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USING GAS-DISCHARGE PHOTOGRAPHY TO STUDY THE BIOLOGICAL ACTIVITY OF WATER

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Abstract. *In the early stages of studying the properties of water and developing models of its structure, most scientific research devoted to the physics of water viewed water solely as a collection of molecules and neglected its structural and energy properties. Most methods for evaluating the physicochemical properties of water use the following parameters: electrical conductivity, oxidation-reduction potential, acid-base equilibrium (pH), and concentration of dissolved impurities. These parameters, although traditionally used, do not take into account the quantum and biological properties of water, which have been the focus of many water researchers over the past decade.*

The present study aims to investigate the biological properties of water using gas discharge photography of various samples and to compare the results with standard physicochemical methods. The corona gas discharge phenomenon occurring around and in the contact zone of water droplets was recorded on X-ray photographic film, which optimally reflects the current experimental data on the absorption of R- and L-polarized water in the ultraviolet range. Experimental studies of the biological and quantum properties of water have been conducted for over twenty years by M.V. Kurik and a group of Ukrainian scientists. The structure of water is presented as a mixture of protonophilic and hydroxylophilic clusters and clathrates. A new feature is the inclusion of protonolytic active water clusters and clathrates in water.

Key words: *water, biological properties of water, gas discharge photography, water and developing models, structure of water, water clusters and clathrates*

I. INTRODUCTION

In the initial stages of studying water properties and developing models of its structure, most scientific studies devoted to the physics of

water considered water solely as a collection of molecules and ignored its structural and energetic properties. Most methods for assessing the physicochemical properties of water use the

following parameters: electrical conductivity, oxidation-reduction potential, acid-base equilibrium (pH), and the concentration of dissolved impurities. These parameters, while traditionally used, do not account for the quantum and biological properties of water, which have been the focus of many water researchers in the last decade.

Experimental studies of the biological and quantum properties of water have been conducted for over twenty years by M.V. Kurik and a group of Ukrainian scientists. In general, the structure of water is represented as a mixture of protonophilic and hydroxophilic clusters and clathrates. A new feature is the inclusion of protonolytic active water clusters and clathrates in water. Primary in determining water properties is its chemical composition. The chemical composition of drinking water must meet standards, and this composition is determined by chemical analysis.

As a physical medium, water has a characteristic structure that determines its phase diagram. Water possessing inseparable properties is most suitable for the human body. The characteristics of natural water include its fractality and coherence [1-7].

At the University of California (USA), nuclear magnetic resonance was used to obtain experimental evidence for the theory of quantum coherence in water [8]. Professor Ignatov and co-authors [9] conducted studies of water properties using modern methods, which resulted in the identification of the water cluster (H₂O)₅ as a critical structure and energy threshold. The research also revealed that with this cluster network size, sufficient connectivity in water is achieved, necessary to maintain conditions for proton transport and dielectric relaxation.

The performed analysis of the current level of research into the biological properties of water indicates that, when assessing the quality of water sources, it is important to consider, in addition to standard physicochemical methods, the quantum nature of water and its associated properties. The structural ordering of water and its energetics are interrelated. The presence and characteristics of quasi-free electrons, which can act as free charge

carriers, can be studied using technologies for visualizing the electric discharge around objects in a high-frequency, high-voltage field, in this case, a drop of water [10]. In the last decade, we have conducted studies of the biological (including coherent) properties of water based on the corona gas discharge method, the results of scientific research are presented in [11-13]. In order to create modern information and measurement technologies, hardware for the corona gas discharge method has also been developed and improved [14-16], which allows for the use of both photo and X-ray film, as well as a modern digital format for recording corona gas discharge images.

Physical processes occurring when an electromagnetic field is applied to a liquid sample lead to the formation of a gas-discharge current and the occurrence of individual gas discharges. These processes depend on the ability of a water sample, in the form of a drop, to emit free charge carriers from its surface [17].

Further refinement of gas-discharge photography methods for various water samples, as well as comparison of the obtained results with other generally accepted physical and chemical methods, appear promising for assessing the biological properties of water, which has important practical implications.

II. MAIN TEXT

The aim of this study was to investigate the biological properties of water using gas-discharge photography of various samples, as well as to compare the results with standard physicochemical methods.

1. Materials and methods

The corona gas discharge occurring around and in the contact zone of water droplets was recorded on X-ray film, which optimally accounts for current experimental data on the absorption of both R- and L-polarized water in the ultraviolet range. X-ray film is sensitive to the latter. A device for recording the gas-discharge glow of liquid-phase objects was used (Fig. 1) [18].

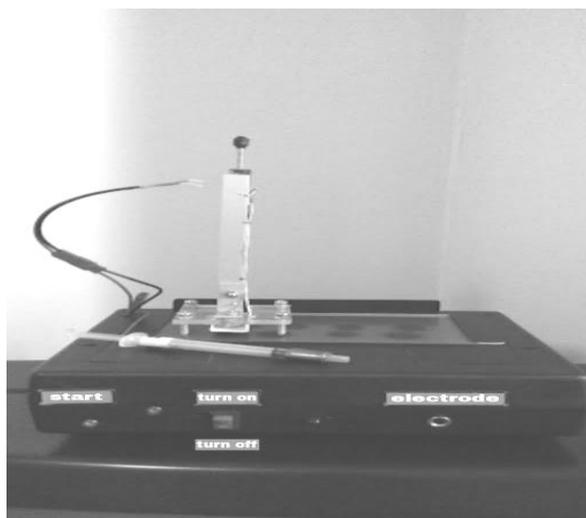


Fig.1. Device for registration of images of gas-discharge radiation

Distilled water (sample #1), melted, settled water prepared at the Institute of Human Ecology (Kyiv) (sample #2), and well water taken from a spring on the territory of the Kyiv-Pechersk Lavra (sample #3) were analyzed. Fifty drops of each water sample were photographed in an X-ray room.

Two-dimensional images of the corona gas discharge around the water droplet were subsequently converted to digital form. A histogram was constructed to obtain integral image characteristics. For grayscale digital images, the number of image histogram columns corresponds to the standard number of grayscale tones - 256. In the course of conducting studies of corona gas discharge image samples and based on expert information, as well as taking into account the metrological requirements for constructing histograms, the number of histogram ranges was chosen equal to 12. The justification for choosing this number of histogram sub-ranges from the point of view of mathematical statistics and metrological requirements is given in [19, 20]. In the synthesis of information and measurement technologies for assessing the properties of water, an important issue is also the assessment of the accuracy of the analysis of the quantitative values of the geometric and photometric parameters of the images. The results of assessing the accuracy of the quantitative parameters of corona gas discharge images are given in [21, 22].

The corona gas discharge method was used for the water samples studied, along with the following standard physicochemical methods: electrical conductivity - σ (in μSm); acid-base balance parameter - pH; oxidation-reduction potential - ORP (mV); determination of the concentration of dissolved impurities - TDS (mg/L). Experimental studies were conducted under the supervision of Prof. M.V. Kurik at the Institute of Human Ecology (Kyiv).

The obtained corona gas discharge images in the second stage of the study were analyzed using application software: median graphs were plotted for twelve histogram brightness intervals, and the difference between the median value from the subsequent subrange and the previous one. Software analysis of water corona discharge images was conducted at Dnipro University of Technology.

2. Results and discussion

Table 1 presents the results of water sample testing using physicochemical methods. Fig. 2 shows the images of corona discharge around drops of the water samples being studied. Table 2 presents the quantitative parameters of corona gas discharge images obtained using software analysis of image histograms: medians in brightness intervals.

Fig. 3 shows the medians in the brightness intervals of the image histogram. Table 3 presents

the quantitative parameters of corona gas discharge images obtained using software analysis

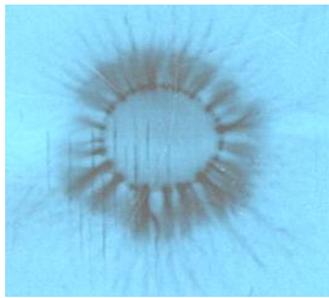
of image histograms: the differences in medians in adjacent brightness ranges of the histogram.

Table 1.
Results of water sample testing using standard physicochemical methods

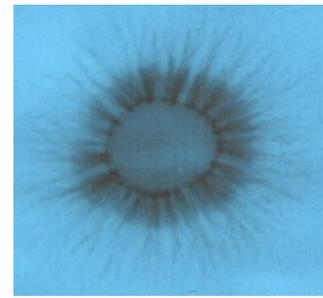
Type of water sample	Distilled water	Melted settled water from the apparatus	Well water
Physicochemical indicator			
pH	5.95	5.90	9.00
σ (μSm)	12	17	605
TDS (mg/l)	6	8	700
Oxidation-reduction potential (mV)	+230	+285	+150



Distilled water



Melt water



Well water

Fig. 2. Images of corona discharge around droplets of the studied water samples

Table 2.
Illustrates the results of medians of histograms of corona discharge brightness of water samples

Brightness interval number	Median values for a water sample		
	Distilled water	Melt water	Well water
1	0	0	0
2	4	2	3
3	1540	2442	1281
4	2426	3664	2112
5	2783	4031	2810
6	3208	5011	4318
7	3972	4495	5932
8	5195	4928	4597
9	6582	6683	5759
10	29870	35738	35583
11	15202	16421	20511
12	1	3	1

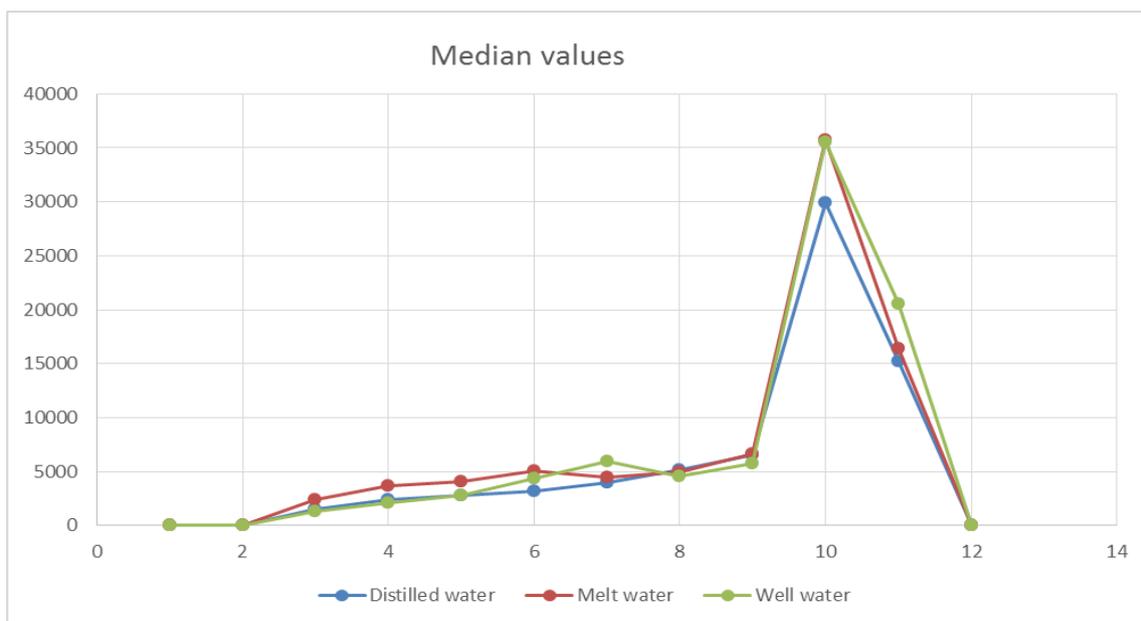


Fig 3. Median values for a water sample

Table 3.
Illustrates the results of differences between medians of histograms

Brightness interval number	Differences between medians		
	Distilled water	Melt water	Well water
1	-	-	-
2	4	2	3
3	1536	2440	1279
4	886	1222	831
5	357	367	698
6	425	980	1508
7	764	-516	1614
8	1223	433	-1335
9	1387	1755	1162
10	23288	29055	29824
11	-14668	-19317	-15072
12	-15201	-16418	-20510

Figure 4 shows the differences in medians between the subsequent and previous brightness intervals of the histogram. Software and expert analysis of corona discharge images, as well as quantitative brightness parameters, revealed the following patterns that correlate with the properties of the water samples studied. The physicochemical parameters of sample #2 differ slightly compared to sample #1 (distilled water),

but more significant differences were found compared to sample #3. However, the values of these parameters were higher for melt water than for distilled water.

Analysis of the pixel distribution across brightness intervals, displayed in the corona discharge histogram graphs, indicates significant differences in the energy of the gas discharge radiation. This difference is related to the

structural differences between the water samples, which are physically determined by the different charged particle emission fluxes that participate in the formation of gas discharges on the surface of the X-ray film around the liquid droplet. In particular, both for distilled water and for melt water, the histogram graph shows a significant increase in the values of the median brightness of the glow from the third interval, which corresponds to the activity of free, unbound water entering into chemical reactions with the X-ray film [23, 24].

The smooth increase in the quantitative values of the medians in the histogram is maintained in subsequent brightness intervals. The identified patterns are consistent with the results of studies presented in [25], whose authors indicate that, despite the fact that distilled water is chemically pure, it exhibits structural dynamics caused by hydrogen bonds and other ionic effects. These effects explain the fact that the distilled water sample, during an active measurement experiment conducted using a high-frequency pulsed electromagnetic field, exhibits only weak polarization, due to the presence of a minimal

amount of chemical compounds involved in the formation of gas discharges.

For sample No. 2 of melted, settled water, standard physicochemical analysis methods show that the electrical conductivity and concentration of dissolved impurities were slightly higher than those of distilled water. Moreover, during the active measurement experiment, meltwater demonstrated greater energy during the formation of gas discharges, as indicated by the large quantitative values of the medians in the middle intervals (fourth through eighth) of the histogram brightness. The presence of large median values in the middle intervals of the histogram indicates an increase in the width of the gas discharge corona, along with a decrease in the radiation brightness. These differences are weakly expressed when analyzing the results obtained by standard physicochemical methods, but they are clearly visible and can be quantified when using the corona gas discharge method.

