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# BOTANY

## STUDY OF THE FUNGAL BIODIVERSITY OF PISTACHIO (*PISTACIA VERA* L.) ORCHARDS IN AZERBAIJAN

**Safarova A.,**

*Ph.D, lecturer, Azerbaijan State Pedagogical University*

**Arabova G.**

*Lecturer, Azerbaijan State Pedagogical University*

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### Abstract

Azerbaijan, with its fertile soils and favorable climatic conditions, hosts a rich biodiversity, among which subtropical fruit trees hold significant importance in agriculture. *Pistacia vera* L. (pistachio), a high-value dry subtropical fruit tree, is widely cultivated in several economic-geographic zones of the Greater Caucasus region, including Guba-Khachmaz, Sheki-Zagatala, and Mountainous Shirvan. Despite the economic and nutritional potential of pistachio cultivation, yields and quality are often affected by fungal pathogens. This study aimed to investigate the mycobiota associated with pistachio trees in Azerbaijan and to identify pathogenic fungal species affecting vegetative and generative organs. A total of 100 samples were collected from various plantations in spring and autumn, followed by laboratory isolation and identification procedures using morphological and statistical methods. Twenty-seven fungal species were identified, primarily belonging to the phylum Ascomycota, with only one species from Basidiomycota. Notably, species such as *Aspergillus amstelodami*, *Fusarium graminearum*, *Penicillium expansum*, *P. tardum*, and *Verticillium dahliae* were recorded on pistachio trees in Azerbaijan for the first time. The most common pathological manifestations included leaf spots and fruit or stem rot. The presence of mycotoxin-producing fungi such as *Aspergillus flavus* underscores the need for strict phytosanitary control. These findings provide a foundational understanding of pistachio mycobiota in Azerbaijan and highlight the necessity for targeted disease management strategies, selection of resistant cultivars, and development of biocontrol measures to ensure sustainable pistachio production and enhance export potential.

**Keywords:** *Pistacia vera* L., fungal pathogens, mycobiota of Azerbaijan, Ascomycota, sustainable agriculture.

With its fertile soils and favorable climatic conditions, the Republic of Azerbaijan is characterized by a rich biodiversity (Aliyev, 2019). One of the main components of this biodiversity is plant life. In its development strategy, Azerbaijan prioritizes sustainability. This emphasis on sustainability is reflected not only in the oil sector but also in non-oil sectors, particularly in the development of agriculture (Ministry of Agriculture of Azerbaijan, 2020). Initiatives such as the establishment of intensive and super-intensive orchards, the introduction of new plant varieties, and the development of new local varieties can be cited as key examples. These efforts are crucial for meeting the population's nutritional demands through domestic production and for achieving effective results in non-oil sectors of the national economy.

Numerous fruit crops characterized by high nutritional value and productivity are cultivated across the country. Among them, dry subtropical fruit crops hold a special place. Although the dry subtropical climate is particularly suitable for the Absheron Peninsula, dry subtropical orchards can be found in nearly every region of the country. Since our research focuses on the Greater Caucasus region, the climate in the relevant economic-geographical zones is mostly temperate. In economic-geographical zones such as Guba-Khachmaz, Sheki-Zagatala, and Mountainous Shirvan, which are part of the Greater Caucasus, various dry subtropical fruit trees—including oleaster, jujube, pistachio, pomegranate, olive, fig, almond, and others—are widely cultivated, yielding high productivity (Ismaïlova & Mammadova, 2021).

Among dry subtropical fruit trees, pistachio (*Pistacia vera* L.) stands out for its high nutritional value and rich biochemical composition, making it valuable for medicinal purposes (Maggs-Kölling et al., 2022). Pistachio trees are long-lived, with lifespans reaching up to 100 years, and grow to heights of 5–10 meters. Flowering occurs in April–May, with fruit ripening in August–September. Main productivity is achieved between the 10th and 15th years, although flowering begins in the 7th–8th year if the tree is not grafted (FAO, 2021). Both traditional and intensive pistachio orchards are cultivated in Azerbaijan. Pistachios are a highly valued product in the global market, especially exported from countries like Iran and the USA. However, the expected productivity is not always achieved, and even when harvested, the product may not fully meet quality standards. One of the main reasons for this is diseases caused by pathogenic fungi (Abdollahi et al., 2016).

Given the increasing demand for food, the high export and import potential, and the need to prevent yield losses, studying these fungi and their characteristics, and developing effective control strategies against them, remains a constantly relevant issue. Therefore, the main aim of this research is to identify the mycobiota of pistachio orchards cultivated in Azerbaijan and to determine the pathogenic species that form this mycobiota.

During the research, approximately 100 samples were collected from both vegetative and generative organs of pistachio trees in permanent plots according to a planned route in spring and autumn. These samples were placed on nutrient media to obtain pure cultures

and incubated in thermostats under mesophilic temperatures for 5–10 days until colonies formed. Experiments were conducted in five replicates, and the results were processed statistically. A total of 27 fungal species were identified during the identification phase: *Aspergillus flavus*, *A.fumigatus*, *A.glaucus*, *A.niger*, *A.amstelodami*, *Aureobasidium pullulans*, ***Botryosphaeria dothidea***, *Cladosporium herbarum*, *Gibberella intricans*, *Fusarium oxysporum*, *F.moniliforme*, *F.solani*, *F.verticillioides*, *Fomes fomentarius*, *Mycosphaerella pistacina*, ***Neofusicoccum parvum***, ***Nematospora coryli***, *Paecilomyces variotii*, *Penicillium crysogenum*, *P.expansum*, *P.tardum*, ***Phaeoacremonium parasiticum***, ***P. cinerum***, ***P. viticola***, *Phoma pulchella*, *Septoria pistaciae*, *Verticillium dahliae*.

Among the fungi identified, *Aspergillus amstelodami*, *Fusarium graminearum*, *Penicillium expansum*, *P. tardum*, and *Verticillium dahliae* were detected for the first time on dry subtropical plants in Azerbaijan. Of the identified fungi, one species belongs to the phylum Basidiomycota (*Fomes fomentarius*), and the remaining 26 belong to the phylum Ascomycota. The dominance of Ascomycota species among the pathogenic fungi suggests their broad distribution and ecological adaptability (Hyde et al., 2019). The most common pathologies caused by the identified fungi were rot and leaf spot diseases.

As a result of the research, a wide and diverse mycobiotic flora was revealed in pistachio orchards cultivated in Azerbaijan, particularly in the economic-geographical zones of the Greater Caucasus. This indicates that pistachio trees grow in a microbiological environment rich in phytopathogenic fungi and are exposed to various biotic stress factors.

Among the identified fungal species, globally recognized phytopathogens such as *Verticillium dahliae*, *Fusarium oxysporum*, *Aspergillus flavus*, *Penicillium expansum*, and *Botryosphaeria dothidea* are of particular concern (Domsch et al., 2007). These pathogens can lead to reduced productivity, lower fruit quality, and post-harvest losses. The most commonly observed pathologies in pistachio orchards were leaf spotting and fruit or stem rot, indicating the vulnerability of both vegetative and generative organs to infection.

Some fungi—such as *Aspergillus amstelodami*, *Fusarium graminearum*, *Penicillium tardum*, *P. expansum*, and *Verticillium dahliae*—were recorded for the first time on pistachio trees in Azerbaijan. This is of significant importance for understanding the country's mycobiota and for identifying new phytosanitary threats in the region.

The results of this research have several practical implications:

- **Planning agro-biotechnical measures:** The findings support the development of targeted agro-technical and phytosanitary strategies.

- **Development of biological control methods:** Some weakly pathogenic or opportunistic fungi identified in this study may serve as potential biocontrol agents in future research.

- **Selection of regional cultivars:** The results provide a scientific basis for breeding and introducing pistachio cultivars resistant to fungal stress factors.

- **Ecological safety:** The presence of toxin-producing fungi such as *Aspergillus flavus*, which produces aflatoxins, should be taken seriously in terms of food safety, necessitating regular monitoring (Pitt & Hocking, 2009).

In conclusion, this research provides a preliminary mapping of pathogenic fungal diversity in Azerbaijan's pistachio orchards and lays the scientific foundation for the healthy cultivation and protection of the crop's export potential. Future genetic identification and pathogenicity assessment using molecular methods will further enrich knowledge in this field.

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# CHEMISTRY

## SYNTHESIS OF ACRYLATES OF SOME ACETYLENE DIOLS BY ESTERIFICATION REACTION

**Ablakulov L.,**

*Chirchik State Pedagogical University, Uzbekistan, Chirchik*

**Ikramov A.,**

*t.f.d., prof*

*Tashkent Institute of Chemical Technology, Uzbekistan, Tashkent*

**Ziyadullaev O.,**

*k.f.d., prof*

*Chirchik State Pedagogical University, Uzbekistan, Chirchik*

*Doctor of Chemical Sciences, Professor,*

*Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan,*

*Uzbekistan, Tashkent*

**Qushbaqov F.**

*Chirchik State Pedagogical University, Uzbekistan, Chirchik*

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### Abstract

For the first time, the synthesis of complex esters was carried out using the etherification reaction of acetylene diols with acrylic acid under the catalysis of  $C_6H_6$  and concentrated  $H_2SO_4$  solvents. The factors affecting the yield of the synthesized complex esters, including the ratios of starting materials, temperature, reaction time, catalysts and solvents, were determined and analyzed. Based on the results obtained, the  $^1H$  NMR spectra of the synthesized complex esters were analyzed. Based on the results obtained, the most optimal conditions for the process were studied, and the composition, purity, structure and quantum-chemical properties and  $R_f$  values of the synthesized complex esters were proven by modern physico-chemical research methods, and the efficiency range was determined.

**Keywords:** acetylene diols, esters, acrylic acid, sulfuric acid, benzene etherification reaction, reaction mechanism, product yield, catalyst and solvent.

**Introduction:** Currently, the synthesis of complex esters based on the esterification reaction of carbon acids with acetylene alcohols is being carried out worldwide and is being widely used in various sectors of society. This includes significant applications in agriculture, medicine, and perfumery [1-3]. For this reason, deep scientific research is being conducted by scientists around the world on the synthesis of complex esters of acetylene diols with carbon acids and their applications [4. 6-10]. Among these, the complex esters of acetylene alcohols with saturated carbon acids, as well as those with unsaturated carbon acids, are of great importance [5. 11-14]. The complex esters of acrylic acid, which is an unsaturated carbon acid, are being widely used in many fields [15-17]. Considering these needs, the synthesis of complex esters of acetylene diols was carried out, and their analysis was conducted using physico-chemical research methods [18-21].

