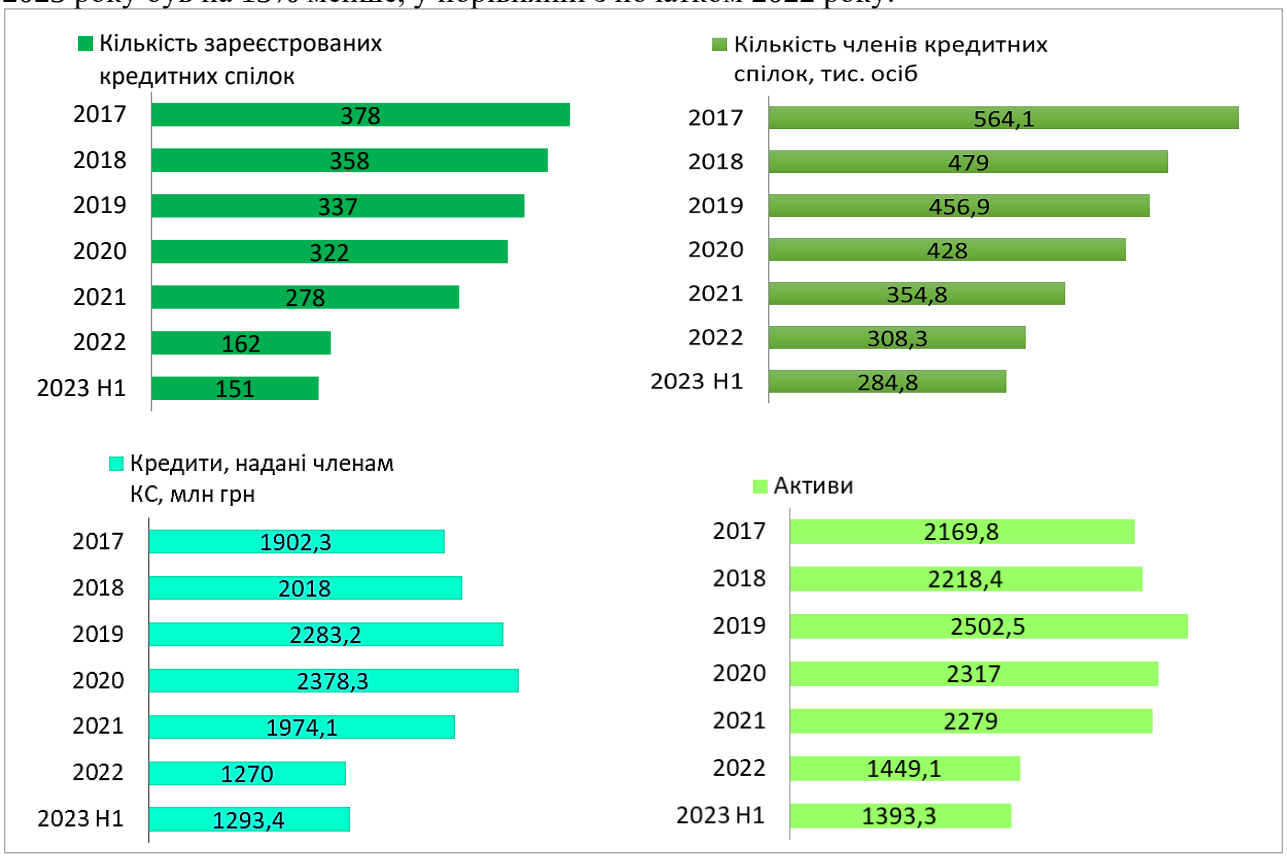

Рисунок 1 – Основні показники ринку кредитних спілок в Україні (*показники станом на кінець відповідного періоду)* [4]

Структура ринку зберігається практично незмінною (див. рис. 2): більшість спілок має обсяг активів менше 10 млн грн (95 спілок у 2023 році), і лише три кредитні спілки мають активи понад 100 млн грн. Ці три компанії входили до топ-найбільших і у 2020 році, однак тоді була ще одна кредитна спілка з активами більше 100 млн грн, якій анулювали ліцензію минулого року за неподання звітності. *Сумарна кількість кредитних спілок може не співпадати з даними на рисунку 1, оскільки не всі з них звітують про свою діяльність.*

Забезпечення належного регулювання та нагляду за діяльністю кредитних спілок є одним з пріоритетних завдань НБУ в межах реалізації його стратегічних цілей. Мета НБУ – сприяння підвищенню рівня фінансового добробуту громадян та економічному зростанню України загалом шляхом створення умов для розвитку ринку кредитних спілок, підвищення рівня його надійності, прозорості та платоспроможності.