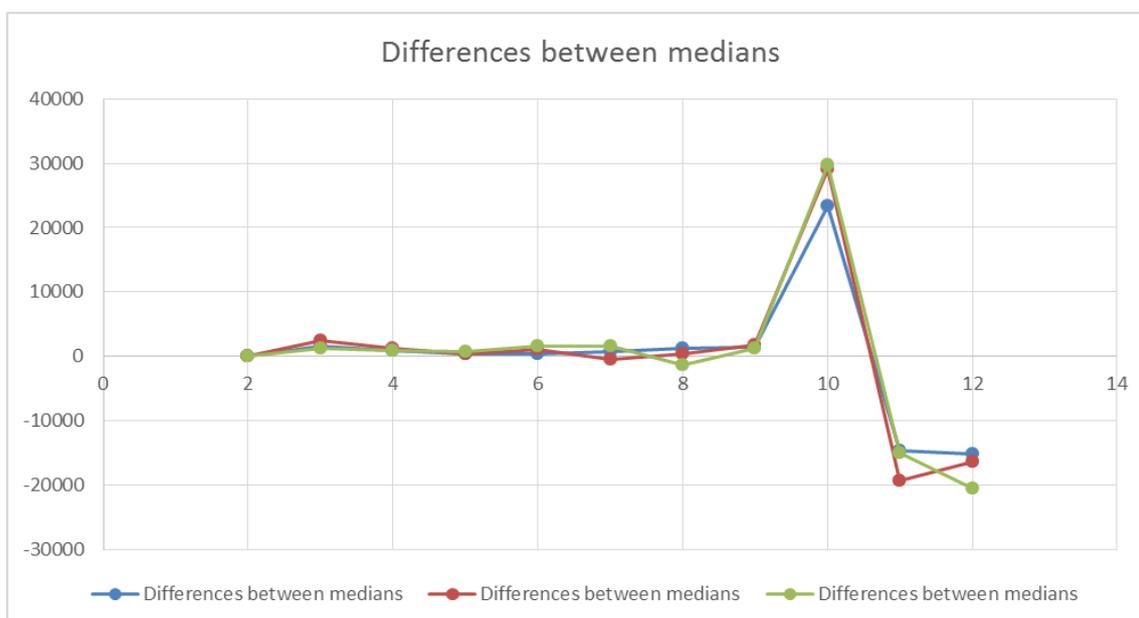


Fig. 4. Differences in medians between adjacent intervals of histogram brightness

For water samples No. 2 and 3, the corona discharge luminescence brightness in the film background range (subrange 10) was higher than that of distilled water, consistent with the presence of a subtle luminescence in their corona images, brighter than the film background. This is also consistent with the differences in medians for samples after subrange 10.

According to [25], liquid water is a coalition, a collection of coherent domains. These features of the corona discharge luminescent layer are characteristic of coherent water. Distilled water is incoherent [26, 27], which explains the absence of a luminescent layer in the corona. A characteristic feature of well water was its higher values in the light portion of the histogram than that of meltwater samples. The uniform change in values across intervals after the tenth subrange is noteworthy for well water, in contrast to sample No. 2. These differences indicate different degrees of structuring in the water samples studied. In particular, the quantum properties of well water are inherent to coherent water with a high degree of order.

A distinctive property of coherent matter is a disproportionately strong response to external stimuli. According to Roberto Germano [28], consistent coherent domains of water with low energy and high entropy can, under certain conditions, restructure, becoming high-energy, low-entropy domains capable of external work. In this study, the resistance to gas discharge in well water was greater than that of samples No. 1 and 2.

In the well water, unlike samples No. 1 and 2, a distinctive feature was the resistance of the corona discharge glow brightness to the action of an external pulsed current, with the values of the seventh interval repeating in subsequent intervals, right down to the brightness of the film background. This is understandable, given the authors' data [29] that water clusters can self-organize in an aquatic environment under the influence of physical fields and chemical compounds, which is similar to the dynamics of dissipative structures. The following characteristic features were identified: a uniform increase in the curve amplitude across the subranges; a small

difference between them; a smaller fraction of free, unbound water, which is reflected by the lower amplitudes on the left side of the graph. Unlike distilled and meltwater, the well water sample exhibited more of the properties of bound water, which is important for cellular organization.

Water sample #3 had high electrical conductivity and soluble impurity concentrations compared to other samples. However, the ratio of these parameters to each other was the lowest, demonstrating the presence of mechanisms underlying electrical conductivity that are not determined solely by the material carriers in the water. These quantum state characteristics of the Lavra springs apparently underlie their high biological activity, with alkalizing effects. We previously established that the impurity concentration in water itself does not affect the corona gas discharge image [31], a finding also demonstrated in the present study.

Consequently, well water, in terms of the structural and energetic characteristics of its corona discharge, differs from both distilled and industrially prepared meltwater, possessing a highly ordered structure and greater biological activity.

According to the results of research conducted under the supervision of Professor M.V. Kurik, water from springs on the territory of the Kyiv-Pechersk Lavra exhibits the highest biological activity compared to other water samples examined in this experimental study. Thus, the corona gas discharge method with subsequent image processing is useful as a complement to existing physicochemical analytical methods. Further research into the quantum effects of water has practical implications for solving environmental, biological, and medical problems.

III. CONCLUSION

1. Experimental studies have established correspondences between the parameters of distilled, melted, settled, and natural well water samples, obtained using physicochemical methods, and the characteristics of corona gas discharge images.

2. For an integrated assessment of the geometric and photometric parameters of corona gas discharge images, it is rational to use an analysis method based on constructing image histograms divided into 12 brightness intervals with an estimate of the median within each subrange. This is because, from a mathematical statistical perspective, the median is more robust to individual outliers in the data sample than the classical estimate of the mathematical expectation in the form of an arithmetic mean.

3. Using the median as an experimental estimate of the mathematical expectation of the number of pixels in a brightness interval allows for a better accounting of the random physical nature of the formation of individual gas discharges and ensures the stability of statistical estimates.

4. The geometric and photometric parameters of water gas discharge images allow for the identification of specific structural and energy characteristics of water.

5. The corona gas discharge method can be recommended for assessing the properties of water related to its quantum properties and biological activity.

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EFFECTS OF MARINE LITTER POLLUTION

ЕФЕКТИ ОТ ЗАМЪРСЯВАНЕТО С МОРСКИ ОТПАДЪЦИ

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Резюме. *Замърсяването с морски отпадъци е признато за екологичен проблем в глобален мащаб с изразен трансграничен характер и значими негативни последици за морските и крайбрежните екосистеми. Настоящата разработка идентифицира краткосрочните преки и отложените във времето биотични и абиотични ефекти от разпространението и акумулацията на морски отпадъци по водната повърхност, във водния стълб, на дъното и по бреговите ивици. Разгледани са основните механизми на негативните ефекти върху морската околна среда, включително промени във функциониране на екосистемите, включване в трофичната мрежа и биогеохимичните цикли, социално-икономическите последици за крайбрежните райони. Анализът е фокусиран върху процесите, на които са подложени морските отпадъци. Предложена е категоризация на въздействията в три основни групи – физико-механични, химични и биологични, които определят фрагментацията, трансформацията и транспорта на морските отпадъци. Резултатите подчертават необходимостта от интегриран подход за превенция, мониторинг и подобряване на управлението на морските отпадъци като ключов елемент от опазването и устойчивото развитие на морската околна среда.*

Ключови думи: морски отпадъци, замърсяване, морска околна среда.

Abstract. *Marine pollution is recognized as global ecological problem with apparent transboundary aspect and significant negative consequences for marine and coastal ecosystems. This study identifies immediate and postponed biotic and abiotic effects of marine litter distribution and accumulation on the surface, in the water column, on the sea bed and along the coastline. The main mechanisms of negative effects on the marine environment are presented along with changes in ecosystem functioning, inclusion in trophic web and biogeochemical cycles, social -economic consequences for coastal areas. Analysis focusses on the processes of which marine litter is subjected. A categorization of the impacts into three main groups is proposed – physico-mechanical, chemical and biological, which determine the fragmentation, transformation and transport of marine litter. The results highlight the need for an integrated approach for prevention, monitoring and improved management of marine litter as a key element of protection and sustainable development of marine environment.*

Key words: marine litter, pollution, marine environment

I. ВЪВЕДЕНИЕ

Според „Аналитичен преглед на морските отпадъци“ [1] около 6,4 млн. тона отпадъци се изхвърлят в Световният океан всяка година.

Морските отпадъци са глобално идентифицирани като глобален екологичен проблем, характеризиращ се с комплексност и трансграничен характер.

Обхвата на замърсяването с морски отпадъци и свързаните с него вредни въздействия не се ограничават само до водната повърхност, водната колона и морското дъно, а се разпростират и върху крайбрежните местообитания (литорал, морски плажове и дюни), и върху цялостното функциониране на морските и крайбрежните екосистеми. За това свидетелстват публикациите на Hanke et al. (2013) [2], Galgani et al. (2013) [3], Galgani (2015) [4], Toneva (2015) [5], Hanke et al. (2019) [6], Simeonova et al. (2020) [7], Bekova, Prodanov (2024) [8], Hanke et al. (2025) [9] и др.

Целта на настоящото проучване е да се идентифицират директните и късните ефекти от замърсяването с морски отпадъци, като се вземат под внимание разпространението и акумулацията на плаващите и отложените на морското дъно, и по бреговете ивици, и плажове морски отпадъци.

II. ОСНОВЕН ТЕКСТ

Анализ на видовете ефекти от замърсяването, разпространението и акумулацията на морски отпадъци

В научната литература въпросът за присъствието на морски отпадъци с различен произход и характер първоначално се появява през втората половина на 60-те години на XX век. През 70-те год. на миналия век за първи път се привеждат научни доказателства за негативни ефекти оказвани от морски отпадъци върху различни биологични видове. През 1960г. е установено, че морските птици при бреговете на Нова Зеландия поглъщат малки пластмасови отпадъци, което крие риск за тяхното физическо оцеляване. В периода от 1970 до 1990 г. се натрупват данни от различни проучвания върху морските птици, недвусмислено доказващи, че поглъщането на пластмаси не е изолиран инцидент, който може да се обясни с видова специфика, а е масово явление сред морските птици. Негативното въздействие се дължи на синтетични бионеразградими полимерни отпадъци – части от пластмасови торбички, рибарски корди, сезал, ластици, пелети и др. Поглъщането на морски отпадъци причинява вътрешни увреждания на различни видове -

птици, риби, костенурки и др. поради факта, че не ги различават от обичайната си храна. При поглъщане те се натрупват в храносмилателния тракт на птиците, нарушават процеса на хранене, предизвикват запушване, а често дори смърт. [10, 11] Това води до блокиране на храносмилателната система, гладуване и дори смърт [12, 13, 14, 15].

Разграничава се първично поглъщане - случайно или в процес на хранене, филтриране, и вторично - по хранителната верига, когато хищен вид улови плячка поглънала морски отпадъци. Замърсяването с морските отпадъци оказва негативно въздействие върху поведението на морските организми. В стремежа си да избегнат замърсените зони организмите променят обичайните места за отхранване и размножаване. [16, 17, 18] В комбинация отрицателните въздействия оказват негативен ефект върху преживяемостта на популациите.

В своите изследвания Kenyon (1969) [19], Werner (2016) [20] и Ryan, P. G. (2015) [11] привеждат доказателства за повишената смъртност при младите албатроси вследствие поглъщане на пластмаса от повърхността на морските води. Те доказват хипотезата, че младите птици не разпознават пластмасовите отпадъци и ги приемат за хранителен ресурс.

В научната литература са документирани случаи с подобни негативни ефекти върху морски костенурки, бозайници и др. Негативно въздействие на морските отпадъци, който предизвиква особена загриженост е т.нар. „Призрачен риболов“ (Ghost fishing). Регистрирани са и множество инциденти със заплитане в изоставено или изгубено риболовно оборудване от устойчиви полимерни материали и повишена смъртност, в граници застрашаващи оцеляването и възпроизводството на някои популации. [21, 22, 23, 24, 25] Заплитането на морски организми в изоставени изгубени рибарски мрежи, въжета и найлони, изхвърлени риболовни съоръжения, изоставени мидени ферми и др., води до физическите наранявания, инфекции, задушаване, ампутации и смърт. [12] Изгубените

риболовни съоръжения, се оценяват на 10% от всички морски пластмасови отпадъци. [26]

Въвеждането на много здрави риболовни съоръжения, изработени от небioresградими синтетични, дълготрайни материали, допринася за феномена на „призрачния риболов“, който компрометира по непряк начин и риболовните запаси. Терминът „призрачен риболов“ е установен за изгубено или изоставено риболовно оборудване, което все още е в работно положение, т.е. действащо, което продължава да улавя и умъртвява голям спектър от морски организми. [27, 14, 28]

„Призрачният риболов“ е с продължителен период на действие поради устойчивостта на полимерите в морската среда, целостта на мрежите варира от години до десетилетия. Проведени са експериментални изследвания за въвеждане на biorазградими рибарски мрежи от полибутилен сукцинатна смола, смесена с полибутилен адипат-ко-терефталатна смола (PBSAT), като екологична алтернатива на конвенционалните мрежи. Резултатите показват по-ниска якост на опън при полеви тестове в сравнение с конвенционалните мрежи и по-ниска ефективност на улова, както това е демонстрирано в [29, 30]. Бiorазградимите рибарски мрежи имат значителен потенциал за намаляване на негативното влияние на морски отпадъци при подобряване на механичната устойчивост.