**Experimental Section:** (As an example, the synthesis of 3,4-dimethyl-1,6-diphenylhexa-1,5-diene-3,4-diol diacrylate is presented.) The synthesis of complex esters was carried out in a double-layer reactor made of thermally and mechanically strong quartz glass with a capacity of 500 ml. The reactor was equipped with a mechanical stirrer, two spray nozzles, a reflux condenser, and a Dean-Stark apparatus. Initially, 130 ml of  $C_6H_6$  and 1.47 ml (0.015 mol) of concentrated sulfuric acid ( $H_2SO_4$ ) were added to the reactor while stirring for 1 hour. The resulting catalytic system was maintained at 75-80°C with  $H_2SO_4/C_6H_6$ , and 95.22 ml (0.3 mol) of 3,4,5-trimethyl-1,7-diphenylheptadiyne-1,6-diol-3,5 and 28.8 ml (0.4 mol) of acrylic acid were

added dropwise through the nozzle over 6 hours. To prevent the water produced from hydrolyzing the expected product, the Dean-Stark apparatus continuously separated it from the system. After the water separation was complete, the resulting reaction mixture was dried for 24 hours with  $MgSO_4$  and extracted with DEE (3×50). The mixture was then fractionated under vacuum. Based on the experimental results, 99.5 grams of 3,4,5-trimethyl-1,7-diphenylhepta-1,6-diene-3,5-diol diacrylate was synthesized with a yield of 80.2%, along with 8% of starting materials, 6% of by-products, and 4% of waste.

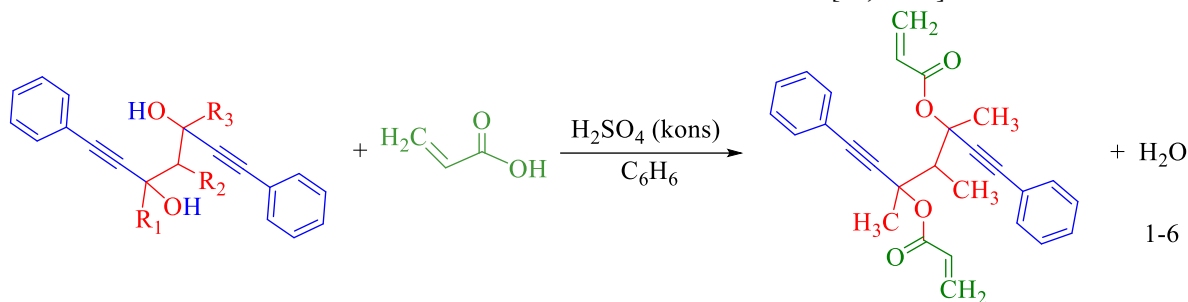
We also synthesized the following complex esters using the same method:

1. 82% yield of 3,4-dimethyl-1,6-diphenylhexa-1,5-diene-3,4-diol diacrylate,
2. 80.6% yield of 3,5-dimethyl-1,7-diphenylhepta-1,6-diene-3,5-diol diacrylate,
3. 80.2% yield of 3,4,5-trimethyl-1,7-diphenylhepta-1,6-diene-3,5-diol diacrylate,
4. 78.5% yield of 3,6-dimethyl-1,8-diphenylocta-1,7-diene-3,6-diol diacrylate,
5. 77.2% yield of 3-methyl-1,7-diphenyl-5-(thiophenyl-2)hepta-1,6-diene-3,5-diol diacrylate, and
6. 75.3% yield of 1,7-diphenyl-3-(thiophenyl-2)-5-(trifluoromethyl)hepta-1,6-diene-3,5-diol diacrylate.

**Reaction Scheme and Mechanism:** The acetylene diol molecules participate in the esterification reaction with carbon acids due to the presence of substituents, three bonds, and the reactive hydroxyl (OH) group. In this work, the esterification reactions of the

following diols with acrylic acid are presented: 3,4-dimethyl-1,6-diphenylhexa-1,2,5-tri-ene-1,5-diol-3,4; 3,5-dimethyl-1,7-diphenylhepta-1,6-diol-3,5; 3,4,5-trimethyl-1,7-diphenylhepta-1,6-diol-3,5; 3,6-dimethyl-1,8-di-

phenylocta-1,7-diol-3,6; 3-methyl-1,7-diphenyl-5-(thiophenyl-2)hepta-1,6-diol-3,5; and 1,7-diphenyl-3-(thiophenyl-2)-5-(trifluoromethyl)hepta-1,6-diol-3,5. The reaction mechanism is proposed based on literature sources as follows [13,18-19].

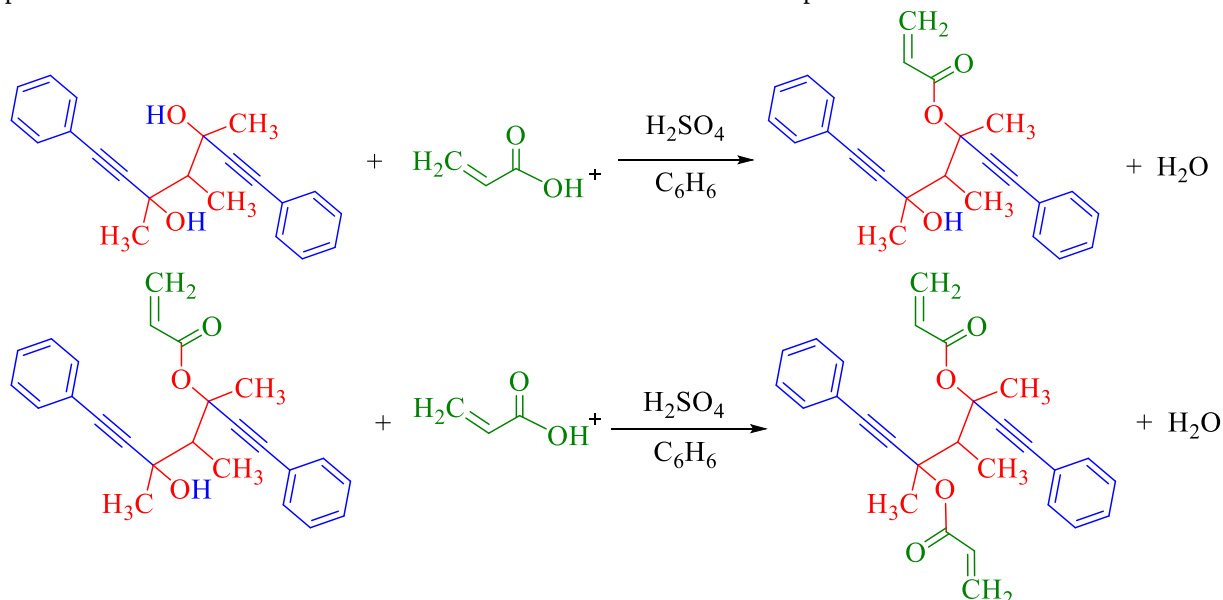


1. R1= Me, R3= Me,
2. R2= Me, R2= H, R3= Me,
3. R3= Me, R2= Me, R3= Me,

4. R4= Me, R2= 2H, R3= Me,
5. R5= Th, R2= H, R3= Me,
6. R6= Th, R2= H, R3= CF<sub>3</sub>,

First, sulfuric acid protonates acrylic acid and increases its electrophilicity. The oxygen atom of the acetylene diol attacks the carbonyl group of the protonated acrylic acid, resulting in the formation of a complex ester and water.

In the case of 3,4,5-trimethyl-1,7-diphenylhepta-1,6-diol-3,5, the oxygen atoms in the two OH hydroxyl groups undergo stepwise electrophilic attack by the protonated acrylic acid, leading to the expected formation of a complex ester and water.



To synthesize complex esters with high efficiency, the nature and structure of substituents in acetylene diols and acrylic acid molecules, as well as the effects of temperature, reaction duration, catalyst, and solvent nature were systematically analyzed and studied [19-21].

Initially, the effect of temperature on the yield of complex esters was investigated. The process was conducted over 6 hours at temperatures ranging from 60 to 100 °C, using benzene as the solvent and sulfuric acid as the catalyst, with acetylene diol and acrylic acid re-

acting at molar ratios of 0.3 and 0.4. At 80 °C, the catalyst H<sub>2</sub>SO<sub>4</sub> interacted with the carbonyl group of acrylic acid, forming an intermediate compound that facilitated an easy reaction with acetylene diols, resulting in a favorable environment for high product yields. However, when the temperature was increased to 100 °C, a decrease in product yield was observed due to the reversion of the synthesized complex esters back to the starting materials or the dehydration of acetylene diols, leading to the formation of by-products.

Table 1

Effect of temperature on the synthesis of esters (catalyst H<sub>2</sub>SO<sub>4</sub>)

| Complex Ester | Product Yield, % |       |        |
|---------------|------------------|-------|--------|
|               | 60 °C            | 80 °C | 100 °C |
| 1             | 74               | 82    | 44     |
| 2             | 73               | 80,6  | 39     |
| 3             | 72               | 80,2  | 42     |
| 4             | 70               | 78,5  | 40     |
| 5             | 69               | 77,2  | 35     |
| 6             | 60               | 75,3  | 29     |

The duration of the reaction for the esterification of acetylene diols with acrylic acid was conducted at 80 °C in a benzene solution for periods ranging from 3 to 8 hours (see Table 2). When the process was carried out for 6 hours, it was observed that only a small amount of intermediate and by-products were formed, and the synthesized product had a low conversion to complex esters and minimal reversion to starting materials. During the reaction, water was continuously collected in a Dean-Stark apparatus, which prevented the hydrolysis of the complex ester by water and achieved high yields.

When the reaction duration was increased to 8 hours, the protons from sulfuric acid attacked the unshared electrons on the oxygen atom of the hydroxyl group in the acetylene diol, resulting in the protonation of the OH group and a decrease in the nucleophilicity of the diol as well as the activity of the catalyst. This led to a decrease in the expected yield of the complex ester. The maximum yield of the product was determined when the reaction time increased from 3 to 5 hours at 80 °C with H<sub>2</sub>SO<sub>4</sub> as the catalyst in benzene solution, but a decrease in yield was observed when extending the reaction time from 5 to 8 hours.

Table 2

Effect of Reaction Duration on the Yield of Complex Esters  
(Temperature: 100 °C, Catalyst: H<sub>2</sub>SO<sub>4</sub>, Solvent: C<sub>6</sub>H<sub>6</sub>)

| Complex Ester | Product Yield, % |         |         |         |
|---------------|------------------|---------|---------|---------|
|               | 3 hours          | 4 hours | 6 hours | 8 hours |
| 1             | 38               | 72      | 82      | 66      |
| 2             | 33               | 68      | 80,6    | 61      |
| 3             | 36               | 71      | 80,2    | 63      |
| 4             | 34               | 70      | 78,5    | 60      |
| 5             | 29               | 60      | 77,2    | 53      |
| 6             | 25               | 52      | 75,3    | 46      |

The amount of starting materials in the esterification reaction of acetylene diols with acrylic acid was also studied (see Table 3). Initially, when the starting materials 3,4,5-trimethyl-1,7-diphenylheptadiene-1,6-diol-3,5 and acrylic acid were taken in molar ratios of 0.3:0.2 and 0.3:0.3, a deficiency of acrylic acid was observed after the process stopped, which led to a decrease in product yield due to excess acetylene diols remaining in the system. When the molar ratio of the

starting materials was adjusted to 0.3:0.4, a higher yield of the product was achieved. This increase in yield was attributed to the complete ionization of acetylene diol and acrylic acid molecules, which enhanced the activity of the intermediate complex compounds, resulting in higher yields of complex esters. However, when the amounts of the reagents and substrates were set to 0.2:0.4 mol, a decrease in product yield was also observed.