Українські законотворці зробили крок до відновлення та пожвавлення ринку кредитних спілок, який стагнував упродовж багатьох років. Новий закон України «Про кредитні спілки» (далі Закон) від 01.01.2024 року [6], замінив морально застарілий закон 20-річної давнини, розширив спектр їхніх послуг, удосконалив процедуру створення та виходу з ринку, посилить регуляторний нагляд та контроль.

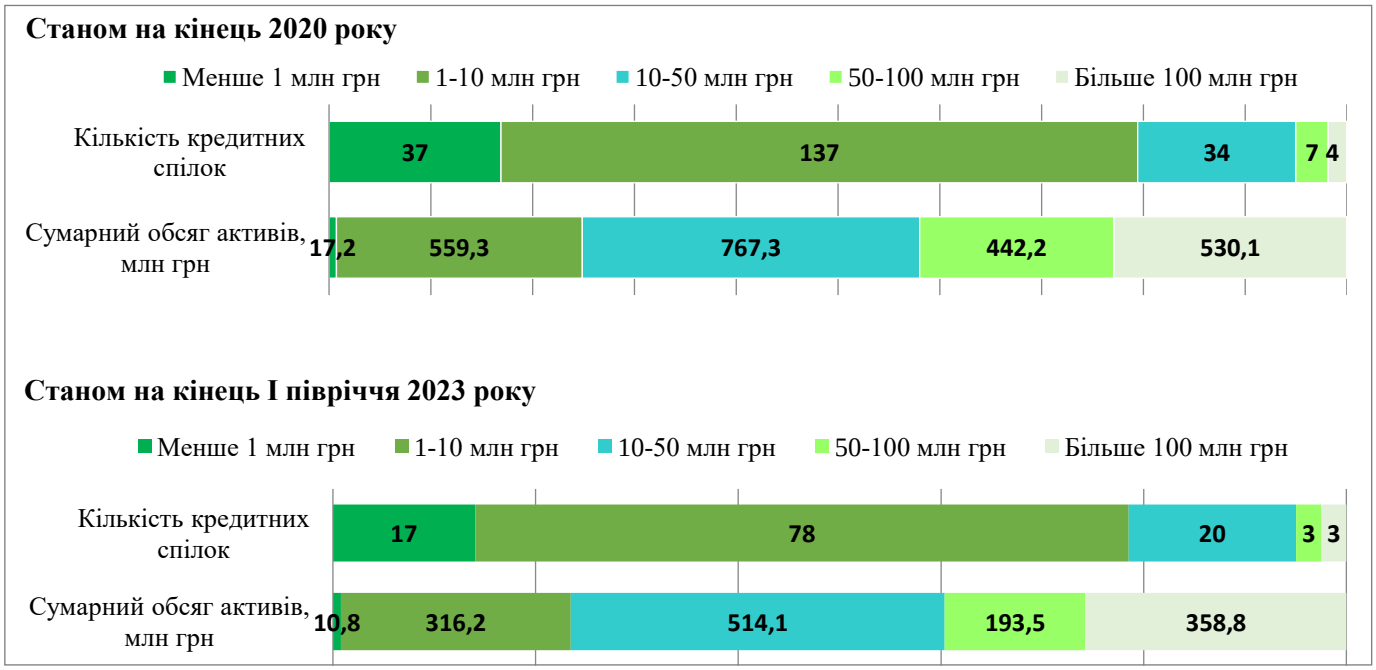

Рисунок 2 – Концепція ринку кредитних спілок в Україні [4]

Незмінно понад половина обсягу кредитних спілок – це споживчі кредити (див. рис. 3).