Остатъците от синтетични полимери са най-значимата част от морските отпадъци [31, 32], а микроотпадъците (частици с размер < 5 мм) е възможно да се включват в хранителните вериги. При поглъщане от морските организми оказват директно негативно въздействие върху екосистемите, а при консумация на морски продукти - индиректно върху човешкия организъм.

Токсичността на микропластмасите се определя от различни фактори - размер на частиците, форма и покритие на повърхността. [33]

Налице са изследвания и резултати за допълнителен негативен ефект на микропластмасите – въздействието им като трансферен вектор за патогени в хидробионтите, респективно човека, при консумация на морски храни. [34, 35]

Въздействията върху морската среда варират от физическо или химическо увреждане на морската биота до необратими ефекти върху биоразнообразието и функционирането на екосистемите. [36]

Според научната общност и докладите на Групата на двайсетте (Г-20) [37, 38, 39] обединяваща 20-те най-бързо развиващи се икономики, включително Европейският съюз, натоваването на морската среда с отпадъци (плаващи, съдържащи се във водния стълб и отложени на дъното), както и нарастващото им натрупване по бреговете е прието за един от основните екологични проблеми в световен мащаб.

Морски отпадъци достигат до дълбоководни, труднодостъпни и отдалечени от брега зони, което доказва, че проблемът с разпространението им не е само в крайбрежните участъци. Дълбоководните акватории са крайната точка за акумулация на морски отпадъци с антропогенен произход. Изследванията на Hanke (2025) [19] констатира замърсяване с морски отпадъци на дълбочина над 5000 м в Средиземно море. Резултатите отчитат, че 88% от идентифицираните отпадъци принадлежат към от групата на изкуствените полимерни материали. Морските отпадъци във водния стълб се транспортират чрез теченията, като отлагането им на дъното е функция на силата на течението и скоростта на потъване. Процеса на обрастване от морски организми повишава плътността им и благоприятства потъването, фрагментирането и утаяването на морското дъно.

Негативните ефекти от замърсяването с морски отпадъци са класифицирани в две основни категории - *абиотични и биотични*.

Морските отпадъци и особено микропластмасите, променят физико-химичния състав на морските води и седименти.

Разграждането на пластмаса, метали и други отпадъци води до освобождаване на токсични химични съединения в матрици „вода“ и „седимент“. В процеса на дезинтеграция на отпадъците в морски условия се отделят токсични съединения като бисфенол А, фталати, тежки метали, които

замърсяват морската среда. [40, 41, 33, 42] Някои ксенобиотици, включително устойчиви органични замърсители, токсични метали, пестициди, хербициди, фармацевтични продукти, пластмаси и микропластмаси, са устойчиви на разграждане и се предполага, че дълбоководното и седиментите са крайният етап на отлагането им. [43]

Плаващите отпадъци на морската повърхност и във водният стълб нарушават светлинния и температурния баланс. Пропускливостта на светлината определя фотичният слой, важен фактор за протичане на процеса на фотосинтеза при фитопланктона и други светлочувствителни организми. Ограничаването на достъпа на светлина нарушава процеса на фотосинтеза и оказва влияние върху количеството биомаса и вида на разнообразие.

Струпванията на отпадъци на голяма площ под действие на теченията и ветровия режим, т.нар „острови от морски отпадъци“, често водят до ограничаване на разпространението на светлината в дълбочина и в някои случаи потенциално могат да доведат до затруднена водна циркулация, нарушен газообмен с атмосферата и понижено съдържание на разтворен кислород във водната колона. [44, 45] Промяната на албедото може да окаже локално влияние на термичния режим.

От всички морски отпадъци, най-вече плаващите показват потенциала да действат като вектор за навлизане и разпространение на чужди и/или инвазивни видове и патогени.

Наличието на големи количества дънни морски отпадъци води до физични изменения на бентосните хабитати и обрастване, т.е с течение на времето се превръщат в неразделна част от екосистемата. Антропогенните отпадъци покриват дъно, рифове и подводни ливади от морски треви и макроводорасли, което води до деградация на хабитати и загуба на биоразнообразие. [43] Отлагането на едрогабаритни, тежки отломки и други отпадъци на дъното често е съпроводено от локални промени в дънните хабитати. Същевременно не трябва да се пренебрегва факта, че отпадъци могат да се превърнат в жизнено пространство и/или укритие за различни халобионти.

Плътни слоеве от отпадъци на морското дъно също могат да са фактор, възпрепятстващ обмяната на газове и вещества между придънният воден слой и седиментите, което нарушава биогеохимичните цикли. [46] Освен това, отлагането и движението на едрогабаритни отпадъци по дъното причинява увреждане на чувствителни структури като коралови рифове и гъби [16]. Големи натрупвания на отпадъци в крайбрежни райони могат да променят местната хидродинамика чрез промяна на локални течения, ускоряване или забавяне на процесите на абразия, седиментация и реседиментация [47].

Пясъчните плажове са сред основните зони, в които се натрупват морски отпадъци, като могат да останат локализирани в пясъчните структури или да бъдат отнесени по-навътре в сушата. [48]

Морските отпадъци отложени на бреговете плажни ивици могат не само да отнемат от естетическият им вид, но имат и потенциал да променят ландшафта (при екстремни отлагания на морски отпадъци), да увредят дънните природни местообитания, както и да затруднят обмена на седименти.

Замърсяването на морските плажове и бреговете линии води до намаляване на ценността на тези зони, отнема от добавената им стойност като обекти за туризъм и рекреация. Отчитат се негативни последици за местната икономика, финансови загуби поради намалена рекреационна стойност и допълнителни разходи за поддържане на плажните ивици. [49]

Твърдите отпадъци, попаднали в морска среда чрез речен вток или ветрови транспорт, са изложени на различни въздействия [50, 51], които са категоризирани в три основни групи: физико-механични, химични и биологични.

Физико-механичните въздействия върху отпадъците във водна среда се изразяват основно в подлагането им на механичното въздействие на вълни, течения, сблъсък с брега, пренос на големи разстояния, потъване в дълбочина и отлагане на дъното. Тези процеси водят до фрагментация, размерите на отпадъците намаляват, което увеличава общата повърхност и ги прави по-достъпни за

последващи трансформации. *Механичният стрес* в резултат вълновото действие и абразионни процеси е ключов фактор за фрагментацията на изкуствените полимерни материали [51]. *Химичните процеси* включват фотодеградация под въздействие на UV радиация, термична деградация при повишени температури на средата (плажни ивици, водна повърхност), хидролиза на полимерните материали. [52, 53] Същевременно при намаляване размера на частиците се увеличава вероятността за тяхното поглъщане и пренос по трофичната мрежа.

Биологичните процеси включват обрастване, биоаккумуляция и биодеградация. Обрастването от морски микроорганизми повишава масата на отделните фрагменти, води до промени в плътността им и благоприятства потъването. При биоаккумуляцията морските отпадъци се поглъщат от организмите, както и се предават по хранителните вериги. Биодеградацията на морските отпадъци е процес, при който морските микроорганизми разграждат отпадъците, вкл. и в анаеробни условия. [54] В зависимост от състава на продукта от който произхождат отпадъците, условията, при които протичат процесите, често резултира в освобождаване на токсични химични съединения с хронични и летални последици върху екосистемите. В дългосрочен план са възможни хормонални нарушения, намалена плодовитост, генетични мутации при морските организми.

Микропластмасите действат като носители на замърсители, които се акумулират в тъканите на организмите и по хранителната верига достигат до човека. [55, 56]

Плаващите морски отпадъци сериозно застрашават морските екосистеми, когато към тях е прикрепена биота. Те се изместват от теченията и приливите, като по този начин могат да бъдат причина за биологични инвазии, чиято степен и интензивност все още не са достатъчно изучени. Плаващите отпадъци могат да действат като вектор за пренос на инвазивни видове през различни морски басейни, където поради липсата на конкуренция могат да нарушат равновесието в локалните екосистеми. [13]

Изследването на Newman, 2015 [49] установява не само екологичните негативни ефекти от морските отпадъци, но и значителните икономически загуби. Примери за преки загуби са разходи направени за почистване на плажни ивици и пристанищни акватории от замърсяване, загуби от намалена посещаемост през курортния сезон поради липса на естетика, загуби от недостатъчен улов, изгубено или повредено оборудване в риболовния сектор, некачествена или недостатъчна продукция от аквакултури. Непреките икономически загуби се изразяват в загуба на биоразнообразие и екосистемни услуги.

III. ЗАКЛЮЧЕНИЕ

Морските отпадъци са един от ключовите проблеми на крайбрежните райони и водят до негативни екологични и социално-икономически последици. Представеният анализ систематизира ефектите от морските отпадъци в две основни категории – биотични и абиотични, като същевременно категоризира въздействията, на които са подложени – физико-механични, химични и биологични.

Доминацията на синтетични полимерни материали, които се характеризират с висока устойчивост, обуславя продължителният престой, разпространението, транспорта и акумулацията на морските отпадъци.

Проблемът със замърсяването с морски отпадъци следва да се разглежда като глобално екологично предизвикателство с комплексен характер и взаимосвързани ефекти.

Резултатите подчертават необходимостта от интегриран подход за превенция, мониторинг, управление и ефективни икономически мерки за намаляване на количествата морски отпадъци, като ключов елемент за опазването на околната среда и устойчивото развитие на обществото.

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KEY DIMENSIONS OF BURNOUT SYNDROME AMONG HEALTHCARE PROFESSIONALS IN BULGARIA, 2025-2026

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Abstract. Professional burnout among healthcare professionals represents a critical challenge for modern healthcare systems, affecting both staff well-being and the quality of patient care.

This study aims to examine burnout from an ethical perspective, exploring its impact on professional responsibility, patient safety, and the moral obligations of healthcare organizations. The research considers core ethical principles such as beneficence, non-maleficence, autonomy, and justice, and evaluates the influence of organizational and managerial factors such as workload, staff shortages, and workplace culture.

The study surveyed 122 Bulgarian healthcare professionals, including physicians, nurses, midwives, laboratory technicians, and other clinical staff. Findings indicate that the combined implementation of organizational, motivational, and communication strategies significantly contributes to burnout prevention. The results underscore the importance of cultivating an ethically grounded and supportive work environment, highlighting that addressing both structural and psychosocial workplace factors is essential for sustaining professional commitment, safeguarding patient care, and promoting the overall resilience and well-being of healthcare personnel.

Key words: ethical principles, workplace culture, staff well-being, burnout prevention, organizational factors

I. INTRODUCTION

In recent years, professional burnout among healthcare professionals has emerged as one of the most pressing challenges in the healthcare sector, with direct implications for staff well-being and the quality of healthcare services. Intensive work schedules, high levels of professional responsibility, prolonged emotional strain, and chronic shortages of human and material resources contribute to a work environment characterized by elevated stress levels and a heightened risk of psychological and emotional exhaustion. Research in this field emphasizes that

burnout is not solely an individual issue but a systemic phenomenon with organizational, managerial, and ethical dimensions, affecting patient safety, job satisfaction, and the sustainability of healthcare institutions [1], [2], [3].

Given these challenges, there is an increasing need for empirical studies aimed at identifying risk factors and developing effective management strategies to prevent burnout and support healthcare professionals.

The primary aim of this study is to examine professional burnout among healthcare professionals in Bulgaria from an ethical perspective, assessing its impact on professional responsibility, quality of care, and the role of healthcare organizations in mitigating this phenomenon. By integrating ethical considerations with organizational and psychosocial factors, this research seeks to provide evidence-based insights for fostering a supportive and sustainable work environment in healthcare settings.

II. MAIN TEXT

Management Approaches for Preventing Professional Burnout Among Healthcare Professionals

1. Theoretical and Conceptual Foundations of Professional Burnout

Professional burnout has been widely recognized in the scientific literature as one of the most significant psychosocial risks in contemporary work environments and as an indicator of imbalance between occupational demands and available individual and organizational resources. The World Health Organization (WHO) included burnout in the 11th Revision of the International Classification of Diseases (ICD-11) as a phenomenon specifically associated with the professional context. The concept was originally introduced by H. Freudenberger, who described it as a state of emotional and physical exhaustion, loss of motivation, and reduced engagement resulting from prolonged stress. A significant contribution to the development of the concept was made by C. Maslach, who developed a theoretical model and measurement tools for the syndrome, defining it through three core components: emotional exhaustion, depersonalization, and reduced personal accomplishment [5]. Her research emphasizes the importance of organizational factors, such as workload, support, managerial style, and team culture, as key determinants in the emergence and development of burnout, highlighting the need to consider it not only as an individual issue but also as a systemic and manageable organizational risk.

Over subsequent years, these theories and concepts have been further refined and expanded

by numerous authors. Between 1974 and 2019, no fewer than 13 distinct definitions of burnout have been published [4], reflecting the evolving understanding of the phenomenon in diverse professional and cultural contexts.

2. Methodology and Organization of the Empirical Study

The study sample comprises 122 healthcare professionals, including physicians, dentists, paramedics, nurses, midwives, and other allied medical staff employed in various clinical settings across Bulgaria. All completed questionnaires were deemed valid for analysis. Nurses constitute the largest proportion of respondents, reflecting their central role in healthcare delivery and their increased exposure to occupational stressors.

Data were collected using an anonymous, standardized questionnaire consisting of 15 closed-ended questions and 2 open-ended questions, designed to assess the level of professional burnout and to explore its association with organizational and managerial factors, such as workload, staffing adequacy, managerial support, and work environment.

The survey was conducted in full compliance with ethical research principles, including voluntariness of participation, informed consent, confidentiality, and anonymity of respondents. No personal identifying information was collected.

The empirical study was carried out during the period 21 November 2025 to 10 December 2025 across healthcare institutions in the Republic of Bulgaria, ensuring a diverse representation of clinical practice environments.