Table 3.

Effect of Starting Materials on the Yield of Complex Esters  
(Temperature: 100 °C, Solvent: C<sub>6</sub>H<sub>6</sub>)

| Complex Ester | Product Yield, % in molar ratios of |         |         |         |
|---------------|-------------------------------------|---------|---------|---------|
|               | 0,3:0,2                             | 0,3:0,3 | 0,3:0,4 | 0,2:0,4 |
| 1             | 38,2                                | 63,6    | 82      | 65      |
| 2             | 35,8                                | 61,4    | 80,6    | 61,6    |
| 3             | 36,4                                | 60,5    | 80,2    | 63,4    |
| 4             | 34,6                                | 59,4    | 78,5    | 60      |
| 5             | 29,5                                | 57,7    | 77,2    | 53,5    |
| 6             | 25,7                                | 52      | 75,3    | 46,8    |

The composition, purity, structure, and physicochemical properties of the synthesized complex esters were determined using modern methods such as <sup>1</sup>H-NMR, spectroscopy, mass spectrometry, chromatographic techniques (TLC, HPLC), quantum-chemical methods, and other physicochemical research methods (see Figures 1, 2, and 3). Based on the research results, the composition of the synthesized complex esters was calculated (see Table 3).

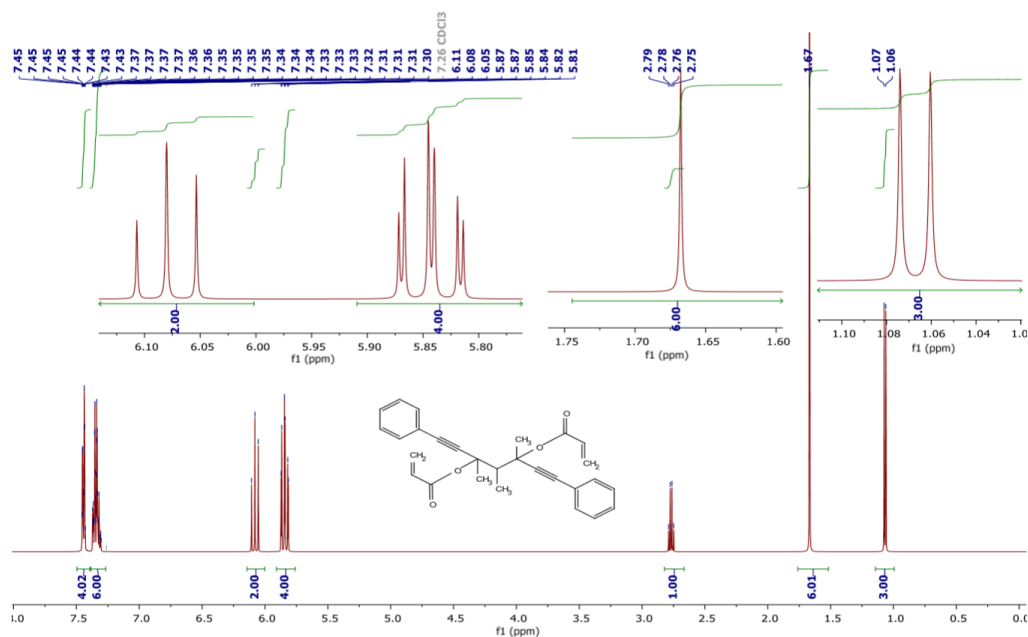


Figure 1.  $^1\text{H}$  NMR Spectrum of 3,4,5-Trimethyl-1,7-Diphenylhepta-1,6-diene-3,5-diol Diacrylate.

Analysis of the  $^1\text{H}$  NMR Spectrum of 3,4,5-Trimethyl-1,7-Diphenylhepta-1,6-diene-3,5-diol Diacrylate.

$^1\text{H}$  NMR (400 MHz, Chloroform- $d$ )  $\delta$  7.50 – 7.38 (m, 4H), 7.39 – 7.27 (m, 6H), 6.08 (t,  $J$  = 13.4 Hz, 2H), 5.84 (td,  $J$  = 13.2, 2.6 Hz, 4H), 2.77 (q,  $J$  = 6.8 Hz, 1H), 1.67 (s, 6H), 1.07 (d,  $J$  = 6.8 Hz, 3H).

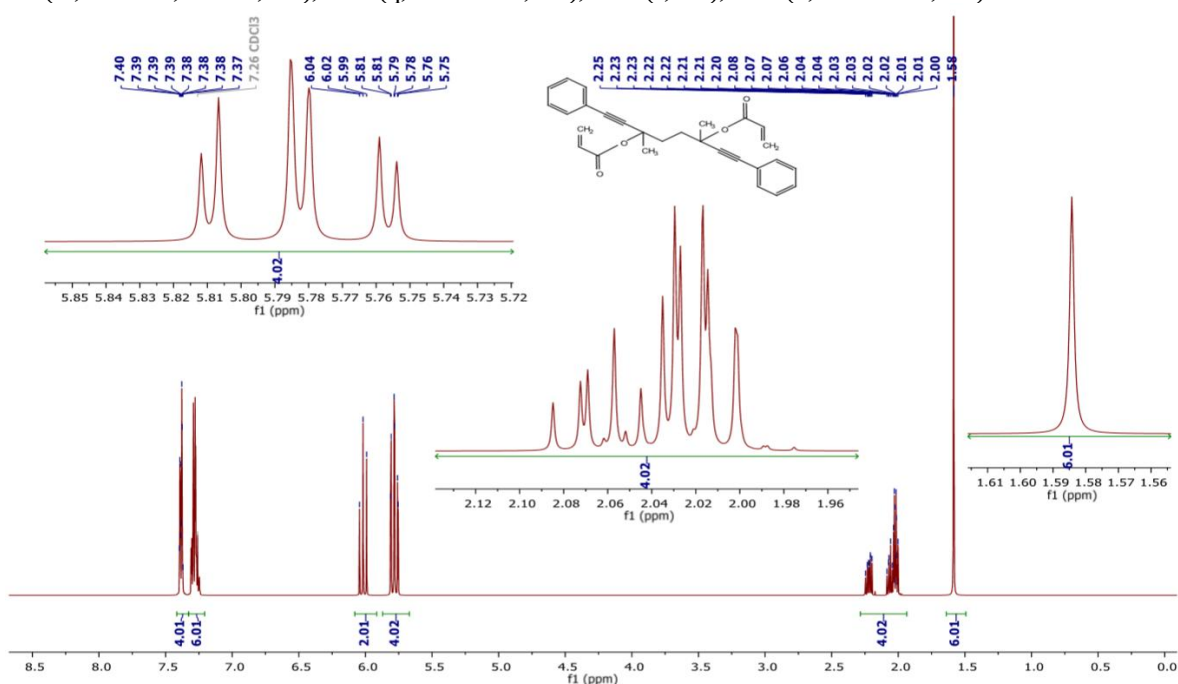


Figure 2.  $^1\text{H}$  NMR Spectrum of 3,6-Dimethyl-1,8-Diphenylocta-1,7-diene-3,6-diol Diacrylate.

Analysis of the  $^1\text{H}$  NMR Spectrum of 3,6-Dimethyl-1,8-Diphenylocta-1,7-diene-3,6-diol Diacrylate.

$^1\text{H}$  NMR (500 MHz, Chloroform- $d$ )  $\delta$  7.42 – 7.33 (m, 4H), 7.33 – 7.21 (m, 6H), 6.08 – 5.91 (m, 2H), 5.78 (td,  $J$  = 13.2, 2.6 Hz, 4H), 2.28 – 1.94 (m, 4H), 1.58 (s, 6H).

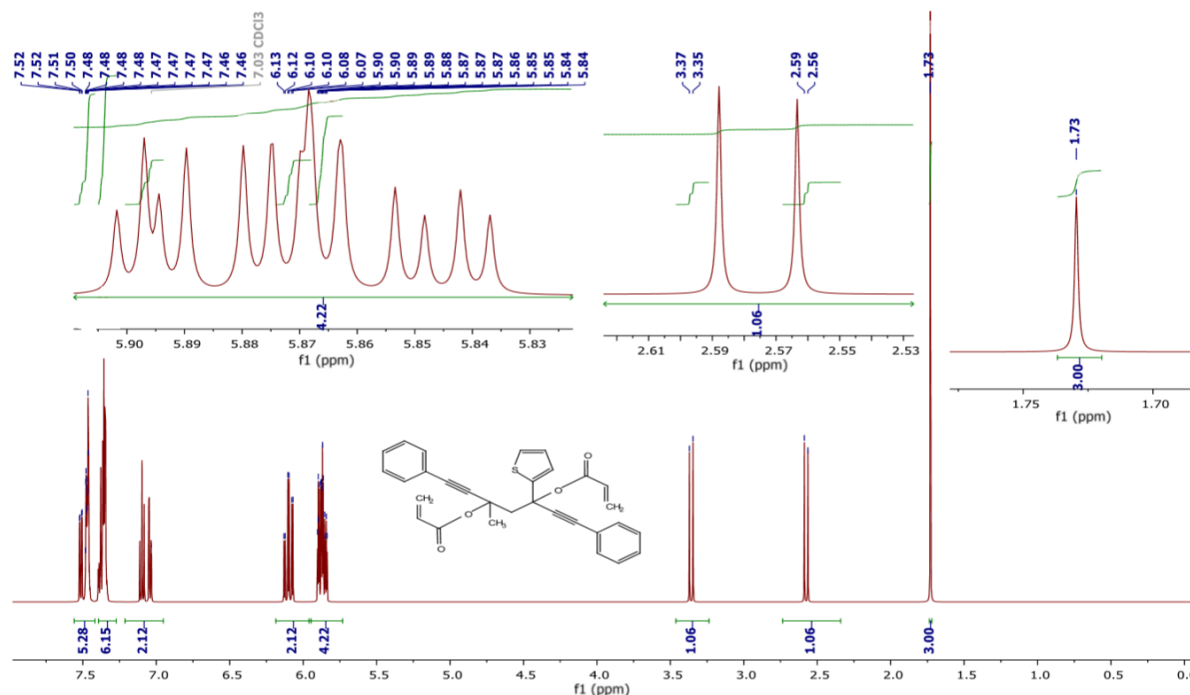


Figure 3. <sup>1</sup>H NMR Spectrum of 3-Methyl-1,7-Diphenyl-5-(Thienyl-2) Hepta-1,6-Diene-3,5-Diol Diacrylate.

Analysis of the <sup>1</sup>H NMR Spectrum of 3-Methyl-1,7-Diphenyl-5-(Thienyl-2) Hepta-1,6-Diene-3,5-Diol Diacrylate.