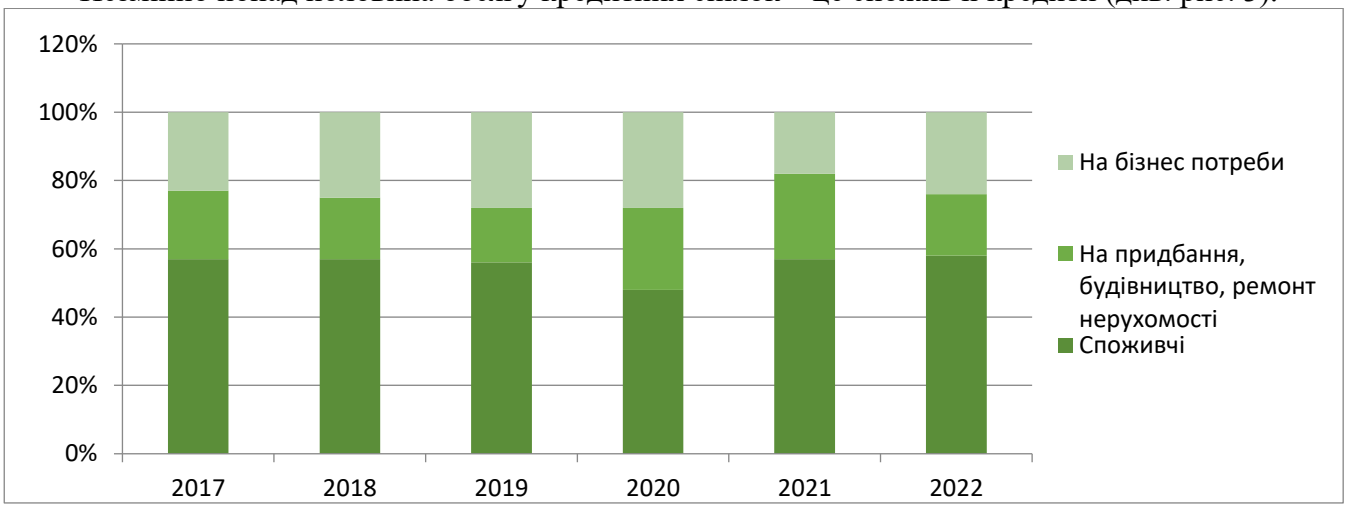

Рисунок 3 – Структура основної суми заборгованості за кредитами членів кредитних спілок, % [4]

Впровадження норм нового Закону є важливим кроком до якісних змін у діяльності кредитних спілок та сприятиме підвищенню їхньої стійкості та результативності», - зазначається у повідомленні. В НБУ нагадали про новації цього закону. Законом, зокрема:

– розширюється перелік осіб, які можуть стати членами кредитних спілок. Ними зможуть бути не лише фізичні особи, а й юридичні. Йдеться про фермерські господарства, ОСББ, кооперативи, мікропідприємства;

– удосконалюються вимоги до структури капіталу кредитної спілки. Зокрема, передбачається розширення джерел поповнення капіталу кредитної спілки, запровадження вимог щодо складових регулятивного капіталу як першого, так і другого рівня;

– посилюється система управління кредитною спілкою. З'являться нові вимоги до системи корпоративного управління та системи внутрішнього контролю, які дадуть змогу запобігти концентрації всіх процесів управління навколо вузького кола осіб. Це зменшить ризики для фінансового стану кредитної спілки та захистить інтереси її учасників;

– оновлюються правила отримання ліцензій. Наприклад, більше не потрібно буде отримувати кілька ліцензій на різні види фінансових послуг, адже кредитна спілка здійснюватиме діяльність на підставі ліцензії на діяльність кредитної спілки;

– передбачається диференціація ліцензій на стандартну (кредитна спілка зможе надавати фінансові послуги з кредитування та залучення від своїх членів коштів та банківських металів, що підлягають поверненню і не є пайовими внесками) та спрощену (може здійснювати лише кредитування);

– надається можливість передати низку функцій на аутсорсинг.

Розглянувши детально текст Закону, можемо виділити наступні зміни [7].

1. Розширення переліку осіб, що можуть бути членами кредитної спілки. Визначення «кредитної спілки» було закріплено ще у 2001 році. Тому нині чинне національне законодавство визначає кредитну спілку як некомерційну організацію, засновану фізичними особами, професійними спілками, їх об'єднаннями на кооперативних засадах з метою задоволення потреб її членів у взаємному кредитуванні та наданні фінансових послуг за рахунок об'єднаних грошових внесків членів кредитної спілки. Кредитна спілка є фінансовою установою, виключним видом діяльності якої є надання фінансових послуг, передбачених Законом. Також кредитну спілку віднесено до кредитних установ – фінансових установ, які відповідно до закону мають право за рахунок залучених коштів надавати кредити на власний ризик.