3. Interpretation of Study Results and Leadership-Driven Interventions for Burnout Prevention

The analysis of the survey data and the open-ended responses provided by healthcare professionals clearly outlines the key factors contributing to the development of burnout, namely staff shortages, excessive workload, and inadequate remuneration. These findings are consistent with the theoretically established relationships and align with trends widely reported in the scientific literature. In addition, a substantial number of responses highlight challenges related to interpersonal

communication, conflict situations, difficulties in teamwork, and insufficient managerial support. This confirms that the communication climate and the quality of interactions within work teams play a crucial role in determining the risk of professional exhaustion.

Furthermore, the analysis reveals a relationship between prolonged professional experience (Fig. 1) and the manifestation of burnout symptoms, indicating that the accumulation of long-term occupational strain and chronic stress increases the likelihood of emotional exhaustion and reduced job satisfaction. The data demonstrate a clear tendency whereby healthcare professionals with longer work experience exhibit a higher level of vulnerability to burnout. This observation suggests that sustained professional engagement and accumulated experience, while valuable, may also be associated with increased psycho-emotional burden if not adequately supported by effective organizational and managerial measures.

The interpretation of these results takes into account the specific characteristics of the working environment, including the intensity of patient interactions, administrative workload, and the availability of adequate support mechanisms and opportunities for recovery.

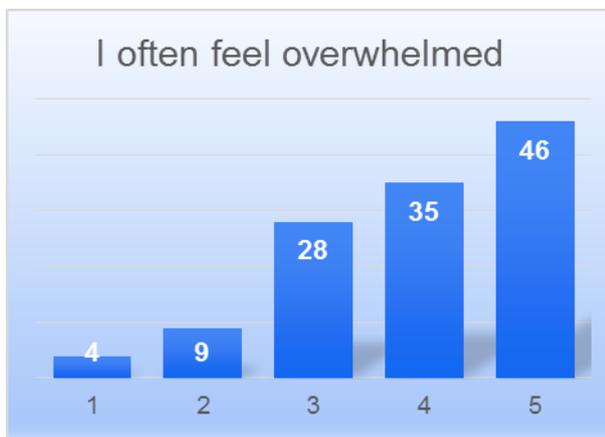


Fig. 1 Distribution of respondents according to work experience

The data indicate that as professional experience increases, there is a corresponding tendency toward higher levels of burnout. This finding supports the hypothesis that accumulated work experience may be associated with increased psycho-emotional strain, likely resulting from

prolonged patient contact, growing administrative demands, and the specific conditions of the working environment.



Fig. 2 Frequency of feeling overwhelmed among healthcare professionals

Figure 2 illustrates the perceived workload among the surveyed healthcare professionals.

The results are presented using a Likert scale, where 1 corresponds to “strongly disagree” and 5 to “strongly agree.”

The chart demonstrates that the majority of respondents (81 individuals, representing 62% of the total sample) tend toward agreement (scores 4 and 5), indicating that most healthcare professionals experience a substantial level of work overload.

The survey also included the question “Do you work overtime?”, the results of which make it possible to examine the relationship between the length of the working day and manifestations of professional burnout (Fig. 3). Responses were categorized by frequency as “Yes,” “Sometimes,” “Often,” and “No.”

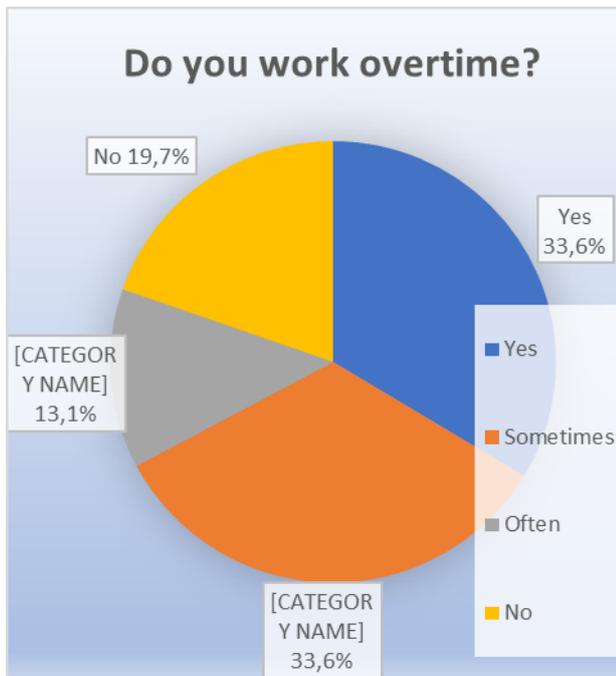


Fig. 3 Overtime Work Among Healthcare Workers

The analysis of the question “Do you work overtime?” indicates that a substantial proportion of the 122 surveyed healthcare professionals (80.3%) perform overtime work to varying degrees. Specifically, 33.6% of respondents report working overtime regularly, an equal proportion indicate that they do so “sometimes,” while 13.1% report working overtime “often.” Only 19.7% of participants state that they do not engage in overtime work.

These findings reveal a trend toward chronically elevated workload, which may be interpreted as a persistent organizational stressor and an indicator of staffing shortages within healthcare institutions. The high prevalence of overtime work suggests a potential association between extended working hours and an increased risk of burnout. The data further imply that chronic fatigue resulting from prolonged working time may contribute to emotional exhaustion among healthcare professionals.

The results highlight the need for targeted managerial approaches aimed at optimizing work schedules, redistributing workload, and ensuring adequate opportunities for rest and recovery.

The subsequent survey question addressed “The main sources of stress in your work.” This

item was designed as a multiple-choice question and included an “Other” option, allowing respondents to identify individual stressors not captured by the predefined response categories. This structure provides greater research flexibility and enables a more comprehensive and realistic representation of the phenomenon under investigation. Participants were allowed to select more than one source of stress (Fig. 4).

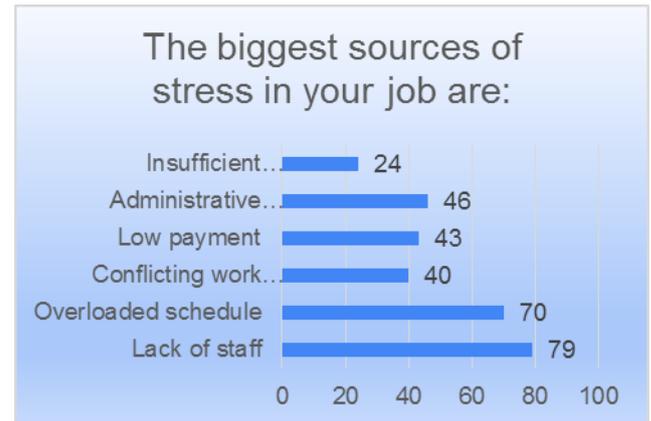


Fig. 4 Main sources of professional stress

The most frequently reported sources of stress among healthcare professionals are staff shortages (64.8%) and overloaded work schedules (57.4%), which unequivocally highlights the critical role of human resources and work intensity as key stress-inducing factors. Administrative burden, low remuneration, and a conflict-prone work environment also emerge as significant stressors, whereas insufficient resources and equipment are reported less frequently (19.7%). These findings emphasize the need for optimization of work organization and staffing structures, as well as the implementation of targeted measures to improve the organizational climate.

In summary, the analysis of the survey data demonstrates significant associations between the work environment, organizational conditions, and manifestations of professional exhaustion among healthcare professionals. Additionally, lower levels of professional qualification among part of the workforce appear to further increase vulnerability to burnout.

4. Perspectives, Recommendations, and Strategies for Burnout Prevention

Based on the analysis of the empirical data and interpretation of the results, key conclusions and recommendations have been formulated to improve working conditions and reduce the risk of professional burnout among healthcare professionals. These guidelines draw both from the survey findings and contemporary scientific evidence on the topic.

Practical strategies to mitigate burnout risk include:

- **Organizational Measures:** Optimization of the work schedules, regulating break times, ensuring adequate recovery periods between shifts, limiting systemic overtime, and providing sufficient qualified staff to reduce workload.
- **Professional Development:** Expanding opportunities for training and skill enhancement through in-house workshops, specialized courses, and participation in scientific conferences.
- **Psychological Support:** Establishing institutionalized programs for access to psychological counselling, emotional support groups, and training in stress and fatigue management.
- **Motivation and Compensation:** Implementation of a fair and transparent remuneration system reflecting qualification, experience, workload, and responsibilities, complemented by additional incentives for high-intensity or complex tasks.
- **Work–Life Balance:** Promoting flexible scheduling, encouraging the use of leave, and supporting personal activities outside of work to foster recovery and mental well-being.
- **Work Environment Optimization:** Creation of quiet rest areas, minimization of interruptions, prioritization of task allocation, and introduction of relaxation techniques to enhance focus and reduce fatigue.

Organizational and Managerial Recommendations derived from our research:

- Establishment of clear rules for equitable task and shift distribution, ensuring sufficient time for rest and recovery.
- Optimization of internal processes to reduce administrative burden and unproductive activities that contribute to burnout.

Based on the findings, the following recommendations to improve communication and teamwork are suggested:

- Implementation of mechanisms for regular feedback between management and staff.
- Organization of programs to develop communication skills and constructive conflict resolution, fostering team cohesion and mutual support.

In summary, integrating organizational, motivational, and communication-based strategies can sustainably reduce burnout risk, enhance the professional well-being of healthcare personnel, and improve the quality of healthcare delivery.

III. CONCLUSION

The findings of this study underscore the pivotal role of an ethical and integrated management approach in mitigating the risk of professional burnout among healthcare professionals. Staff shortages, excessive workloads, and limited managerial support were identified as primary stressors, while supportive interpersonal relationships, recognition, and a sense of team belonging serve as protective factors. An ethically grounded work environment, characterized by clear ethical standards, fair treatment, and the promotion of respect and empathy, emerges as essential for maintaining professional identity and well-being [6].

The survey data demonstrate that combined organizational, psychosocial, and ethical interventions significantly enhance professional satisfaction and workforce resilience. Long-term strategies should focus on optimizing workload distribution, improving working conditions, providing adequate qualified staff, and fostering a culture of recognition and support. Implementing such measures constitutes a comprehensive,

ethically committed framework that not only enhances the professional well-being of healthcare personnel but also strengthens the quality, safety, and sustainability of healthcare services.

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ECOLOGICAL TEXTILES - BEST PRACTICES AND ECONOMIC PROSPECTS

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Abstract: *The aim of the present article is to evaluate the impact and potential for sustainability of the efforts in one particular category related to eco-innovation - ecological textiles in Bulgaria. The research will focus on the best international practices that have been developed and implemented in the country since 2017. It will examine the prospects for their long-term application and potential for replication. In addition, the project study explores future opportunities for cross-sector collaboration and knowledge transfer between the business sector, research and development (R&D), and academia, with specific reference to the current 2021-2027 programming period.*

Key words: *ecological textile, eco-innovation, funding, circular economy, career prospect*

Резюме: *Целта на настоящата статия е да се оцени въздействието и потенциалът за устойчивост на усилията в една конкретна категория, свързана с екоиновациите - екологичният текстил в България. Изследването ще се фокусира върху най-добрите международни практики, разработени и внедрени в страната от 2017 г. насам. Ще бъдат разгледани перспективите за тяхното дългосрочно приложение и потенциалът за възпроизвеждане. Освен това, проектното проучване проучва бъдещите възможности за междусекторно сътрудничество и трансфер на знания между бизнес сектора, научно-изследователската и развойна дейност (НИРД) и академичните среди, с особен акцент върху текущия програмен период 2021-2027 г.*

Ключови думи: *екологичен текстил, екоиновации, финансиране, кръгова икономика, кариерни перспективи*

I. INTRODUCTION

The year 2020 presented the EU with unprecedented challenges as the global and the European economy faced the COVID-19 pandemic and its impact and consequences. This complicated further the already heated debate within the EU around the ambitious European Green Deal, which aims to make the European Union climate neutral by 2050 by transferring the political commitment into legal obligation for EU member states [1]. The achievement of the ambitious goals implies that all EU member states should commit to more and ever-increasing efficiency of the use of resources, investment in environmentally friendly technologies, and renewable energy sources. Innovation, development and application of eco-innovations in

industry is crucial. Innovation is one of the milestones towards a circular economy (repair, reuse, recycle). This model of production and consumption relies on sharing leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible so the cycle of products is extended at its maximum. The important part is reducing waste to a minimum, especially in view of the global trend for population growth.

The aim of this paper is to evaluate the impact and potential for sustainability of the efforts in one particular category related to eco-innovation - ecological textiles in Bulgaria. The research will focus on the best international practices developed and implemented in the country since 2017, the prospects for their long-term application

and multiplication, as well as the future opportunities for cross-sector collaboration and transfer of knowledge (between the business sector, R&D and the academic sector) in view of the 2021-2027 programming period.

II. MAIN TEXT

1. Quality and appropriateness of the training and of the two way transfer of knowledge between the researcher and the host

Eco-innovation has been a strong aim for the past 20 years all over the world but only a few countries have followed this strong direction so far, regardless of their political situation. As already known, the eco-innovation is any innovation that reduces the use of natural resources and decreases the release of harmful substances across the whole life-cycle. The EU alone produces more than 2.5 billion tons of waste per year [1]. Many countries still use raw materials as basic source of energy, which drastically increases energy consumption and CO₂ emissions.

With new measures taken – prevention, waste control and recycling, eco-design, EU companies can save €600 billion (equal to 8% of annual turnover). New materials and products could be much more helpful and may increase people’s life, save money etc. In the programming period 2021-2027, there are priorities for new technologies, new studies, and environmental policy. The focus of this budget period is on five main investment priorities in the regional development, with funding for the first two priorities accounting for between 65% and 85% of the total budget:

- 1) More intelligent Europe – innovation, digitalisation and support for the small and middle enterprises;
- 2) Greener and carbon-free Europe – investments in transition to clean energy, renewable energy sources and prevention of climate change;
- 3) More connected Europe – strategic transport networks;
- 4) More social Europe – in line with the European pillar on social rights and support for quality employment, access to quality education, social inclusion and equal access to healthcare;
- 5) Closer to citizens – support for local development strategies and sustainable urban development in the EU [2].