<sup>1</sup>H NMR (400 MHz, Chloroform-d) δ 7.56 – 7.42 (m, 5H), 7.39 – 7.27 (m, 6H), 7.21 – 6.95 (m, 2H), 6.10 (td, J = 13.4, 4.0 Hz, 2H), 5.96 – 5.73 (m, 4H), 3.36 (d, J = 12.4 Hz, 1H), 2.58 (d, J = 12.3 Hz, 1H), 1.73.

Table 4

Elemental Analysis Results of Synthesized Complex Esters

| Complex esters | Brutto formula                                                 | Molecular Mass, g/mol | Analysis Results | Element Name and Analysis |      |       |      |       |
|----------------|----------------------------------------------------------------|-----------------------|------------------|---------------------------|------|-------|------|-------|
|                |                                                                |                       |                  | C                         | H    | O     | S    | F     |
| 1              | C <sub>26</sub> H <sub>22</sub> O <sub>4</sub>                 | 398,48                | Calculated       | 78,5                      | 5,8  | 15,9  | -    | -     |
|                |                                                                |                       | Identified       | 78,3                      | 5,6  | 16,1  | -    | -     |
| 2              | C <sub>27</sub> H <sub>24</sub> O <sub>4</sub>                 | 412,51                | Calculated       | 78,25                     | 5,54 | 15,30 | -    | -     |
|                |                                                                |                       | Identified       | 78,6                      | 5,9  | 15,5  | -    | -     |
| 3              | C <sub>28</sub> H <sub>26</sub> O <sub>4</sub>                 | 426,54                | Calculated       | 79,21                     | 6,18 | 15,82 | -    | -     |
|                |                                                                |                       | Identified       | 78,8                      | 6,1  | 15,0  | -    | -     |
| 4              | C <sub>28</sub> H <sub>26</sub> O <sub>4</sub>                 | 426,54                | Calculated       | 79,21                     | 6,18 | 15,82 | -    | -     |
|                |                                                                |                       | Identified       | 78,8                      | 6,1  | 15,0  | -    | -     |
| 5              | C <sub>30</sub> H <sub>24</sub> O <sub>4</sub> S               | 480,61                | Calculated       | 75,87                     | 5,38 | 13,31 | 6,8  | -     |
|                |                                                                |                       | Identified       | 75,0                      | 5,0  | 13,3  | 6,7  | -     |
| 6              | C <sub>30</sub> H <sub>21</sub> O <sub>4</sub> SF <sub>3</sub> | 534,58                | Calculated       | 66,9                      | 4,17 | 11,97 | 5,95 | 10,15 |
|                |                                                                |                       | Identified       | 67,4                      | 4,0  | 12,0  | 6,0  | 10,7  |

**Conclusion:** The synthesis of complex esters was conducted for the first time through the esterification reaction of acetylene diols using concentrated sulfuric acid as a catalyst and benzene as a solvent, with acrylic acid involved. The reaction mechanisms were proposed based on literature sources, and the structure, composition, and R<sub>f</sub> values of the synthesized complex esters were determined using modern physicochemical research methods.

As a result, the following complex esters were synthesized:

1. 3,4-Dimethyl-1,6-Diphenylhexa-1,5-diene-3,4-diol diacrylate,
2. 3,5-Dimethyl-1,7-Diphenylhepta-1,6-diene-3,5-diol diacrylate,

3. 3,4,5-Trimethyl-1,7-Diphenylhepta-1,6-diene-3,5-diol diacrylate,

4. 3,6-Dimethyl-1,8-Diphenylocta-1,7-diene-3,6-diol diacrylate,

5. 3-Methyl-1,7-Diphenyl-5-(Thienyl-2) Hepta-1,6-diene-3,5-diol diacrylate, and

6. 1,7-Diphenyl-3-(Thienyl-2)-5-(Trifluoromethyl) Hepta-1,6-diene-3,5-diol diacrylate.

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**ОПРЕДЕЛЕНИЕ МЕДИ, СВИНЦА, КАДМИЯ И ЦИНКА В ПРЯНОСТЯХ, ПРОИЗВЕДЕННЫХ В ГРУЗИИ, МЕТОДОМ ДИФФЕРЕНЦИАЛЬНО – ИМПУЛЬСНОЙ ПОЛЯРОГРАФИИ****Енукидзе Л.Г.**

*К.х.н. старший научный сотрудник отдела физико-химических исследований и анализов  
Института неорганической химии и электрохимии им. Р.И. Агладзе Тбилисского Государственного  
Университета им. Иване Джавахишвили.  
Грузия, Тбилиси.*

**Лоладзе Т.Ж.**

*Научный сотрудник отдела физико-химических исследований и анализов  
Института неорганической химии и электрохимии им. Р.И. Агладзе Тбилисского Государственного  
Университета им. Иване Джавахишвили.*

**DETERMINATION OF COPPER, LEAD, CADMIUM AND ZINC IN SPICES, PRODUCED IN GEORGIA, BY THE DIFFERENTIAL – IMPULSE POLAROGRAPHY METHOD****Enukidze L.,**

*Candidate of Chemical Sciences, senior researcher of Department of Physico-Chemical Research and Analysis  
R.I. Agladze Institute of inorganic chemistry and electrochemistry of Ivane Javakhishvili Tbilisi State University  
Georgia, Tbilisi*

**Loladze T.**

*Scientific Researcher of Department of Physico-Chemical Research and Analysis R. I. Agladze Institute of inorganic chemistry and electrochemistry of Ivane Javakhishvili Tbilisi State University*

DOI: [10.5281/zenodo.15874559](https://doi.org/10.5281/zenodo.15874559)**Аннотация**

Как и в предыдущей работе, мы продолжили исследование содержания тяжелых металлов (меди, свинца, кадмия и цинка) в пряностях, произведенных в Грузии.

Как показало двухлетнее исследование, специи, произведенные в Грузии, являются чистыми. Концентрация меди лишь в нескольких образцах незначительно превышает допустимую норму. Свинец во всех исследованных нами образцах или отсутствует вообще (в большинстве исследованных проб), или присутствует в незначительных количествах, не превышающих предельно-допустимую концентрацию. Кадмий во всех исследованных нами образцах отсутствует. Что касается цинка, практически во всех исследованных образцах содержание цинка значительно превышает норму, принятую Всемирной организацией здравоохранения. Ранее нами было высказано осторожное предположение, что цинк в организм человека попадает не только с цинксодержащими препаратами, особенно популярными во-время пандемии COVID-19. Двухлетнее исследование содержания тяжелых металлов в пряностях, произведенных в Грузии, показало, что цинк дополнительно с препаратами попадает в организм человека и из специй.

**Abstract**

As in the previous study, we continued the investigation of heavy metal content (copper, lead, cadmium, and zinc) in spices produced in Georgia.

A two-year study showed that spices produced in Georgia are clean. Copper concentrations slightly exceeded the permissible limit in only a few samples. Lead was either entirely absent (in the majority of samples analyzed) or present in trace amounts that did not exceed the maximum allowable concentration. Cadmium was absent in all samples. However, in nearly all samples, zinc levels significantly exceeded the limit established by the World Health Organization. Previously, we cautiously hypothesized that zinc enters the human body not only through zinc-containing supplements, which became especially popular during the COVID-19 pandemic. The two-year study of heavy metal content in spices produced in Georgia confirmed that, in addition to supplements, spices are also a source of zinc intake in the human body.

**Ключевые слова:** тяжелые металлы, пряности, здоровье, дифференциально-импульсная полярография, предельно-допустимая концентрация.

**Keywords:** heavy metals, spices, health, differential-pulse polarography, maximum allowable concentration.

Постоянный рост производства и быстрое его развитие привели в конце 20-го века ситуацию с состоянием окружающей среды во многих странах и регионах мира на грань экологического кризиса. К числу основных факторов деградации природной среды относится ее загрязнение различными поллютантами, среди которых одно из главных мест занимают тяжелые металлы, поскольку ионы тяжелых металлов проявляют высокую устойчивость в

окружающей среде, обладают высокими токсичными свойствами, бионеразлагаемостью, стойкостью и накапливаются при распространении через пищевые цепи [1].

Тяжелые металлы встречаются повсюду: в выхлопных газах автомобилей, выбросах заводов, почве, воде и, что самое опасное, в продуктах питания. Тяжелые металлы не имеют вкуса и запаха, они могут незаметно накапливаться в организме и

вызывать серьезные проблемы со здоровьем. Хотя все ионы тяжелых металлов в избыточных концентрациях вредны для человека, многие металлы, такие как цинк, железо, кобальт, молибден, марганец и медь, необходимы для организма человека [2,3]. Однако наиболее важными по степени воздействия на организм и частоте содержания в объектах окружающей среды – почве, воде, воздухе, а следовательно, и в продуктах питания – являются свинец и кадмий [4]. Например, ионы кадмия могут вызывать рак, остеопороз, заболевания легких, почек и костного мозга, а ионы свинца — умственную отсталость, врожденный паралич, а также острые или хронические поражения нервной системы, печени и почек у детей [5,6].

Загрязнение пищевых продуктов тяжелыми металлами зависит от присутствия загрязняющих веществ в результате сельскохозяйственной и промышленной деятельности. Травы и специи из некоторых стран, не входящих в ЕС (особенно из Индии и Китая), подвержены более высокому риску. Однократный прием трав или специй, загрязненных свинцом и другими тяжелыми металлами, не нанесет вреда здоровью. Проблема возникает при многократном ежедневном использовании, поскольку травы и специи обладают способностью накапливать в организме человека соли свинца и кадмия [7]. Более того, трудно представить себе кухню без специй. Специи придают пище вкус и доказанно полезны для здоровья. Они содержат клетчатку, которая способствует росту полезных микробов в микробиоме кишечника, а также мощные антиоксиданты и противовоспалительные вещества. Следовательно, употребление специй, загрязненных тяжелыми металлами, представляет угрозу для здоровья человека [6]. Поэтому необходим строгий государственный контроль за качеством специй. Например, в декабре 2023 года федеральное правительство США (FDA) инициировало отзыв яблочного пюре после 125 случаев отравления свинцом у детей. Свинец попал в яблочное пюре из корицы. Концентрация этого металла в специи в 2000 раз превышала допустимую норму. Следует

отметить, что безопасной концентрации свинца в продуктах питания не существует, в связи с чем предпринимаются усилия по минимизации его содержания в продуктах питания. Свинец был добавлен в состав специй из-за желания производителя придать ей более яркий цвет. Например, при сушке и измельчении куркумы, она теряет цвет и внешнюю привлекательность, поэтому бангладешские производители добавляли в нее хромат свинца — краситель, очень опасный для здоровья человека.

1 сентября 2022 года Национальное агентство по безопасности пищевых продуктов Грузии провело 197 образцов на содержание свинца и выявило нарушения в 4 образцах специй. Установлено, что содержание свинца в этих специях превышало предельно- допустимую концентрацию.