Закон змінює це визначення і відповідно до ст. 1 Закону, кредитна спілка – фінансова установа, створена на засадах кооперації з метою задоволення потреб її членів у взаємному кредитуванні та наданні фінансових та інших послуг, передбачених цим Законом, а також здійснення іншої діяльності, визначеної цим Законом, за рахунок об'єднання грошових внесків членів кредитної спілки та інших визначених цим Законом джерел.

Згідно Закону членами кредитної спілки можуть бути фізичні особи, фізичні особи-підприємці та юридичні особи, визначенні в ст. 14 Закону. Так, це нововведення дає можливість стати членами кредитної спілки фермерським господарствам, кооперативам, мікропідприємствам, професійним спілкам зі статусом первинних або місцевих, релігійним організаціям, об'єднання співвласників багатоквартирних будинків та мікропідприємствам.

2. Перелік послуг, що надаються кредитними спілками. ЗУ «Про кредитні спілки» від 2001 р. передбачав, що кредитна спілка – це неприбуткова організація з обмеженим переліком послуг (кредитування та надання фінансових послуг за рахунок об’єднаних грошових внесків членів кредитної спілки). Новий же Закон, по-перше, не має посилання на «неприбутковість» кредитної спілки, а також значно розширює послуги, що може надавати кредитна спілка.

Зокрема, Закон визначає, що кредитна спілка може надавати такі види фінансових послуг:

1) на підставі стандартної ліцензії: а) надання коштів та банківських металів у кредит; б) залучення коштів та банківських металів, що підлягають поверненню;

2) на підставі спрощеної ліцензії - надання коштів та банківських металів у кредит.

Крім того, кредитна спілка має право здійснювати іншу господарську діяльність, виключно за умови, що така діяльність, послуги пов'язані з основною діяльністю кредитної спілки з надання фінансових послуг або необхідна кредитній спілці для забезпечення більшої доступності фінансових послуг для її членів. Тому, кредитні спілки можуть здійснювати посередницькі, консультаційні, інформаційні послуги, пов'язані із наданням фінансових послуг, вести благодійну діяльність, надавати в оренду та суборенду майно і т.д.

3. Удосконалення системи управління кредитною спілкою. Раніше вимог до системи управління кредитною спілкою не було закріплено в законодавстві. Наразі новий Закон передбачає, що кредитна спілка повинна мати ефективну систему управління, організовану з дотриманням вимог цього Закону з урахуванням розміру, особливостей діяльності кредитної спілки, її плану діяльності, переліку та обсягів послуг, що нею надаються, профілю ризику, значущості кредитної спілки. Також система управління кредитною спілкою повинна відповідати ряду вимог, таких як прозорість організаційної структури, ефективність системи внутрішнього контролю, забезпечення підконтрольності між наглядовою радою та правлінням, посадовими особами та підрозділами кредитної спілки, а також унеможливлення (запобігання) прийняття зазначеними органами, особами, підрозділами рішень, що можуть призвести до негативних наслідків у діяльності кредитної спілки тощо.

Також Закон вносить зміни до процедури проведення загальних зборів та дозволяє проведення дистанційних зборів у режимі відеоконференції. Крім цього, розбудовується система здійснення контролю за діяльністю, а також щорічної оцінки ефективності діяльності спілки. Закон встановлює заборону керівникам кредитної спілки та особам, що здійснюють ключові функції у кредитній спілці, бути представниками інших членів кредитної спілки на загальних зборах членів кредитної спілки, та запроваджує вимогу погодження НБУ кандидатів на посади керівників кредитної спілки. Також НБУ отримує право вимагати заміни будь-кого з керівників, головного ризик-менеджера та головного комплаєнс-менеджера, керівника підрозділу внутрішнього аудиту, якщо їх професійна придатність та/або ділова репутація не відповідають встановленим НБУ вимогам.

Також кредитні спілки матимуть право передавати функції, окремі завдання та процеси у межах таких функцій на аутсорсинг.