Over the past decade, a lot of efforts have been made in Bulgaria to promote, support, and implement (eco-) innovation in various industrial sectors. Legislative measures have been supported by various investment incentive schemes, funding opportunities (under EU-funded programs) and projects aiming at increasing the research and development capacity in Bulgaria and translating this capacity into sustainable economic growth potential. Still, according to the Eco-Innovation Observatory 2016-2017 country report on Bulgaria, the country ranks last in the EU in terms of eco-innovations. The eco-innovation index of the country is more than 3 times smaller than that of the states that top the ranking – Germany, Finland and Sweden [3] (Figure 1)

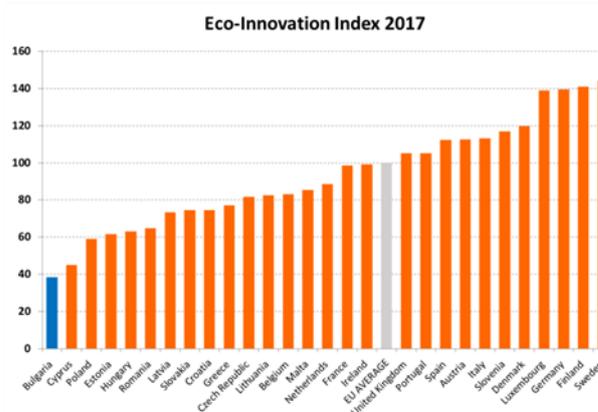


Fig.1 Chart – Eco-innovation index [4]

Given the leading position of the University of Chemical Technology and Metallurgy and its potential in building capacity, knowledge and driving innovation in the textile sector, as an institution it could benefit from:

- analysis of eco-innovative practices and initiatives implemented at national level;
- accumulation and creation of database of upcoming funding opportunities where project proposals can be developed with UCTM as a partner;
- strengthening the connection between UCTM and the leading enterprises in the textile sector;
- expansion of the opportunities for collaboration between UCTM and the textile sector.

2. Impact

2.1. Enhancing the future career prospects

A student at UCTM could have a significant research and project experience, as well as practical knowledge gained through interaction with the business sector in Bulgaria and abroad. The current environment presents an opportunity to develop a focused and in-depth knowledge of an industry. Furthermore, the present research offers a comparative advantage by positioning the researcher at the forefront of innovative developments in the textile sector and enhancing the capacity to promote and apply innovations within the Bulgarian textile industry.

2.2. Quality of the proposed measures to exploit and disseminate

The fashion industry is the second most polluting in the world after oil, because it uses materials derived from oil. Every textile product leaves harmful waste for the environment. The traditional textile industry consumes a large amount of natural resources. It is very important to control pollution in the production process, to clean textile products from toxic effects. A study by Italian laboratories shows that 93 million tons of non-renewable resources are used annually, 93 billion m³ of water are consumed and 1.2 billion tons of CO₂ are released [4]. For example, the production of an acrylic T-shirt emits 8.5 kg of CO₂, which is equivalent to 74 km drive in a car [5]. Only 1% of the produced fashion is recycled, there is no policy to stimulate the recycling of fashion products. Only 15% of the world's industries seek to use recycled materials and reduce the use of chemicals [6].

In the production of large quantities of fabrics, the issue is more in the purification of water and waste materials after the production than in the complete abandonment of chemicals. One of the new streams for several years already is discovering new textile materials – an example of its huge impact is the event TexTailor Expo. This project aims to build a common platform connecting different sectors with similar marketing interests. One of the goals of TexTailor Expo is for companies to show off and improve their marketing. The leading emphasis is on pooling their potential within the Balkans in order to create conditions for a stronger presence on the European market. They also have a special start-up area for young designers, where new and original ideas and products are displayed.

The innovations in the industry are orientated towards ecological textiles. The ecological production

of textiles, which prevents all possible dangers, is carried out by removing harmful chemicals and recycling the products. Fabrics made of organic cotton, wool, hemp, linen or silk are the basis of ecological textile products. Cotton is among the most polluted crops in the world due to the high use of insecticides. 2,700 liters of water are needed for growing cotton for the production of only one T-shirt [7]. That is enough water for a person to live 900 days or for a toilet to be flushed 270 times.

The Ecological Textile Certificate is the most valuable international certificate for textile products containing 70 percent organic fibers. This proves that the business has the highest quality and effective safety of products in the supply chain. Companies with such certificate can become ecological brands and will increase the volume of trade.

A good initiative was launched in the period 2017-2019 – partners from 6 countries (Bulgaria, Italy, Slovenia, England, Spain, Poland) joined in an international project called Ecotextyle - European training initiative related to environmental trends in footwear and textiles. Its focus is on raising the qualification and attitude of those working in the footwear and textile sector to using environmentally sustainable raw materials. Ecotextyle is funded by the European Commission's Erasmus+ program. As a final result, the Ecotextyle program has been able to offer training and self-assessment opportunities that could provide all the necessary skills, certifying the acquired qualifications and relevant certificates in the footwear sector, both for environmentally sustainable products and their manufacturers. In the collection, recycling and waste treatment stages, it is important that circular business models enable recycling and reuse. Investment is needed to ensure sufficient capacity. EU policies oblige Member States to collect textiles separately by 2025 and ensure that waste collected separately is not incinerated or landfilled. Policies also encourages setting up systems for repair and reuse of textiles to prevent waste in the first place.

Another example for good practice is Germany. The country introduces a new environmental certificate for the textile industry. The new certificate, called the "Green Button", will be issued to textile manufacturers that meet at least 26 social and environmental standards. These include a ban on the use of plasticisers and other chemicals, as well as the payment of a minimum wage and non-use of child labor.

Experts expect the percentage of fabrics and fabrics made from recycled materials to grow to 60-70% over the next few years. This will lead to the sustainable development of the sector. The change in the industry is present: from the revolutionary fabrics from optical fibres, through the dyeing without water to 100% recyclable fashion fabrics.

More and more experiments are held to re-discover the Nature experience, such as:

- Seaweed (sustainable alternative to plastic and other materials) – used for a fabric called SeaCell, made up of seaweed and eucalyptus, to create sustainable alternatives to disposable diapers and the materials used in fashion, respectively;
- Spider silk - clothes from vegan spider silk – one of the biggest sports brands cooperates with start-up company to create "completely biodegradable clothing";
- Adaptable materials - researchers at the University of Maryland invent textiles made from polymer fibres coated with carbon nanotubes that heat the wearers when it's cold and cool them when it's hot;
- Residual animal products – invention of bioplastic packaging of animal skin;
- Cellulose - an organic compound that gives plants their structure - to create durable packaging for cosmetics.

The last generation technologies allowed the creation of Smart textile. The intelligent textiles (also called wearable / functional / E-Textiles) conduct, heat, send, receive, measure and can even glow, whereat their textile characteristics will be preserved. An essential advantage is the free choice of fiber materials and carrier fabrics. No limits are set to the application possibilities. Especially in the areas of Medicine and Sports these Wearable Textiles becomes more and more important, as they supervise vital functions or stimulate muscles. Meanwhile, the aerospace and the automotive industries have recognised the potential of E-textiles and increasingly rely on the smart fabrics.

2.3. Quality of the proposed measures to communicate the project activities to different target audiences

The topic of the research area, the multidisciplinary nature of the approach and the relevance of the subject, make it easy to disseminate and integrate various communication channels, modes and adapt it to various target groups. The main target groups of the project remain the businesses in the textile industry and the research/academic institutions. However, relevant stakeholders also include consumers, local and state activists, as well as other potential investors in eco-innovations in the textile sector. To this end, the nature of project activities and the communication strategy and tools will ensure reaching out to and engaging the relevant actors through the main project activities:

Activity 1: Analysis of eco-innovative practices and initiatives implemented at national level (2015-2020). – the Report produced as a deliverable under the activity will be disseminated both internally at UCTM (in the respective departments and training activities) and externally to relevant stakeholders.

Activity 2: Accumulation (and creation of database) of upcoming funding opportunities for innovations in the textile sector (2021-2027). The database will mobilise resources internally at the host institution (UCTM), as well as external partners / beneficiaries who might take advantage of funding opportunities and experiment further with innovative concepts/materials.

Activity 3: Study of successful case studies – This activity will connect (private) companies and research / academic institutions through the demonstration of best practices and through the presentation of practical guidelines for successful collaborations.

Activity 4: Publication and dissemination, including through:

- UCTM study programs, journals, website, events;
- Specialised events and conferences;
- B2B events, in-person meetings with representatives of companies in the textile industry;
- Job fairs.

3. Implementation

3.1. Coherence and effectiveness of the work plan, including appropriateness of the allocation of tasks and resources

Activity 1: Analysis of eco-innovative practices and initiatives implemented at national level (2015-2020).

Activity 2: Accumulation (and creation of database) of upcoming funding opportunities for innovations in the textile sector (2021-2027).

Activity 3: Study of successful case studies (textile companies in Bulgaria that introduced eco-textiles and/or eco-labels and or another type of eco-innovation in the sector) and definition of:

- Incentives and challenges faced by companies in the textile sector in Bulgaria;
- Definition of the role of and recommendations for better collaboration with research; and academic institutions, laboratories.

Activity 4: Publication and dissemination

The main activities in the project take into account both the academic background and the professional experience of the researcher. The tasks are designed in a way that will allow the researcher to optimally utilise the time available (full-time dedication to the activities in the proposal) in order to complete the interim and final deliverables, to conduct high-quality research and to be able to properly popularise and disseminate the results in a sustainable manner through the channels of the host institution as well. The project activities rely both on desk research (public available information and documents analysis) and interviews, on-the-field research at Bulgarian companies. This guarantees that the results and recommendations formulated are based on real-life example and will reflect the status-quo and the real demands of the sector to the greatest possible extent.

3.2. Appropriateness of the management structure and procedures, including risk management

UCTM is one of the leading Bulgarian institutes for higher education in the chemical, technological, and environmental engineering disciplines, which

trains highly qualified specialists competitive not only in the Bulgarian economy, but also abroad. In its almost 70 years of history and experience in various research projects it has developed a risk management structure, which contains risk identification, risk analysis, risk control, risk financing and claims management. These principles are actually applied on daily basis in every project and initiative.

The management structure specifically applicable to the project ensure regular communication and check-ins between the researcher and the supervisor, as well as guidance and consultation provided by the respective department / experts at UCTM who have the capacity to provide expertise in regard to the study.

In terms of risks associated with the subject, the main possibilities are:

- Lack of sufficient quality information on the topic, which is considered to be negligible given the large amount of publicly available data on national/regional legislation, EU initiatives, funding opportunities and beneficiaries;
- Lack of interest among businesses to participate in or contribute to the research. The risk is already mitigated by preliminary talks stemming from former cooperation and collaboration between the researcher and some of the leading textile companies in the country (which happened in the context of the researcher's work at UCTM)
- Given the nature of the project activities, the bulk of the envisaged tasks can be conducted online if the need arises. Therefore, the effect of the eventual pandemic crisis will not affect the quality of the research.

3.3. Appropriateness of the institutional environment (infrastructure)

Innovative strategy for smart specialisation is essential for the implementation of effective measures to stimulate the competitiveness of the industry based on new knowledge and ideas. The EU Council emphasises the concept of "smart specialisation", in which each region builds on its own achievements by setting priorities in national and / or regional innovation strategies.

Taiwan is at the forefront of eco-textile innovation. Textile production in Taiwan remains one of the most important sectors of the manufacturing industry,

providing 70% of the total industry's specialised artificial fabrics on a global scale. Taiwan's textile industry is respected, widely recognised and recognised around the world as main supplier of special fabrics for sports goods and companies producing clothes, accessories and supplies for hunting, fishing, tourism. Over 70% of textile products and clothing are imported from Asian countries – China, Bangladesh, India, Cambodia, etc. They produce on behalf of global brands which are looking for low prices and more efficient production.

Bulgaria is more recently known as Europe's Textile Workshop, with over 100,000 workers, comprising 19% of its industrial workers. One of the largest textile industries in Europe is located in the southern part of Bulgaria [8]. It is here that European brands today produce some of their collections. It specialises not in cheap mass clothes trade, but in clothing of medium and high range, such as the production of dresses, T-shirts and shirts. More than 5,000 companies work in the production of textiles and clothing. The textile industry forms 8% (2.06 billion euro) of Bulgarian exports. Its labor productivity has increased by about 10% over the past 10 years. Bulgaria has traditions in the production of cotton and silk with more than 120 years of history in those trades. In addition to traditions, the exchange of experience is extremely important for the development of the industry and the faster achievement and implementation of innovations in the industry.

A Chinese textile giant studies the Bulgarian market and offers training to specialists. Orient International Holding has 77 thousand employees, owns a number of fashion brands, and occupies a leading position in the production of textiles for the automotive industry. Of the group's plants, 50 are in China and the rest are outside the country. The company still has no investment in Eastern Europe. The company has made a proposal for training of Bulgarian specialists. The purchasing power of consumers in China has increased and therefore the demand for imported goods in the country is growing. Bulgaria's textile industry has to take every opportunity to develop and learn from the headliners.