Как и в 2023 году, целью настоящей работы было продолжение изучения содержания некоторых тяжелых металлов (меди, свинца, кадмия и цинка) в наиболее популярных специях, производимых в Грузии. Количественное определение токсичных микроэлементов в пряностях проводили на полярографе ПУ-1 в режиме дифференциально-импульсной полярографии с ртутным каплющим электродом по трехэлектродной схеме в термостатируемой ячейке. Медь (II), свинец (II), кадмий (II) и цинк (II) анализировались согласно разработанной нами ранее методике [8].

В таблице 1 представлены нормы содержания микроэлементов в овощах, фруктах и зелени (Приказ Министра труда, здравоохранения и социальной защиты № 301/Н от 2001 г.).

|                  |             |
|------------------|-------------|
| Cu <sup>2+</sup> | ≤5 мг/кг    |
| Pb <sup>2+</sup> | ≤0,5 мг/кг  |
| Cd <sup>2+</sup> | ≤0,03 мг/кг |
| Zn <sup>2+</sup> | ≤10 мг/кг   |

Были исследованы следующие образцы: Оджахури-6; Хомли-7; Джео-2; Згапари-1, Alpine Spice LLC -1; Агропай-1; Сванетия-1; Дезертирский рынок-6; Остальное было предоставлено частными лицами. Всего было исследовано 31 образец.

Таблица 2.

Результаты исследований содержания тяжелых металлов (медь, свинец, кадмий, цинк) в образцах специй фирмы «Оджахури»:

| # | Образец (Оджахури) | Содержание металлов, мг/кг |      |      |       |
|---|--------------------|----------------------------|------|------|-------|
|   |                    | Cu                         | Pb   | Cd   | Zn    |
| 1 | Имбирь             | 2,12                       | 0,44 | 0,00 | 37,13 |
| 2 | Сушеный чеснок     | 2,88                       | 0    | 0    | 80,57 |
| 3 | Черный кунжут      | 4,83                       | 0,00 | 0,00 | 74,70 |
| 4 | Душистый перец     | 1,97                       | 0    | 0    | 15,34 |
| 5 | Зира               | 4,99                       | 0    | 0,00 | 85,37 |
| 6 | Голубой пажитник   | 1,72                       | 0    | 0,00 | 79,97 |

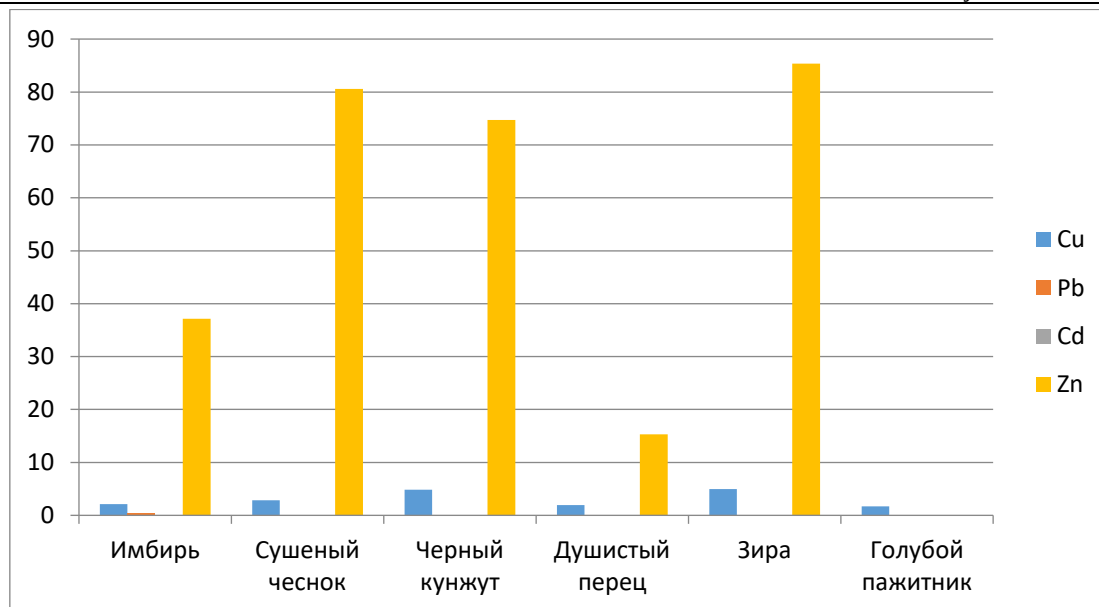


Рисунок 2. Диаграмма содержания меди, свинца, кадмия и цинка в образцах фирмы «Оджахури»

Как видно из таблицы, содержание меди во всех образцах находится в пределах нормы; Свинец обнаружен лишь в одной пробе в небольшой концентрации, не превышающей предельно-допустимую концентрацию; Кадмий не был обнаружен ни в одном из исследованных образцов; Что касается

цинка, то во всех образцах он превышает норму, в некоторых образцах даже в 8,5 раз.

В таблице 3 представлены результаты исследования содержания тяжелых металлов (меди, свинца, кадмия и цинка) в образцах специй фирмы «Хомли»:

| # | Образец («Хомли») | Содержание металлов, мг/кг |      |      |       |
|---|-------------------|----------------------------|------|------|-------|
|   |                   | Cu                         | Pb   | Cd   | Zn    |
| 1 | Шафран            | 4,51                       | 0,00 | 0,00 | 54,63 |
| 2 | Куркума           | 2,85                       | 0    | 0    | 85,35 |
| 3 | Хмели сунели      | 5,16                       | 0,00 | 0,00 | 86,97 |
| 4 | Черный перец      | 6,13                       | 0    | 0    | 64,67 |
| 5 | Сванская соль     | 1,77                       | 0    | 0.00 | 33,10 |
| 6 | Зира              | 4,36                       | 0,00 | 0,00 | 87,90 |
| 7 | Укроп             | 3,15                       | 0    | 0.00 | 88,12 |

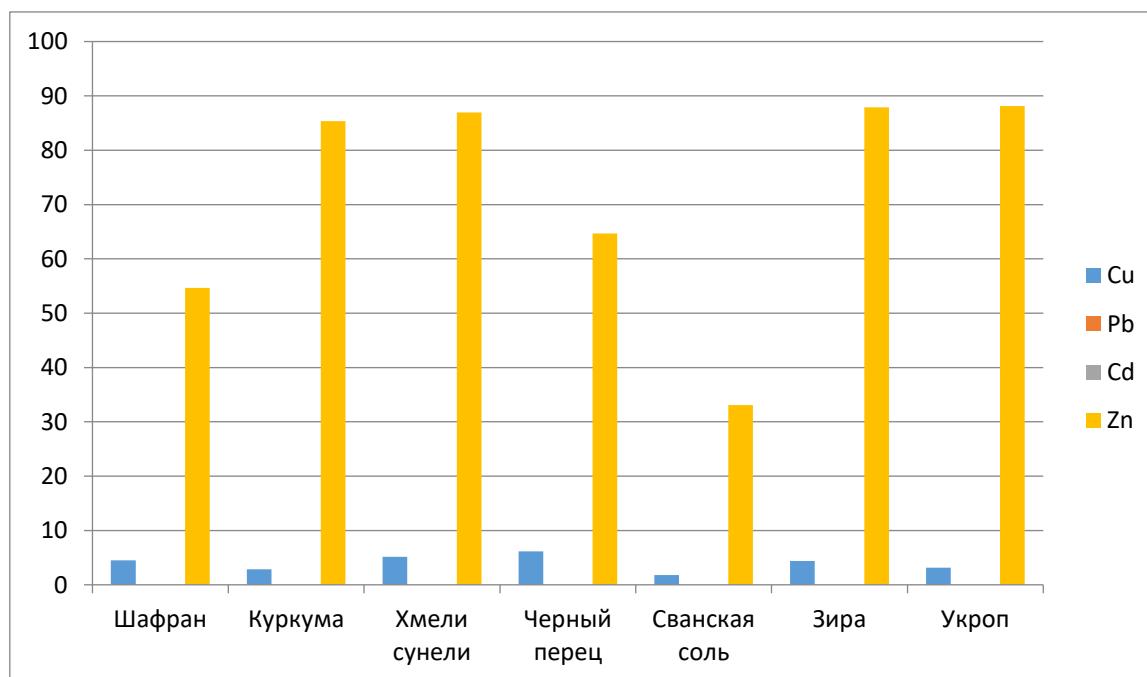


Рисунок 3. Диаграмма содержания тяжелых металлов меди, свинца, кадмия и цинка в специях фирмы «Хомли»

Как видно из таблицы 3, содержание меди выше нормы наблюдается в двух образцах. Свинец и кадмий не были обнаружены ни в одном из образцов; Содержание цинка во всех образцах превышает допустимую норму, а в некоторых — почти в 9 раз.

Таблица 4.

Содержание тяжелых металлов в специях из образцов компании «Джео»

| # | Образец (Джео)    | Содержание металлов, мг/кг |      |      |       |
|---|-------------------|----------------------------|------|------|-------|
|   |                   | Cu                         | Pb   | Cd   | Zn    |
| 1 | Ассорти из перцев | 3,60                       | 0,00 | 0,00 | 25,31 |
| 2 | Красный перец     | 4,95                       | 0,00 | 0,00 | 46,74 |

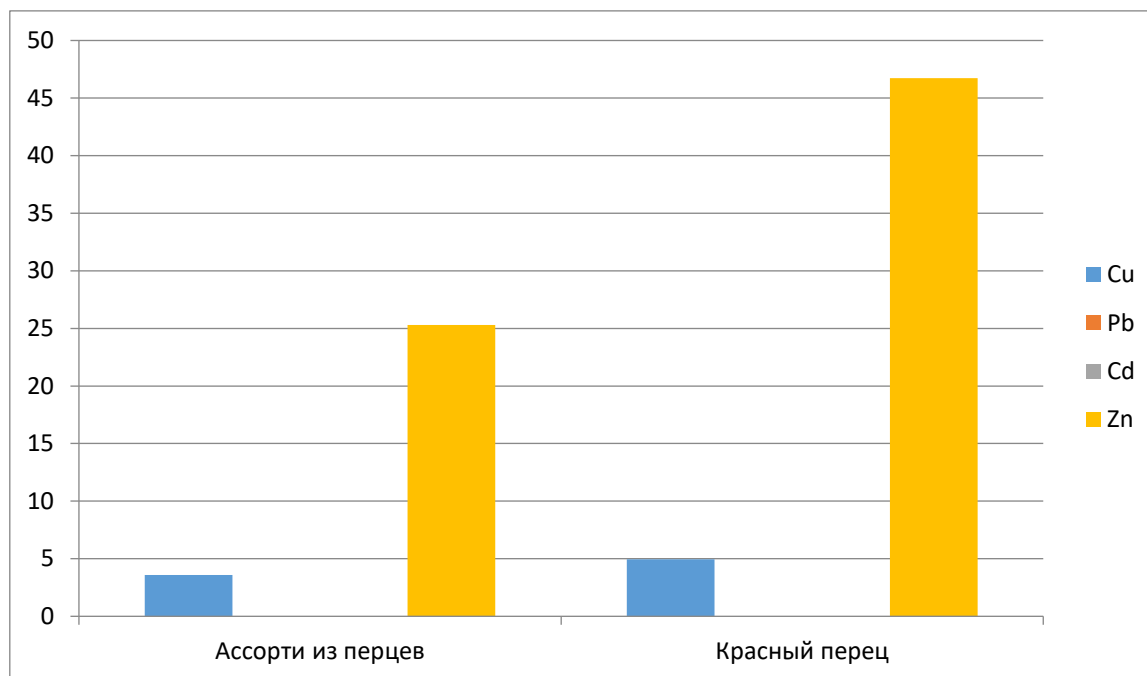


Рисунок 4. Диаграмма содержания тяжелых металлов в специях из образцов компании «Джео»

Результаты исследования показывают, что содержание меди в обоих образцах находится в пределах нормы. Свинец и кадмий не присутствуют ни в одном из образцов; цинк, напротив, превышает допустимую норму в несколько раз.