4. Удосконалення вимог до структури капіталу кредитної спілки. Так, кредитна спілка зобов'язана спрямовувати до резервного капіталу не менше 50% прибутку, що залишається у її розпорядженні за підсумками звітного періоду), до моменту, коли на кінець звітного періоду співвідношення резервного капіталу до активів кредитної спілки становитиме не менше 15%, а непокритий збиток буде відсутній.

У разі якщо за підсумками звітного періоду співвідношення резервного капіталу до активів кредитної спілки становить від 15% до 20%, а непокритий збиток відсутній, кредитна спілка зобов'язана спрямувати до резервного капіталу не менше 10% прибутку, що залишається в розпорядженні кредитної спілки за підсумками звітного періоду. А у випадку, якщо співвідношення резервного капіталу до активів кредитної спілки становить понад 20%, а непокритий збиток відсутній, кредитна спілка спрямовує до резервного капіталу частину прибутку, в розмірі, визначеному рішенням загальних зборів членів кредитної спілки [8].

НБУ, який з 1 липня 2020 року став регулятором небанківських фінансових установ і постійно надає роз’яснення громадянам щодо роботи кредитних спілок. Оскільки, громадяни не завжди добре обізнані про свої права як учасників кредитної спілки та пов’язані із цим ризики.

Перше правило - перед оформленням вкладу до кредитної спілки, клієнту потрібно перевірити, чи має фінансова установа діючу ліцензію. **У деяких випадках кредитна спілка повинна мати навіть дві ліцензії.** Кредитна спілка може залучати кошти від своїх членів двома шляхами – через договори вкладів на депозит та через обов’язкові або добровільні пайові внески.

Якщо спілка залучає кошти через пайові внески, то їй достатньо мати одну ліцензію – на надання коштів у позику, в тому числі і на умовах фінансового кредиту.

Якщо спілка залучає кошти через депозитні договори, то їй необхідно мати дві ліцензії – на залучення фінансових активів із зобов'язанням щодо наступного їх повернення та на надання коштів у позику, в тому числі і на умовах фінансового кредиту.

Друге правило вкладника – звертати увагу, що кредитні спілки не є учасниками системи гарантування вкладів. Кредитні спілки не є учасниками Фонду гарантування вкладів фізичних осіб. Тобто держава не гарантує повернення коштів вкладникам у разі банкрутства спілки. Вкладники повинні розуміти цей ризик, ухвалюючи рішення.

Кредитні спілки належать до високо ризикових фінансових установ, оскільки вони залучають кошти громадян. Тому завдання НБУ – встановити такі вимоги та таке регулювання, щоб попереджувати проблеми з платоспроможністю спілки [9].

НБУ змінює підходи до застосування заходів впливу до кредитних спілок в умовах воєнного стану, зокрема поновлює застосування плану відновлення фінансової стабільності.

Відповідні зміни внесені до постанови Правління НБУ від 06 березня 2022 року № 39 «Про врегулювання діяльності учасників ринку небанківських фінансових послуг, небанківських фінансових груп, учасників платіжного ринку, колекторських компаній та юридичних осіб, які отримали ліцензію на надання банкам послуг з інкасації» [10].

Згідно зі змінами НБУ може застосувати до кредитної спілки захід впливу у вигляді затвердження плану відновлення фінансової стабільності та не застосовувати інші заходи впливу, якщо відповідні порушення спричинені негативним впливом військової агресії рф проти України. Варто також зазначити, що після закінчення війни, сектор небанківських фінансових послуг підлягатиме новим змінам від Регулятора [11].

Отже, кредитні спілки мають переваги перед іншими фінансовими установами позабанківської системи: механізм створення є простим, структура управління є демократичною, а система контролю не дозволяє допускати зловживань; кооперативні принципи є привабливими для населення; статус неприбуткової організації дає пільги в оподаткуванні. Тому сьогодні урядові структури України повинні чітко визначитись щодо сприяння розвиткові кредитного кооперативного руху [12].

Перспективними напрямами створення ефективної системи державного сприяння належить визнати такі: узгодження всіх законодавчих і удосконалення підзаконних актів, що стосуються діяльності кредитних спілок; початковий державний внесок у Фонд гарантування депозитів КС; надання кредитним спілкам пільгового довгострокового кредиту з боку банків; формування інформаційної мережі для висвітлення особливостей діяльності кредитних спілок і для створення здорової конкуренції на фінансовому ринку.

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