III. CONCLUSION

The topic of eco-innovation in textiles is highly relevant and timely to be pushed up the agenda in Bulgaria because of factors such as:

- Increasing the competitiveness of Bulgarian producers and businesses;
- Relocation of some production from Asia to Bulgaria which is less dependent in times of crisis. Bulgaria has traditions in the textile industry and garment industry, which could guarantee job creation, better working conditions, modernisation of the production process, reduction of dependence on China, bringing production closer to the market, specialisation in the production of certain niche products (e.g. protective clothing – the most successful and demanded in Europe due to the current crisis), specialised professional clothing, eco-materials;
- Operational Program "Innovation and Competitiveness" (OPIC) - Since the launch of the program until now, nearly 2,500 Bulgarian companies have been supported. The agreed funds are about 78% of the program's budget, and the disbursed ones amount to BGN 1.2 billion or over 45% of its budget. The program has focused on education and development, upgrading, trainings in labor offices, and the social aspect of employment;
- Another opportunity is the EuroBoosTEX [9] project, funded by the European Union, designed to accelerate the green and digital transition of textile SMEs, enhancing their resilience and access to new markets;
- Campaign for return of Bulgarians from abroad / adequate working conditions and pay - social aspect / demographic aspect;
- Economic impact - promotion of private initiative and development of production;
- Youth Employment Initiative (YEI) – which aims to reach unemployed young people and to encourage initiatives of young people from areas with higher youth unemployment (the Northwest region is the poorest one in Bulgaria). The YEI is one of the main EU financial resources to support the implementation of Youth Guarantee schemes.
- Youth guarantee - a commitment by all Member States to ensure that all young people under the age of 25 years receive a good quality offer of employment, continued education, apprenticeship and traineeship within a period of four months of becoming unemployed or leaving formal education. All EU

countries have committed to the implementation of the Youth Guarantee in a Council Recommendation of April 2013;

- Dual education in the profiled schools in the country - providing solid practice within the educational process and providing mentoring after starting work. Access to work with modern technologies, continuing training within the workplace, the opportunity to upgrade and master new competencies (depending on the work process and the requirements of the employer, adequate pay), avoiding incompetence on the part of the employer on workflow and production cycle and technological time,

- OP "Rural Development" and OPIC (e.g. for organic cotton production).

* * *

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TRENDS AND CHALLENGES IN WATER RESOURCES MANAGEMENT

ТЕНДЕНЦИИ И ПРЕДИЗВИКАТЕЛСТВА В УПРАВЛЕНИЕТО НА ВОДНИТЕ РЕСУРСИ

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Резюме Настоящото изследване разглежда съвременните тенденции и ключовите предизвикателства пред управлението на водните ресурси в условията на ускоряващи се климатични промени, нарастваща урбанизация и задълбочаващ се глобален воден дефицит. Анализът се основава на актуални проучвания и статистически данни относно разполагемостта и състоянието на водните ресурси. Изследването проследява нарастващия натиск върху водните системи, породен от климатично обусловени суши, довели през 2022 г. до засягане на приблизително 63% от територията на Европа, както и от интензивното водоползване в селското стопанство, индустрията и урбанизираните зони. Обоснована е необходимостта от прилагане на интегриран, адаптивен модел на управление, съчетаващ мониторинг, превантивни политики и ефективно прилагане на европейската нормативна рамка с цел гарантиране на водна сигурност и устойчиво социално-икономическо развитие.

Ключови думи: водни ресурси, качество на водите, воден дефицит, подземни води

Abstract The present study examines contemporary trends and the key challenges in water resources management under conditions of accelerating climate change, increasing urbanization, and intensifying global water scarcity. The analysis is based on up-to-date studies and statistics on the availability and status of water resources. The study traces the growing pressure on water systems driven by climate-induced droughts, which in 2022 affected approximately 63% of the European territory, as well as by intensive water abstraction in agriculture, industry, and urbanized areas. The necessity of implementing an integrated and adaptive management model is substantiated, combining systematic monitoring, preventive policies, and effective enforcement of the European regulatory framework in order to ensure long-term water security and sustainable socio-economic development.

Key words: water resources, water quality, water scarcity, groundwater

I. ВЪВЕДЕНИЕ

Съвременното общество е изправено пред динамични промени, които засягат както околната среда, така и социално-икономическите процеси. Глобалният воден дефицит вече засяга над 2 милиарда души. Климатичните промени усилват засушаванията и нарушават устойчивостта на подземните водоносни хоризонти. Ограниченото количество прясна вода и неравномерното ѝ

разпределение се определят като един от основните екологични проблеми в световен мащаб [1, 2, 3, 4].

Климатичните промени вече не се разглеждат като хипотеза, а като безспорен факт, повишаването на температурите ускорява засушаването и изчерпването на подземни водоносни хоризонти [5]. Очаква се населението на света да достигне над 9 милиарда души в рамките на следващите 15–

20 години, като урбанизацията ще доведе до концентрирано търсене на вода в градовете, особено в развиващите се страни [6]. През 2030г. в градовете ще живеят почти 5 милиарда души или процентно погледнато 60% от населението. От тях 80% ще са жители на градове в бедни страни. А на фона на изострящата се ресурсна криза, намаляване на водните ресурси и климатичните промени, това ще обостри още повече водният дефицит.

Настоящата статия разглежда съвременните тенденции и ключовите предизвикателства пред управлението на водните ресурси в условията на ускоряващи се климатични промени, нарастваща урбанизация и задълбочаващ се глобален воден дефицит.

II. ОСНОВЕН ТЕКСТ

Глобални тенденции и предизвикателства пред управлението на водните ресурси.

Глобалният воден недостиг се проявява и чрез драстични примери. Аралско море е загубило над 90% от обема си вследствие на прекомерно водоползване за напояване, а езерото Чад е намаляло с повече от 70%, което е довело до тежки социални и миграционни кризи. В Близкия изток напрежението около използването на водите на Ефрат, Тигър и Нил показва, че водата все повече се превръща във фактор за регионална и международна сигурност.

Недостигът на вода вече засяга не само традиционно сухи региони като Африка и Австралия, но и части от Европа [7]. Това показва, че проблемът е глобален, многопластов и изисква комплексни управленски решения.

В Европа недостигът на вода се проявява най-осезаемо в южните страни, но сезонни и регионални прояви има и в северната част на континента. Въпреки относителното изобилие от ресурси, търсенето на вода нараства през последните 50 години. Сушите в Европа причиняват огромни финансови загуби, но аспекта не е само финансов. Сушите през последните десетилетия са довели до значително спадане на нивата в ключови водни басейни като басейна на река По (Италия) през 2022 г. е отчетено намаляване на водните

ресурси с близо 40% спрямо дългосрочната средна стойност [8].

Подобни ситуации са регистрирани и в река Дунав, където екстремно ниски нива през 2018 и 2022 г. затрудниха както водоснабдяването, така и речния транспорт [9].

В Германия по-малко от 10% от реките, езерата и крайбрежните води са в добро екологично състояние [10]. В Испания и Португалия хроничните засушавания водят до намаляване на обема на язовири и реки с над 20–30% в сухи години, което допълнително ограничава възможностите за пречистване и поддържане на добро качество на водите. В Северните части на Европа водният стрес обикновено не е такъв постоянен проблем, тъй като се проявява като сезонен тип. Въпреки относителното изобилие на ресурси от прясна вода, търсенето на вода в Европа непрекъснато се увеличава през последните 50 години, отчасти като последица от нарастването на населението. Това е довело до цялостно намаляване на възобновяемите източници на вода на глава от населението с 24 % в цяла Европа [11].

Водният стрес не само влияе върху наличието на вода по отношение на количеството, но и въздейства пряко върху качеството. Качеството на водите е сериозен глобален проблем около 80% от отпадъчните води в световен мащаб се заустват в природни водни тела без пречистване, което влошава достъпа до безопасна питейна вода за милиарди хора [12]. Проблемът не засяга единствено развиващите се страни. В Калифорния хроничните суши и свръхексплоатацията на подземни води ограничават селското стопанство, а в Австралия, в басейна на Мъри-Дарлинг, конфликтът между земеделските нужди и опазването на екосистемите е достигнал критично ниво [3].

Намаленото количество вода в даден воден басейн засяга не само физико-химични, но и биологични процеси, които са ключови за функционирането на водните екосистеми и водоносни хоризонти [6].

В Европа *качеството на водните ресурси* остава сериозен проблем, въпреки въведените регулации. Според Европейската агенция по

околна среда (ЕАОС, 2023)[10], едва 39% от повърхностните води в Европейския съюз достигат „добро екологично състояние“. Аналогично е и състоянието на подземните водни тела- 26% от подземните води в ЕС не са в добро химично състояние, а 11% от тях в не са в добро количествено състояние [10]. Европейският съюз полага усилия за единно управление на натиска над водните ресурси за което свидетелстват Директива 91/271/ЕИО за пречистването на градските отпадъчни води от 21.05. [13] и Директива 98/83/ЕО на Съвета относно качеството на водите, предназначени за консумация от човека от 03.11.1998 [14]. Замърсяването от селското стопанство и индустриалните отпадъчни води продължава да бъде основен източник на натиск – приблизително 60% от нитратите в реките и езерата идват от селскостопански практики [10]. Заустването на непречистени или частично пречистени отпадъчни води остава разпространено явление, според данни на Европейската комисия (2022) [9], в някои райони на Южна и Източна Европа до 30% от отпадъчните води все още не преминават през съвременен третиране. Това води до локално влошаване на качеството на подземните и повърхностните води [10].

В контекста на глобалните предизвикателства, като климатичните изменения и урбанизацията, важноста на водните ресурси не може да бъде подценявана [12]. Липсата на достъп до чисти питейни води в световен мащаб, увеличава конкуренцията за достъп до безопасна и качествена питейна вода [11, 15, 16] .

В много региони на света *водната криза е перманентен проблем* с многообразни измерения [12], [1]. Водните ресурси и тяхното управление безспорно могат да бъдат определени като значим фактор за социално-икономическа стабилност и развитие за всяка страна.

В световен мащаб *повърхностните води* – реки, езера и водоеми – са основен източник на прясна вода за човешките нужди, като осигуряват приблизително 60–70% от общото водоснабдяване за питейни, селскостопански и промишлени цели [17, 18]. Те играят ключова роля в поддържането на хидрологичния

баланс, енергийните системи, транспорта и опазването на биоразнообразието. Около 2 милиарда души в света зависят пряко от повърхностни водоизточници за питейна вода и за напояване [19]. Въпреки това, изменението на климата, замърсяването и увеличаващото се водопотребление поставят сериозни предизвикателства пред тяхното устойчиво управление. През последните десетилетия глобалните промени доведоха до намаляване на обема на големи реки и езера – например, басейнът на река По в Италия отчита спад с около 40% спрямо дългосрочните средни стойности по време на сушата от 2022 г., а нивото на Аралско море е намаляло с повече от 70% от средата на ХХ век [19, 20].

В рамките на Европейския съюз повърхностните води имат критично значение за обществото и икономиката, като осигуряват вода за около 35% от питейните нужди, за енергийния сектор и за поддържане на екосистемните услуги. Въпреки това, състоянието им остава тревожно: към 2021г. едва 39.5% от повърхностните водни тела са класифицирани като „добро“ или „много добро“ екологично състояние, докато останалите страдат от натиск, свързан със замърсяване, прекомерно водоползване и хидроморфологични изменения [21]. Сушите в Европа също нанасят сериозни щети – например през 2022 г. около 63% от територията на континента беше засегната от различни степени на суша, което доведе до спад на нивата на реки като Рейн и Дунав и наруши водния транспорт и електропроизводството [22].

В световен мащаб *подземните води* са източникът на една трета от всички иззетите сладководни води, доставяйки приблизително 42%, 36% и 27% от водата, използвана съответно за селскостопански, битови и промишлени цели. Като такива подземните води са от решаващо значение за икономическото развитие, особено в контекста на изменение на климата и свързаните с него въздействия [23]. През 2010 г. глобалното водовземане на подземни води се оценява на приблизително 1000 km³, което представлява 25% от общото потребление на прясна вода в

световен мащаб и приблизително 10% от възобновяемите подземни водни ресурси [24, 25]. Следователно подобряването за разбирането на системите за подземни води е от съществено значение, не само за оптимизиране на тяхната употреба, но и за осигуряване на ефективно и устойчиво управление на водните ресурсите [26, 27].

Подземните води представляват ключов елемент на водните ресурси и в рамките на Европейския съюз, осигурявайки не само приблизително 65% от питейната вода, но и с решаваща роля в обезпечаването на необходимостта от вода за аграрния сектор, индустрията и екосистемите [28], [29]. Въпреки това, нарастващият натиск от антропогенна дейност и климатичните промени поставя под въпрос разполагаемостта, качеството и количеството на тези ресурси [30]. В някои урбанизирани райони амортизираната водопреносна мрежа е основна причина за налагане на режим на водоползване дори на домакинствата [31].

В този контекст, Европейската комисия подчертава необходимостта от подобро управление на водите, като отбелязва, че само 39.5% от повърхностните води в ЕС са в „добро“ екологично състояние, а 26.8% са в „добро“ химическо състояние към 2021 г. [23].

III. ЗАКЛЮЧЕНИЕ

Изследването ясно потвърждава, че управлението на водните ресурси се намира в критична фаза, в която традиционните управленски подходи вече не отговарят на мащаба и сложността на съвременните предизвикателства.

Нарастващият глобален воден дефицит е все по-задълбочен от климатичните промени, урбанизацията и интензивното водоползване и води до системен натиск върху количественото и качествено състояние на повърхностните и подземните води.

Изключително ниските равнища на екологично и химично съответствие на водните тела от 39.5% при повърхностните и под 73% при подземните води, разкриват системен управленски дефицит и недвусмислено потвърждават несъответствието между съществуващите институционални механизми и реалната динамика на съвременните хидроособенности и климатични предизвикателства.

Анализът показва, че климатичните промени, и в частност продължителните периоди на суша, се превръщат в доминиращ системен риск за водната сигурност, оказвайки многоизмерно въздействие върху водоснабдяването, енергийните системи, аграрното производство и функционирането на водните екосистеми.

Паралелно с това, влошаването на качеството на водите вследствие на непречистени отпадъчни води, аграрно замърсяване и амортизирана инфраструктура допълнително ограничава реално достъпните водни ресурси и повишава социално-икономическите рискове.

В този контекст изследването обосновава, че устойчивото управление на водните ресурси следва да се базира на интегриран и адаптивен модел, който отчита взаимовръзките между климатични процеси, хидроложки системи, икономически дейности и екологични ограничения. Такъв модел изисква не само засилен мониторинг и прогнозиране, но и ефективно прилагане на нормативната рамка, икономически механизми за оптимизиране на водоползването и активно участие на всички заинтересовани страни.