Таблица 5.

Содержание тяжелых металлов в образцах специй от Alpine Spice LLC, Агропай, Сванетия, с. Шрома (Гурия), с. Кутири (Имерети) и компании «Згапари»

| # | Образец                           | Содержание металлов, мг/кг |      |      |        |
|---|-----------------------------------|----------------------------|------|------|--------|
|   |                                   | Cu                         | Pb   | Cd   | Zn     |
| 1 | Красный перец (Alpine Spice LLC)  | 3,69                       | 0,00 | 0,00 | 30,5   |
| 2 | Семена льна (Агропай)             | 4,22                       | 0,00 | 0,00 | 88,8   |
| 3 | Гицрули (Сванетия)                | 3,37                       | 0,00 | 0,00 | 41,71  |
| 4 | Лавровый лист (село Шрома, Гурия) | 0,49                       | 0,19 | 0,00 | 34,19  |
| 5 | Реган (село Кутири, Имеретия)     | 9,93                       | 0,33 | 0,00 | 217,32 |
| 6 | Зира (фирма «Згапари»)            | 10,42                      | 0,26 | 0,00 | 174,07 |

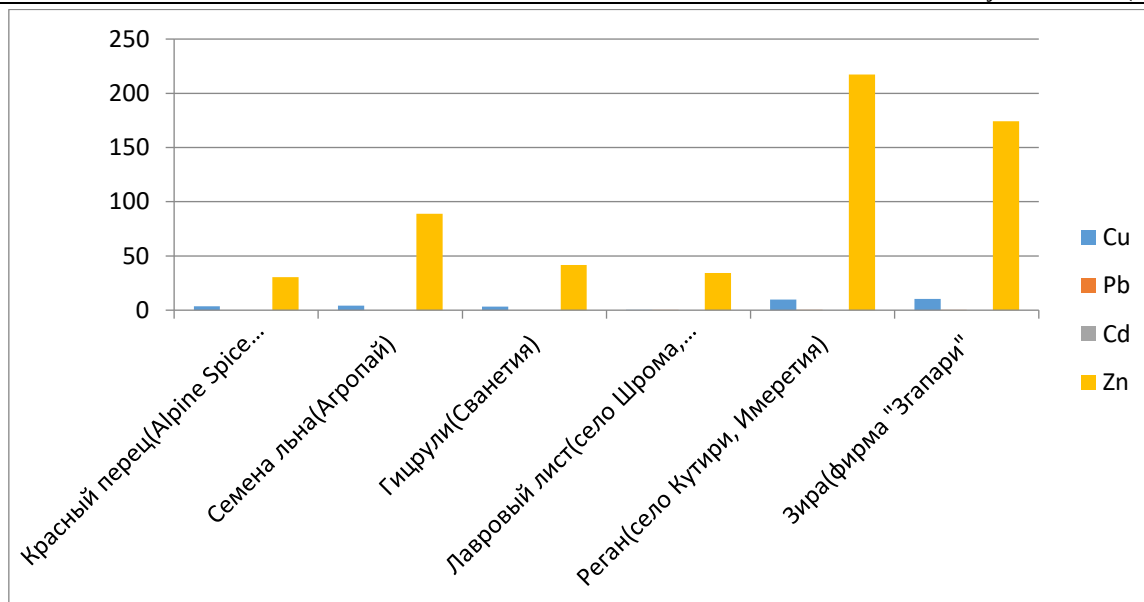


Рисунок 5. Диаграмма содержания тяжелых металлов в образцах специй от Alpine Spice LLC, Агропай, Сванетия, с. Шрома (Гурия), с. Кутири (Имерети) и фирмы «Згапар»

Как видно из таблицы 5, содержание меди в двух пробах превышает норму почти в два раза. Свинец и кадмий не обнаружены ни в одном из образцов. Что касается цинка, то в одном образце он превышает норму в 20 раз, а в другом — в 17 раз.

Таблица 6.

Содержание тяжелых металлов в образцах специй, предоставленных частным лицом (Н.К.)

| # | Образец (предоставлен частным лицом) | Содержание металлов, мг/кг |      |      |        |
|---|--------------------------------------|----------------------------|------|------|--------|
|   |                                      | Cu                         | Pb   | Cd   | Zn     |
| 1 | Аджика по-мегрельски                 | 1,23                       | 0,08 | 0,00 | 21,6   |
| 2 | Хмели сунели                         | 4,99                       | 0,00 | 0,00 | 123,29 |
| 3 | Сушеный кориандр                     | 5,6                        | 0,00 | 0,00 | 65,49  |
| 4 | Мята                                 | 2,57                       | 0,00 | 0,00 | 51,47  |

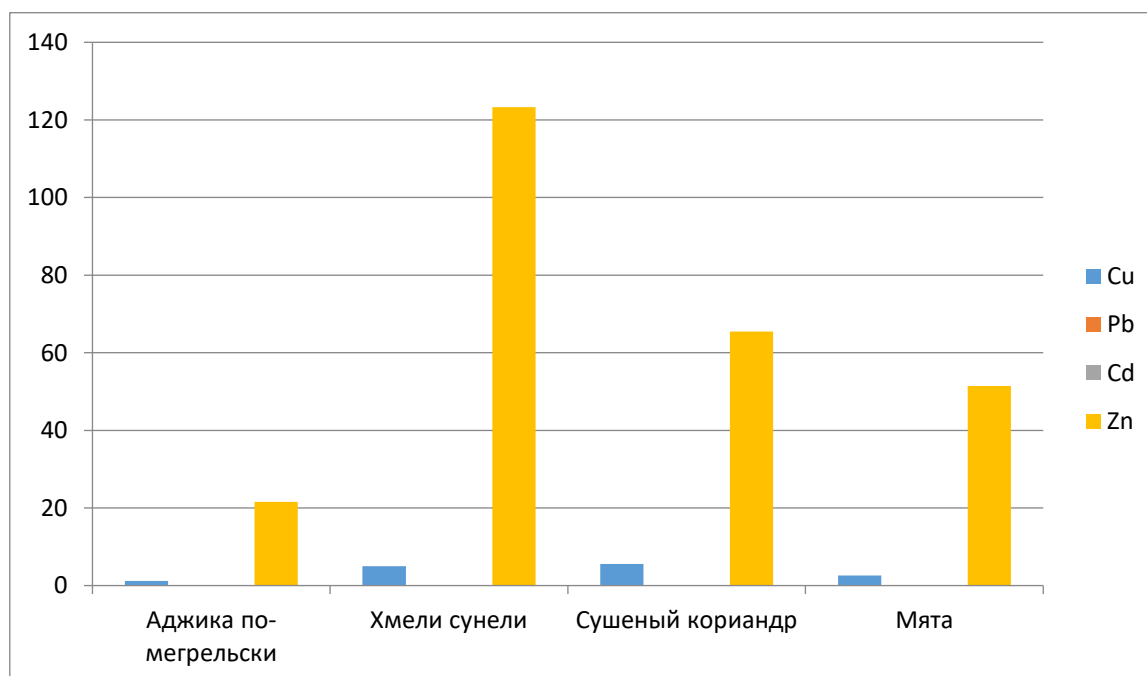


Рисунок 6. Представлена диаграмма содержания тяжелых металлов в образцах специй, предоставленная частным лицом.

Из таблицы 6 видно, что из четырех образцов только в одном концентрация меди превышает норму; Что касается свинца и кадмия, то в трех образцах волны свинца или кадмия вообще не проявились, и только в одном образце свинец присутствует в следовых количествах; Содержание цинка во всех образцах значительно выше нормы.

Таблица 7.

Содержание тяжелых металлов в специях, взятых с Дезертирского рынка

| # | Образец (рынок «Дезертирский») | Содержание металлов, мг/кг |      |      |        |
|---|--------------------------------|----------------------------|------|------|--------|
|   |                                | Cu                         | Pb   | Cd   | Zn     |
| 1 | Тмин                           | 4,85                       | 0,00 | 0,00 | 68,13  |
| 2 | Реган                          | 5,30                       | 0    | 0    | 62,20  |
| 3 | Шашкклави                      | 7,54                       | 0,32 | 0,00 | 105,94 |
| 4 | Шафран                         | 4,58                       | 0    | 0    | 69,58  |
| 5 | Тимьян                         | 5,34                       | 0    | 0,00 | 115,75 |
| 6 | Эстрагон                       | 10,22                      | 0    | 0,00 | 26,96  |

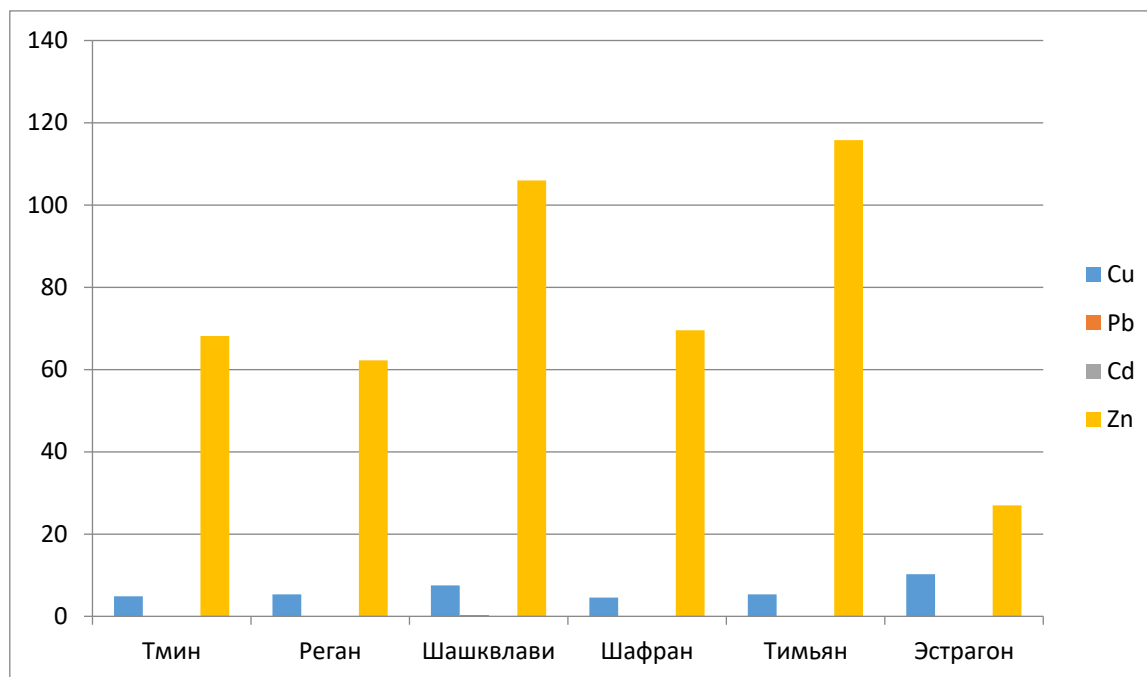


Рисунок 7. Диаграмма содержания тяжелых металлов в специях, взятых с Дезертирского рынка

Из таблицы 7 видно, что в четырех образцах концентрации меди превышают норму; Свинец обнаружен в одной пробе, но не превышает предельно-допустимую концентрацию; Кадмий не был обнаружен ни в одном из образцов; А цинк, как и во всех исследованных нами образцах, значительно превышает допустимые нормы.