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IMPACT OF THE WORK ENVIRONMENT ON JOB SATISFACTION AMONG NURSING PROFESSIONALS

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Резюме Настоящото изследване анализира влиянието на работната среда върху професионалната удовлетвореност на медицинските сестри, като фокусът е насочен към физическите, организационните и социално-психологическите фактори на труд. Проучването е осъществено в края на 2025г. чрез анонимно анкетно изследване в електронен формат сред 103 медицински сестри, работещи в различни здравни заведения на територията на град Бургас.

Резултатите показват, че материално-техническите условия на труд се оценяват сравнително положително, но сами по себе си не са достатъчни за постигане на висока обща професионална удовлетвореност. Като водещи проблеми се открояват ниското възнаграждение, високото работно натоварване, недостигът на сестрински персонал и ограничената управленска подкрепа. В същото време добрите междуличностни отношения и чувството за екипна принадлежност изпълняват защитна роля по отношение на професионалната удовлетвореност.

На основата на получените резултати са формулирани препоръки, насочени към оптимизиране на работната организация, усъвършенстване на мотивационните политики и изграждане на подкрепяща професионална среда с цел повишаване на удовлетвореността, устойчивостта и задържането на сестринския персонал.

Ключови думи: професионална мотивация, условия на труд, организационна подкрепа, работно натоварване, устойчивост на персонала

Abstract: This study examines the impact of the work environment on the professional satisfaction of nurses, focusing on physical, organizational, and socio-psychological work-related factors. The study was conducted at the end of 2025 through an anonymous online questionnaire survey among 103 nurses employed in various healthcare facilities in the city of Burgas.

The results indicate that the material and technical working conditions are assessed relatively positively; however, they are not sufficient on their own to achieve a high level of overall professional satisfaction. The main challenges identified include low remuneration, high workload, shortage of nursing staff, and limited managerial support. At the same time, positive interpersonal relationships and a sense of team belonging play a protective role in relation to professional satisfaction.

Based on the findings, recommendations are formulated to optimize work organization, enhance motivational policies, and create a supportive professional environment, thereby improving satisfaction, sustainability, and retention of nursing staff.

Key words: Professional motivation, Working Conditions, Organizational Support, Workload, Workforce Sustainability

I. INTRODUCTION

The impact of the work environment on the professional satisfaction of nursing staff is of critical importance for the quality of healthcare and the effectiveness of the treatment process. The factors influencing satisfaction are diverse, and each plays a significant role in ensuring favourable working conditions.

The study aims to determine how individual elements of the work environment, physical, organizational, socio-psychological, and motivational, affect the professional satisfaction, motivation, and occupational well-being of nurses. The object of the study is the work environment of nurses in healthcare facilities, while the subject focuses on the specific elements of the professional environment and their influence on professional satisfaction.

This study combines analytical and applied approaches, providing evidence that can guide the formulation of practical strategies to improve working conditions in healthcare institutions.

II. MAIN TEXT

Work Environment Impact on Job Satisfaction Among Nursing Professionals

1. Conceptual Foundations of the Work Environment and Professional Satisfaction among Nursing Staff

The work environment encompasses the set of conditions and factors in which employees perform their professional activities. It includes the material, social, organizational, and psychological characteristics of the workplace, all of which influence the health, efficiency, and professional satisfaction of personnel. The work environment covers both physical conditions, such as equipment, workspace, technology, and safety, and intangible elements, including team relationships, management style, supervisory support, and opportunities for professional development [1].

Understanding the motivation of nurses requires the application of both classical and contemporary motivational theories, which explain how work environment factors influence staff engagement and satisfaction. Maslow's hierarchy of needs (1954) [2] proposes a structured model of human needs, starting from basic physiological needs and safety and

progressing to social connections, esteem, and self-actualization (Fig. 1) [3]

Herzberg's two-factor theory (1959) [4] complements this approach by distinguishing between "hygiene" and "motivational" factors. Hygiene factors, such as working conditions, salary, and organizational policies, prevent dissatisfaction but do not inherently generate motivation. Motivational factors, such as recognition, professional development, and taking responsibility, foster intrinsic motivation and strengthen engagement. Empirical studies among nurses in Sweden and Norway confirm that combining stable hygiene conditions with stimulating motivational factors is essential for enhancing professional satisfaction [5].



Fig. 1. Job satisfaction components

2. Methodology and Organization of the Empirical Study

The present study was conducted using a questionnaire-based method, which allows for the collection of primary data regarding working conditions, motivational factors, and professional satisfaction among nurses. The study has a descriptive-analytical character and was carried out through an anonymous questionnaire consisting of 24 questions, 23 closed-ended and one open-ended question, designed to explore respondents' attitudes, opinions, and assessments on the topic under investigation.

The survey was conducted between November 15 and December 15, 2025, among 103 nurses employed in healthcare facilities in the city of Burgas.

The participation was voluntary and anonymous, ensuring a higher level of reliability and honesty in the responses obtained.

The questionnaire was structured into several thematic sections covering:

- socio-demographic characteristics of the respondents.
- working conditions and the work environment.
- work organization and management.
- interpersonal relationships.
- social environment.
- professional satisfaction and motivation.

The questionnaire was completed electronically and independently by the respondents, without any influence from the researcher.

The fundamental ethical principles were observed, including voluntary participation, anonymity, and confidentiality of the provided information.

3. Analysis of Results and Implications for the Sustainable Development of Healthcare Organizations

The analysis of data from the questionnaire survey, along with the open-ended responses of nurses, clearly identifies the key factors influencing professional satisfaction and the sustainability of nursing staff within healthcare organizations.

The results indicate that physical working conditions and technical equipment are generally evaluated positively, with over 70% of respondents expressing satisfaction with the material infrastructure. This provides a favourable foundation for the fulfilment of professional duties, yet it alone is insufficient to achieve a high level of overall professional satisfaction (Fig. 2).

Notable strengths include the high educational and professional level of the staff, with 49.5% holding a bachelor's degree and 31.1% a master's degree (Fig. 3), as well as a strong sense of team belonging, reported by 69.9% of respondents (Fig. 4).

These factors play a protective role, contributing to the resilience of the team and the maintenance of a positive psychosocial climate.

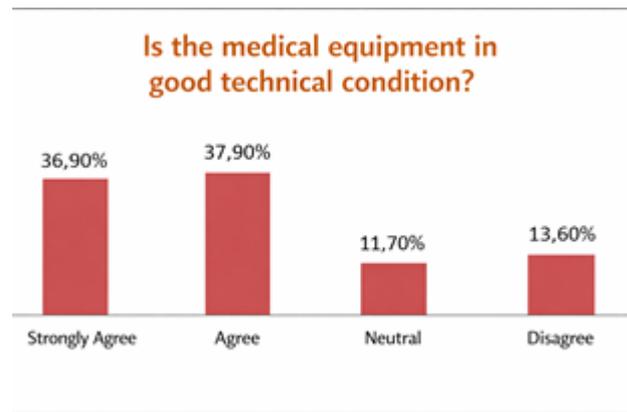


Fig. 2. Degree of satisfaction with the requirements of medical equipment and devices

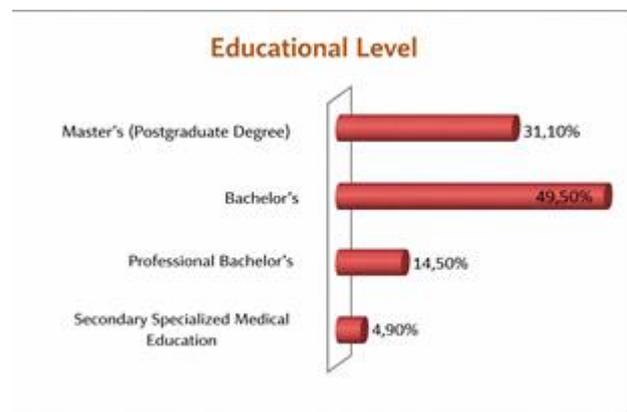


Fig. 3. Degree of education of nurses

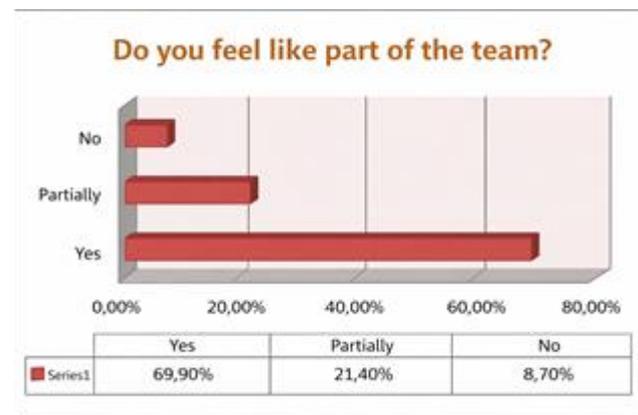


Fig. 4. Feeling of belonging to the team

At the same time, the SWOT analysis highlights several significant weaknesses that negatively affect professional satisfaction. Key challenges include low remuneration, with only 8.7% of respondents reporting being fully satisfied with their salary (Fig. 5), and excessive workload, largely associated with staff shortages. These are compounded by limited managerial support and insufficient recognition of work, as 35.9% of nurses indicated that they do not feel adequately valued. These factors are directly linked to an increased risk of professional burnout, reduced motivation, and intentions to leave the organization.



Fig. 5. Level of satisfaction with pay

Identified opportunities for improvement include the expansion of training and professional development programs, optimization of staff allocation and work schedules, salary increases, and the introduction of additional incentives, as well as the development of team culture through team-building activities and enhanced internal communication. These areas represent potential managerial interventions aimed at increasing motivation and retaining personnel.

The main threats include the chronic shortage of nurses, mental and physical exhaustion of staff, inadequate remuneration, poor communication, and insufficient attention to the social and motivational aspects of the work environment [6]. In the long term, these factors may compromise both the sustainability of human resources and the quality and safety of healthcare services.

In summary, the quality of the work environment exerts a significant and multifaceted

impact on professional satisfaction, motivation, and the resilience of nursing staff. Deficiencies in remuneration, workload, and managerial support emerge as key risk factors for burnout and staff turnover, regardless of adequate material and technical resources. These factors directly affect the sustainable development of healthcare organizations, as the retention of qualified personnel, prevention of professional burnout, and maintenance of high motivation are essential prerequisites for long-term stability, quality, and safety of healthcare delivery.

4. Recommendations and Innovative Approaches for Improving the Work Environment and Professional Satisfaction of Nurses

Based on the findings and analysis, a range of recommendations and innovative approaches can be formulated to create a more balanced, safe, and motivating work environment for nursing staff, thereby enhancing professional satisfaction and the sustainability of healthcare organizations.

A primary priority is the optimization of workload through increasing the number of nurses and ensuring a more equitable distribution of shifts. Implementing flexible rotational schedules and opportunities for shift swaps by mutual agreement could improve work-life balance, reduce physical and psychological fatigue, and enhance staff autonomy [7].

Enhancing compensation policies is also of critical importance, including the introduction of additional financial incentives, bonuses, and social benefits tailored to the workload and responsibilities of nursing staff. Formal and informal recognition mechanisms, such as certificates, letters of appreciation, internal awards, and symbolic rewards, can strengthen the sense of professional significance and engagement.

Improving managerial support and internal communication represents another key aspect [8]. Regular team meetings, clear feedback channels, and the involvement of nurses in organizational decision-making foster trust, fairness, and team cohesion. Organizing team-building activities and joint initiatives can further strengthen collegial relationships and a positive psychosocial climate.

The development of professional competencies through regular training, qualification courses, and mentorship programs is a crucial tool for increasing confidence, expertise, and motivation among staff. Organizing in-house training sessions and seminars aligned with work schedules, as well as opportunities for sharing best practices, can support career advancement and facilitate the integration of junior staff.

Finally, improving health and safety conditions through the maintenance of adequate material and technical resources, provision of personal protective equipment, and implementation of programs for the prevention of professional stress and burnout is essential for the long-term well-being of nursing personnel [9].

The implementation of these approaches is expected to create a more balanced and supportive work environment, thereby enhancing the professional satisfaction and resilience of nurses within healthcare institutions.

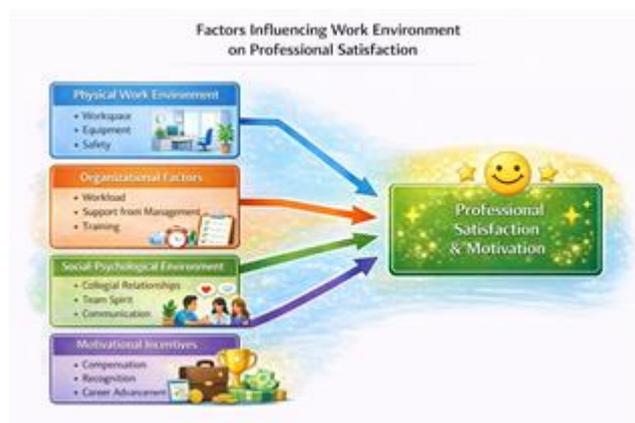


Fig. 6. Influence of the work environment on professional satisfaction

The analysis encompasses physical, organizational, and socio-psychological aspects of the work environment, and the data collected through the questionnaire survey allow for the identification of key problem areas as well as potential opportunities for improvement in working conditions (Fig. 6).

III. CONCLUSION

The present study examines the impact of the work environment on the professional satisfaction of nursing staff, with a focus on factors that either facilitate or hinder daily professional activities.

The findings of this study highlight the multifaceted influence of the work environment on the professional satisfaction of nursing staff. While physical working conditions and technical resources are generally evaluated positively, they are insufficient on their own to ensure high levels of overall satisfaction. Critical challenges identified include excessive workload, inadequate remuneration, perceived safety concerns, and limited managerial support. These factors not only affect motivation and emotional well-being but also increase the risk of burnout and staff turnover, consistent with findings from international studies on nursing workforce sustainability.