Двухлетнее исследование показало, что специи, произведенные в Грузии, являются чистыми. Как в прошлом году [9], так и в этом году концентрация меди лишь в 8 пробах незначительно превышает допустимую норму. Что касается свинца, только в 6 пробах появилась волна свинца, но его содержание не превышает предельно-допустимую концентрацию. Кадмий не был обнаружен ни в одном из образцов. Содержание цинка во всех исследованных нами образцах значительно превышает норму. Стоит отметить, что в период пандемии COVID-19, мы исследовали содержание вышеперечисленных тяжелых металлов в волосах жителей городов Зестафони, Ахалцихе и Тбилиси. Практически во всех исследованных образцах содержание цинка во много раз превышало норму, принятую Всемирной организацией здравоохранения. Мы предположили, что это, очевидно, было вызвано применением цинксодержащих препаратов во время пандемии. Наше двухлетнее исследование

показало, что цинк поступает в организм не только из лекарств, но и из специй.

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# COMPUTER SCIENCES

## EMOTION CLASSIFICATION USING MACHINE LEARNING METHODS

**Mamatov N.,**

Professor,

*“Tashkent Institute of Irrigation and Agricultural Mechanization Engineers”*

National Research University

**Niyozmatova N.,**

Associate Professor (PhD),

*“Tashkent Institute of Irrigation and Agricultural Mechanization Engineers”*

National Research University

**Tojiboyeva Sh.,**

Assistant,

*“Tashkent Institute of Irrigation and Agricultural Mechanization Engineers”*

National Research University

**Samijonov A.,**

*“Tashkent Institute of Irrigation and Agricultural Mechanization Engineers”*

National Research University

**Mashanpin T.,**

*“Tashkent Institute of Irrigation and Agricultural Mechanization Engineers”*

National Research University

**Yakhyayev B.**

*Tashkent University of Information Technologies named after Muhammad al-Khwarizmi*

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### Abstract

This article studies the problem of automatic classification of emotions using human facial expressions, and compares various machine learning algorithms, in particular k-NN, SVM, Random Forest, MLP and CNN, with the widespread FER2013, KDEF RAFDB and AffectNet databases and a single database created on their basis. Geometric and image-specific features were formed and recognition was performed using facial features and visual cues. The results obtained showed that the CNN model has high accuracy. It was also proved that data augmentation, ensuring class imbalance and selecting effective architectures are important factors in emotion classification. The results of this research can be used in areas such as human-computer interaction, education, and psychology.

**Keywords:** emotion, facial expression, machine learning, CNN, neural network, classification, database, automatic recognition.

### Introduction

The classification of human emotions is one of the important and relevant research areas in such fields as information technology, psychology, human-computer interaction, healthcare, and security. Accurate and rapid identification of emotions allows for the assessment of human emotional states, the early detection of fears, the enhancement of interest and desires in education, and the understanding of human emotions by virtual assistants [1-3].

Emotions are expressed through subtle changes in the human face and voice, body movements, and physiological signals. The most widely studied method for detecting emotions based on facial expressions is the Facial Action Coding System (FACS). FACS is a system for analyzing and classifying human facial movements, developed by American psychologists Paul Ekman and Wallace Friesen [4]. It analyzes the movements of facial muscles and encodes each emotion based on action units (AUs). Each AU represents the movement that occurs when a specific muscle or group of muscles on the face is activated. This system allows us to detect emotions, reactions, and even false states through human facial expressions. The combination of action units can determine what kind of emotion, reaction, or facial movement a person is experiencing.

Machine learning is a set of algorithms that allow automatic learning based on available data, identifying patterns and making predictions based on them. This technology allows not only to increase the accuracy of emotion detection, but also to work in real time, to use multi-source data, and to create models specific to a person [5].

In recent years, the use of neural networks, in particular convolutional neural networks (CNN) and recurrent models (LSTM), has provided excellent results in emotion classification. Studies have shown that emotions can be recognized with an accuracy of 90% or higher using 20–35 specific points on the human face [5-9].

This article presents ways to form a set of features necessary for emotion classification and recognize emotions based on them using machine learning methods (such as k-NN, SVM, Random Forest, and MLP). The purpose of the study is to compare the effectiveness of various algorithms based on the proposed set of features and determine the most suitable method for application in real conditions.

### Theoretical foundations

The issue of understanding and automatic detection of human emotions is relevant not only for com-

puter science, but also for psychology, neurophysiology, education and medicine. Emotion is the main psycho-emotional component of human thinking, speech and social relations, it is a set of reactions that are formed in response to situations in the human inner world and changes in the external environment. Emotion reflects the internal psycho-emotional state of a person and is expressed through facial expressions. Facial expressions are the most powerful, reliable and universal source of expression of emotions [5, 7].

In psychology, emotion is studied not only as a mental state, but also as a mediator between conscious and unconscious mental processes, impressions and actions. There are several theoretical approaches to classifying emotions, and one of the most widely used models is the theory of "basic emotions" developed by Paul Ekman. According to him, there are six emotions that are naturally and universally expressed on the human face: joy, sadness, anger, fear, disgust and surprise [4]. Later, Plutchik's models expanded the number of these emotions and showed the interrelationships between them [10]. According to classical theories, joy, sadness, anger, fear, disgust and surprise are the basic emotions. They are universal and occur in all people, regardless of gender, ethnicity, age and culture.

Emotion recognition is widely used not only in understanding the internal state of a person, but also in many areas such as education, medicine, and security [11].

The face is the most tangible and rich source of human emotions, and facial muscle movements allow for a complete and reliable expression of emotions. FACS is used to standardize and analyze these movements. Various combinations of emotions are formed based on FACS. In order to adapt complex facial movements to machine learning, geometric signs are generated based on special points (landmarks) [9].

Identifying specific points on a human face is the first step in automatic emotion recognition systems. Using the Dlib and MediaPipe libraries, it is possible to distinguish between 68 and 468 facial points [6, 12]. The distances, angles, and symmetry relationships between the obtained points form a feature vector representing facial expressions. For example, parameters such as the distance between the eyes and mouth, the degree of lip and mouth opening, and the height of the eyebrows are crucial in identifying emotions [5].

Facial landmarks and landmarks formation. The first step in automatic emotion recognition is to identify facial landmarks. These landmarks represent the geometric structure of the face and take into account movements in various parts of the face (opening of the lips, raising of the eyelids, scrunching of the nose, etc.). Typically, such landmarks are used as input data for artificial neural networks or classical algorithms.

Machine learning methods. Machine learning methods play an important role in emotion recognition. This involves automatic classification of various emotions based on human faces, voices, or biometric data [2]. The following machine learning methods are widely used in emotion classification:

K-Nearest Neighbors (k-NN). This is a simple but effective algorithm that classifies data based on its

nearest neighbors. In this method, proximity is calculated based on Euclidean, cosine, Manhattan, and other distances. The method works well on small data sets but slows down on large datasets.

Support Vector Machine (SVM). It constructs hyper-smoothness that maximally separates data in a large-dimensional feature space. It is an effective method for solving complex classification and categorization problems and can be further enhanced with polynomial and RBF kernels.

Decision Tree and Random Forest. Decision Tree builds paths based on data features and forms a classification model. Random Forest is an ensemble of many trees, each of which gives a different solution and makes a decision based on voting. This allows to reduce the risk of overfitting.

Multilayer Perceptron (MLP). This is a classic artificial neural network, consisting of fully connected layers. MLP allows for a high level of fine-tuning. When used correctly, it can achieve high accuracy with the required features.

Convolutional Neural Network (CNN). CNN automatically generates image features. This architecture can also recognize micro-expressions on the face. CNN models (VGG16, ResNet50, EfficientNet) allow for direct image-based emotion classification.

Recurrent Neural Network (RNN) and LSTM. RNN and its extended version LSTM are used to detect time-dependent emotional changes. This method also has the ability to perform classification based on the dynamics of emotions across multiple frames in a video.

#### Evaluation criteria and metrics

It is very important to evaluate the performance of classifiers in machine learning, which uses the following metrics:

Accuracy: is one of the main metrics that shows how well a machine learning model classifies across all cases and is calculated as follows.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

where TP is True Positive, TN is True Negative, FP is False Positive, FN is False Negative.

Precision: A metric that indicates how many objects the model correctly identifies as actually belonging to the specified class and is calculated as follows.

$$Precision = \frac{TP}{TP + FP}$$

where TP is True Positive, FP is False Positive.

Recall: A metric that indicates how many true positive cases the model was able to identify and is calculated as follows.

$$Recall = \frac{TP}{TP + FN}$$

where TP is True Positive, FN is False Negative.

F1-score: Measures the degree to which Precision and Recall correlate with each other and combines these two metrics based on the harmonic mean. This metric is used in balanced scoring.

Confusion Matrix: A matrix that shows the correct and incorrect classifications for each class of a classification model, comparing the actual values and predicted values.

Using the above-mentioned metrics, the performance of different models is evaluated and suitable algorithms are selected.

### Research methodology

Automatic recognition of human emotions based on facial expressions is a complex and multi-stage process, which consists of such components as data collection, processing, identifying informative features, creating a model, and evaluating the results. The main goal of this study is to classify emotions based on data obtained from facial special points through different machine learning methods and to determine which algorithm has the highest performance. For this, statistical and neural network-based models were used and their results were compared in the same database.

The study used the widely used FER2013, KDEF, RAFDB, and AffectNet databases that allow working with facial expression data.

The FER2013 database contains 48×48 facial expression images representing seven emotions. The images in these databases are collected from different age, gender, and ethnic groups, which serves to increase the generalizability of the models.

KDEF is a standard image database designed to study emotions through facial expressions, containing images of 35 men and 35 women each displaying 7 different emotions. The database contains more than 4,900 facial images, each of which is captured from multiple angles.