Conversely, supportive interpersonal relationships, a cohesive team environment, and adequate recognition emerge as significant protective factors, reinforcing engagement, resilience, and job satisfaction. The results underline that intrinsic motivators, such as professional recognition and opportunities for development, in combination with favourable work conditions, are essential for sustaining a motivated and committed nursing workforce.

The recommendations derived from this study provide practical and innovative approaches for improving the work environment. These include optimizing workload and shift distribution, implementing flexible scheduling, enhancing compensation and incentive systems, strengthening managerial support and communication, and promoting professional development through training and mentorship programs. Implementation of these strategies is expected to improve both the professional satisfaction and retention of nursing personnel, while simultaneously enhancing the quality, safety, and efficiency of healthcare services.

Importantly, these measures are not only beneficial for individual nurses but also crucial for the sustainable development of healthcare organizations. By fostering a supportive, safe, and motivating work environment, healthcare institutions can ensure long-term stability, resilience, and high-quality care delivery, aligning organizational practices with broader goals of workforce sustainability and sustainable healthcare management.

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BEST PRACTICES IN CIRCULAR ECONOMY IN REGION APULIA, SOUTH ITALY

НАЙ-ДОБРИ ПРАКТИКИ НА КРЪГОВА ИКОНОМИКА В РЕГИОН ПУЛИЯ, ЮЖНА ИТАЛИЯ

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Резюме: Настоящият доклад илюстрира сборна картина на италиански регионален проект с годишен мултипликационен ефект за прилагане на кръгова икономика в регион Пулия, Южна Италия. Представена е информация за отличени най-добри практики на кръгови успешни модели и приложението им. Статията е синтез, носещ образователен характер за трансфер на знания, идеи и технологии.

Ключови думи: кръгова икономика, добри практики, Пулия, екосистема, компании

Abstract: This report illustrates a composite picture of an Italian regional project with an annual multiplier effect for the implementation of a circular economy in the Apulia region, South Italy. Information is presented on awarded best practices of circular successful models and their implementation. The document is a synthesis of an educational nature for the transfer of knowledge, ideas and technologies

Keywords: circular economy, good practices, Apulia, ecosystem, companies

I. ВЪВЕДЕНИЕ

Целта на разработката е да представи информация за отличени най-добри практики на кръгови успешни модели и тяхното приложение в един италиански регион. PЕС /от итал. в превод на бълг. съкр. ПКИ/: Пулия за Кръговата Икономика е проект, изпълняван от Регионалния съюз на търговските камари на Пулия, Южна Италия за насърчаване на модела на кръговата икономика в региона. [1] Проектът развива действията, предвидени в проектната линия на Изравнителния фонд за растеж на региона, озаглавена „Екологични политики - действия за насърчаване на кръговата икономика“. Основната цел на проекта е икономическият и устойчив растеж на региона, чрез насърчаване на кръговата икономика. Традиционните линейни икономики са били развивани без оглед на

околната среда и рециклирането. Това е довело до екстремни последици за екосистемите, дългосрочни икономически тежести за бизнеса и индустриите, високи нива на замърсяване и неустойчиви модели на развитие. Кръговата икономика предлага алтернативи за устойчиво икономическо развитие, като насърчава индустриална икономика, която не произвежда отпадъци и замърсяване, и предлага възможности за преоткриване на икономиката, правейки я по-ефективна и конкурентоспособна, в полза на бизнеса, индустриите и местните общности. ПКИ е проект, който предвижда действия за насърчаване на кръговата икономика чрез експериментално обучение, информация и инициативи за повишаване на осведомеността относно кръговата икономика. Тези инициативи помагат на предприемачите и бизнеса да се възползват от възможностите,

предлагани от концепцията, и да интегрират кръговата икономика в разработването на регионални и национални политики.

II. ОСНОВЕН ТЕКСТ

1. Най-добри практики в регион Пулия

В настоящата се разглеждат набор от компании, отличили се като изпълняващи / представящи най-добри практики, които са били признати за кръгови „модел“ от водещи италиански списания в сектора.

Описаните проекти и практиката са примери за компании, които са постигнали по-голяма конкурентоспособност, чрез въвеждане на принципите на кръговата икономика и технологични иновации в своите производствени процеси. Всички тези компании работят за намаляване на отпадъците и увеличаване на използването на рециклирани материали. Разпространението на опита и резултатите, постигнати от компании, определени като „най-добри практики“ в сектора, се превръща във възможност за насърчване на компании, които все още не са запознати с възможностите за развитие, предлагани от кръговата икономика, да се образуват и да повишат уменията си.

Идентифицирането на най-добрите практики позволява да измерваме продуктите, респективно услугите на компаниите и да идентифицираме фактори за успех, които други компании могат да усвоят, за да подобрят и развият бизнеса си. Използвани са основни италиански източници, за идентифициране на най-добрите практики в кръговата икономика на регион Пулия:

2. Томът „100 истории за италианска кръгова икономика“.

От 2015 г. насам фондация Symbola популяризира „Произведено в Италия“, чрез изследвания, събития и проекти, фокусирани върху иновациите, развитието и устойчивостта на запазената марка. [2] Томът, публикуван от фондация Symbola в сътрудничество с ENEL, представя 100 компании, работещи в Италия в съответствие с принципите на иновациите и устойчивостта. Всички те са примери за компании, които са въвели принципите на кръговата икономика в своите производствени

процеси. Те използват вторични суровини, които преди това са били отпадъци за други компании. Това е създавало синергии между различните вериги за доставки и е вдъхновило компаниите да разработват иновативни решения за устойчивост. През 2018 г. томът събира 100-те инициативи, разделяйки ги на 11 сектора: Облекло и аксесоари (15 компании); Хранително-вкусова промишленост (4 компании); Мебели и строителство (15 компании); Производство и промишлени продукти (6 компании); Хартия и опаковки (2 компании); Химическа и фармацевтична промишленост (2 компании); Дизайн и изследвания (13 компании); Електроника (2 компании); Нови материали (6 компании); Платформи (25 компании); Информация и обучение (4 компании).

3. Trenoverde / на бълг. "зеленият влак"/

Инициативата се подкрепя от Legambiente. Trenoverde е инициатива на Legambiente, италианска асоциация за опазване на околната среда. Legambiente предоставя информация за екологичното здраве, за да повиши осведомеността сред отделни лица, компании и политически институции, за да участват в промяната. Проектът Trenoverde има за цел да насърчи устойчивостта сред гражданите, чрез физическо пътуване с няколко спирки в италиански градове. [3] Влакът е домакин на повече от сто опита на организации, асоциации, стартиращи компании и бизнеси, които на борда му представят най-иновативните идеи за устойчивост. Онлайн платформа на инициативата включва всички компании, представящи своите проекти за намаляване на отпадъците и разпространение на вторични суровини и всички спирки за качване на борда и слизане.

4. Атлас на кръговата икономика.

Италианският атлас на кръговата икономика е уеб платформа, която обединява италианския бизнес опит, включително асоциации, прилагащи принципите на кръговата икономика. [4] Това е инструмент, който предприятията могат да използват, за да се свързват с други компании и да повишават своята видимост. Той е и инструмент за

граждани и потребители, които могат да преглеждат профили на компании безплатно. Платформата се актуализира непрекъснато.

5. "Италия на рециклирането"

По същество представлява доклад относно сектора на отпадъците, изготвен от Фондацията за устойчиво развитие и организацията UNICIRCULAR. [5] Във фондацията за устойчиво развитие членуват повече от 100 компании, асоциации и експерти по устойчивост, които целят да насърчат развитието на зелената икономика в Италия. Фондацията насърчава културата и практиката на устойчиво развитие чрез изследвания, срещи и публикации, както и чрез идентифициране и разпространение на най-добри практики за устойчивост. Докладът на фондацията за 2024г. представя следните инициативи в следните сектори: Рециклиране на опаковки, рециклиране на пластмаси, рециклиране на каучук, рециклиране на електрическо и електронно оборудване, рециклиране на органични отпадъци и утайки, рециклиране на излезли от употреба превозни средства, рециклиране на строителни и разрушителни агрегати, рециклиране на използвано масло, рециклиране на растително масло и животински мазнини, рециклиране на текстил, рециклиране на пелени и дамски превръзки.

III. ЗАКЛЮЧЕНИЕ

В настоящата работа са представени промени в технологиите, които вече са в ход и показва колко по-взаимосвързани са веригите за доставки за обмен на материали и енергия. Процес, който ще направи системата по-устойчива като цяло и същевременно ще направи компаниите по-конкурентоспособни на пазара. Изводите от изследването показват, че кръговата икономика изисква цялостна промяна в мисленето от „вземи-произведи-изхвърли“ към устойчивост. Вследствие на това произтичат ползи за бизнеса, потребителите и околната среда, както и приоритета на иновациите и партньорствата.

Основните препоръки от изследването са за повишаване на експертизата, информиране на потребителите, държавни

стимули, развитие на зелени технологии и въвеждане на стандарти, като всичко това цели изграждане на неутрална спрямо климата икономика до 2050 г., както е заложено от ЕС. Преходът е неизбежен: Линеиният модел е неустойчив, а кръговата икономика предлага решение за ограничаване на отпадъците, повишаване на конкурентоспособността и зависимостта от суровини.

Иновациите са ключови за кръговия преход чрез разработването на нови продукти, услуги и бизнес модели. Успехът зависи от тясното сътрудничество между бизнеса, правителствата, науката и потребителите.

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Изказвам специални благодарности към проект „BiOrgaMCT“ (Биоактивни органични и неорганични авангардни материали и чисти технологии), Договор №: BG-RRP-2.004-0002-CO1, по който имах възможността като изследовател да посетя университети, центрове за технологичен трансфер и бизнес организации в регион Пулия и събера знания и обмена опит.

Приложение 1

Табл.1. Петнадесет най-добри практики в регион Пулия, Южна Италия

1	Име на компания: ASECO Град: Марина ди Джиноза (Таранто) Сектор: Органични отпадъци
	Иновации: Изследвания в областта на оползотворяването на органични и биоразградими материали. По-специално, тя е създавала автоматизирана система за принудително аериране на компоста по време на фазата на биоокисление, минимизирайки емисиите на газове и разходите за енергия.
2	Име на компания: CORGOM Град: Корато / Бари/ Сектор: Продажби на гуми

	Иновации: Събиране, оползотворяване и рециклиране на използвани гуми.
3	Име на компания: CORVASCE Град: Барлета Сектор: Мебели и дизайн
	Иновации: Компанията произвежда мебели, контейнери, дисплеи и обзавеждане за търговски панаири и магазини, използвайки рециклирани картонени листове.
4	Име на компания: TEOREMA Град Аквавива деле Фонти / Бари/ Сектор: Екологични услуги
	Иновации: Компанията е създала машина за третиране и оползотворяване на твърди битови отпадъци от разделно събиране
5	Име на компания: Завод за патладжани Град: Полиняно а маре/ Бари/ Сектор: Биопластмаси
	Иновации: Патент за създаването на козметичен крем и патент за създаването на листове за селското стопанство и опаковъчната индустрия.
6	Име на компания: Sfregola Град: Барлета Сектор: Оползотворяване и рециклиране
	Иновации: Патент за торба за отпадъци с микрочип вътре, който позволява проследяването на отпадъците, докато достигнат до заводите, и патент за торба с баркод, който позволява проследяване на отпадъците
7	Име на компания: Innovaction Град: Лече Сектор: Околна среда и социални услуги
	Иновации: Иновационен патент за „Ecofesta Puglia“, доброволен сертификат, който гарантира устойчивостта на планирането и провеждането на международни събития
	Име на компания: Prespallia Град: Модуньо / Бари/ Сектор: Строителни материали

8	Иновации: Иновационен патент за „Модулен екоблок“, изработен от слама, глина и хидравлична вар. Той осигурява здравословни и достъпни жилища, както и осигурява високи нива на топло- и звукоизолация.
	Име на компания: REVI' Град: Бишеллие, (Барлета-Андрия-Трани) Сектор: Реставрация и възстановяване
9	Иновации: Иновационен велосипеден проект в сътрудничество с други организации за създаване на действия, които генерират положителни ефекти за опазване на околната среда.
	Име на компания: FINSEA Град: Мартина Франка /Таранто/ Сектор: Екологични услуги
10	Иновации: Награда за иновации за инициативи, които помагат на компаниите да растат и да се интернационализират.
	Име на компания: FIUSIS Град: Калимера / Лече / Сектор: Енергетика
11	Иновации: Това е първата микрогенераторна централа, захранвана от млада дървесина от резитба на маслини в Централна и Южна Италия.
	Име на компания: RICILARIO Град: Мартина Франка / Таранто/ Сектор: Управление на отпадъците и екологични услуги
12	Иновации: Приложението предоставя подкрепа на общини и компании при събирането на градски отпадъци и услуги за екологична хигиена. Също така помага на гражданите да намалят производството на отпадъци.

13	Име на компания: BIOFABER Град: Мезание/ Бриндизи/ Сектор: Биоматериали
	Иновации: Компанията използва отпадъци от хранително-вкусовата промишленост за употреба в модния, дизайнерския, мебелния, биомедицинския и козметичния сектори.
14	Име на компания: MAJRA MODA MAGLIERIE Град: Касано деле Мурдже /Бари/ Сектор: Мода и облекло
	Иновации: Компанията използва отпадъци от хранително-вкусовата промишленост за употреба в модния, дизайнерския, мебелния, биомедицинския и козметичния сектори.
15	Име на компания: APS FARINA 080 Град: Бари Сектор: Социално образование
	Иновации: Асоциацията действа в град Бари, като предлага действия и инициативи за социални иновации по въпроса за хранителните разхищения.

Източници:

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