RAF-DB is a database of facial expressions, consisting of real-world facial images, spanning different ethnic groups, ages, and genders, taken from the Internet. The database contains over 30,000 images.

AffectNet is a database of over 1 million facial images automatically downloaded from the Internet, of which over 450,000 have been manually labeled.

The 68-point detector from the Dlib library and the 468-point detector from Google's Mediapipe FaceMesh were used to detect facial points in the images. These tools work effectively in real time and allow for an accurate representation of the geometric structure of the face. Based on the detected points, geometric features, distances between points, angles, ratios, symmetry indicators, and other statistical features, were calculated. The number of features was optimized by selecting 29–35 important points in the set of facial points that most closely correspond to a particular emotional state. After the set of features was formed, several machine learning algorithms were tested on them. From the classical statistical methods, the k-NN, SVM, algorithms were selected. Among these algorithms, SVM and RF stood

out for their effectiveness. In addition, models based on artificial neural networks such as MLP were also studied. In the MLP modification, a 3-layer (128–64–32 neurons) architecture was chosen, the ReLU activation function and the Adam optimizer were used.

The work also used Convolutional Neural Network (CNN) architectures for classification based not only on specific facial features, but also on the entire image. CNN models automatically learn features from images and do not require special work on how to shape them. A simple architecture with 2 Conv2D layers and MaxPooling elements was chosen in the study. The number of Epochs was set to 50, Batch Size — 64. To train these models, the FER2013 database was fully normalized, stored in grayscale format and assigned to appropriate classes.

The main metrics were used to evaluate the models. In addition, the Confusion Matrix was used to analyze the degree to which each emotion was correctly and incorrectly classified in the test. For example, images belonging to the "surprise" class were often classified as belonging to the "fear" and "joy" classes, which indicates that there are very similar features between some classes.

Data augmentation was performed, the generalization ability of the model was increased by methods such as image rotation, brightness change, and symmetry rotation. This allowed to increase the accuracy by an average of 2–4%. In addition, in order to restore class balance, artificial samples of some rare emotions were created using the SMOTE algorithm.

Using features based on facial features, SVM and MLP models achieved 74–77% accuracy on the FER2013 database, while the CNN architecture achieved about 82%. Geometric features based on facial features are an effective source for emotion detection, but deep learning models such as CNNs can achieve higher results by independently forming features from images. Therefore, a general approach, i.e., creating hybrid models by combining geometric features and image-based features, may be a promising direction.

### Practical results

In this study, which is aimed at automatically classifying human emotions based on facial expressions, several machine learning algorithms were compared. All models were trained and tested on existing emotion image databases. Experimental studies were carried out in the Python environment, mainly using the Scikit-learn, TensorFlow, Keras and OpenCV libraries. First, the data was normalized, and facial special points were identified using Dlib and Mediapipe. Geometric features in the range of 70–100 were formed. Then, algorithms such as SVM, RF, MLP and k-NN were trained on them.

Accuracy results by model (%):

| № | Model               | FER2013+KDEF+RAFDB+AffectNet (Accuracy) |
|---|---------------------|-----------------------------------------|
| 1 | k-NN (k=3)          | 63.2%                                   |
| 2 | SVM (RBF kernel)    | 74.6%                                   |
| 3 | Random Forest       | 71.8%                                   |
| 4 | MLP (3-layer)       | 76.1%                                   |
| 5 | CNN (2 Conv + Pool) | <b>81.9%</b>                            |



Analysis of results  
F1-score in the class (FER2013+KDEF+RAFDB+ AffectNet)

| Emotion  | SVM  | MLP  | CNN  |
|----------|------|------|------|
| Joy      | 0.77 | 0.82 | 0.89 |
| Sad      | 0.69 | 0.71 | 0.78 |
| Angry    | 0.73 | 0.75 | 0.83 |
| Fear     | 0.62 | 0.67 | 0.74 |
| Surprise | 0.65 | 0.70 | 0.76 |
| Disgust  | 0.66 | 0.68 | 0.72 |
| Neutral  | 0.75 | 0.80 | 0.86 |

The CNN model distinguished similar emotions such as “fear” and “surprise” better than other models. The “neutral” emotion was easier to detect than the other classes because it is a less dynamic form of facial expression. Many models labeled “surprise” as “joy” or “fear.” This suggests that multimodal (voice + face) data is needed to train the model.

A confusion matrix was created to analyze how the models made classification errors. For example, the CNN model correctly classified the emotion “joy” 89% of the time, while “fear” was incorrectly classified as “surprise” 24% of the time. These results demonstrate the visual proximity of the emotions.

### Conclusion

The issue of automatic recognition of human emotions through facial expressions is an important scientific and practical direction in computer vision, artificial intelligence, and human-computer interaction. In this study, emotion classification was performed using geometric features based on facial landmarks and deep neural networks working with direct images. A comparative analysis of several classical and deep learning machine learning algorithms was performed. Studies have shown that geometric features based on facial landmarks can represent human emotions to a high degree. Models such as SVM, MLP, and RF based on these features showed good results. In particular, the accuracy of the MLP model was about 76%. This confirms the need to develop an approach based on facial landmarks. At the same time, the CNN model achieved high accuracy in all tests. The accuracy of CNN in the resulting combination of databases was 81.9%.

During the study, the models also observed cases of incorrect classification of emotions in some cases. In particular, the probability of incorrect classification was high for closely related visual expressions such as “surprise” and “fear”. This situation shows that facial images alone are not enough to correctly understand emotional states, that is, additional sources such as voice, hand gestures, and contextual information should be involved in identifying human emotions. In addition, the development of hybrid models that combine facial features and image-based features can improve the efficiency of emotion classification, allowing for a more complete understanding of emotions by using additional features such as voice, body movements, and speech context in addition to the face.

Based on the results of the study, it can be said that the issue of creating optimized, fast and lightweight models for various devices is urgent. In this case, since automatic classification of emotions is associated with

personal data, it is necessary to comply with confidentiality and ethical standards. In general, this study, devoted to classifying emotions through facial expressions, demonstrated the current effectiveness of popular models and the need to use more universal and complex approaches in the future.

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# EARTH SCIENCES

## ПРИМЕНЕНИЕ РАДИОФИЗИЧЕСКИХ МЕТОДОВ ДЛЯ ДИСТАНЦИОННОГО ОБНАРУЖЕНИЯ ПОДПОВЕРХНОСТНЫХ ОБЪЕКТОВ С БОРТА САМОЛЕТА- ЛАБОРАТОРИИ

**Яцевич С.Е.**

*Старший научный сотрудник, кандидат физико-математических наук, Институт радиофизики и электроники им. А.Я. Усикова НАН Украины, Харьков.*

**Ефимов В.Б.**

*Старший научный сотрудник, кандидат физико-математических наук, Институт радиофизики и электроники им. А.Я. Усикова НАН Украины, Харьков.*

**Бычков Д.М.**

*Старший научный сотрудник, кандидат физико-математических наук, Институт радиофизики и электроники им. А.Я. Усикова НАН Украины, Харьков.*

**Яцевич Е.И.**

*Научный сотрудник, кандидат физико-математических наук, Институт радиофизики и электроники им. А.Я. Усикова НАН Украины, Харьков*

## APPLICATION OF RADIOPHYSICAL METHODS FOR THE REMOTE SENSING OF SUBSURFICIAL OBJECTS FROM THE SLAR OF AIRPLANE-LABORATORY

**Yatsevich S.,**

*Senior Research Scientist,  
Ph.D. in Radio Physics, Usikov Institute of Radiophysics and Electronic, NAS of Ukraine, Kharkov.*

**Yefimov V.,**

*Senior Research Scientist,  
Ph.D. in Radio Physics, Usikov Institute of Radiophysics and Electronic, NAS of Ukraine, Kharkov.*

**Bychkov D.,**

*Senior Research Scientist,  
Ph.D. in Radio Physics, Usikov Institute of Radiophysics and Electronic, NAS of Ukraine, Kharkov.*

**Yatsevich E.**

*Ph.D. in Radio Physics, Usikov Institute of  
Radiophysics and Electronic, NAS of Ukraine, Kharkov*

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### Аннотация

Теоретически и экспериментально показана возможность определения проявлений подповерхностных объектов, а также определения их параметров с использованием данных многоканального радиолокационного зондирования, в частности, многочастотных и поляризационных методов. Приведены многоканальные радиоизображения полученные с борта самолета лаборатории, а также их тематическая интерпретация.

### Abstract

Possibility of determination of manifestation subsurface objects, as well as determination of their parameters using multichannel radar sensing, in particular, multifrequency and polarization methods, is shown theoretically and experimentally. Multichannel radar images obtained on board of airplane-laboratory and their thematic interpretation are presented.

**Ключевые слова:** дистанционное зондирование, радиолокация, боковой обзор, СВЧ, поверхность, почва.

**Keywords:** remote sensing, radiolocation, side lookin, microwaves, surface, soil.

### Введение

Радиолокационные методы исследования природной среды находят применение для решения широкого круга задач дистанционного зондирования. Одним из перспективных направлений радиолокационного дистанционного зондирования является наблюдение различных структур и объектов под слоем почвы. Достигается это за счет проникающих свойств длинноволновой части диапазона СВЧ радиоволн. Поскольку характерная глубина проникновения радиоволн для почв составляет

$\delta = \lambda \sqrt{\varepsilon' / \pi \varepsilon''}$  ( $\lambda$  - длина волны, а  $\varepsilon'$  и  $\varepsilon''$  - действительная и мнимая части диэлектрической проницаемости грунта), в длинноволновой части СВЧ диапазона  $\delta$  для сухих песков может достигать многих десятков метров.

Отдельные эксперименты, выполненные с использованием радиолокационных космических систем, например, наблюдения подповерхностных структур [1 – 4] позволили убедиться на практике,

что и в режиме бокового радиолокационного обзора возможно получение информации о геологических структурах, находящихся под слоем песка.

Для обнаружения подповерхностных объектов и структур представляет интерес синхронное многочастотное радиолокационное зондирование, по крайней мере, в дециметровом и метровом диапазонах, где значительны, но существенно различны глубины проникновения радиоволн в грунт  $\delta$ .

#### Особенности подповерхностного радиолокационного зондирования

В настоящее время не существует однозначной физической модели, позволяющей строго описать процессы рассеяния радиоволн различными объектами, расположенными под слоем грунта. Ниже приводится упрощенная модель [5], которая позволяет интерпретировать результаты, полученные с использованием многочастотных РСА.

Радиолокационные сигналы при подповерхностном зондировании объектов ( $G$ ) формируются в результате совместного влияния нескольких факторов: рассеяния на неровностях границы раздела воздух (среда 1) и грунта (среда 2); рассеяния на неоднородностях грунта; отражения от объекта  $G$ , находящегося на глубине  $H$  под поверхностью; дифракции и рассеяния волн на неровностях поверхности самого объекта  $G$  и т.д. (рис.1).

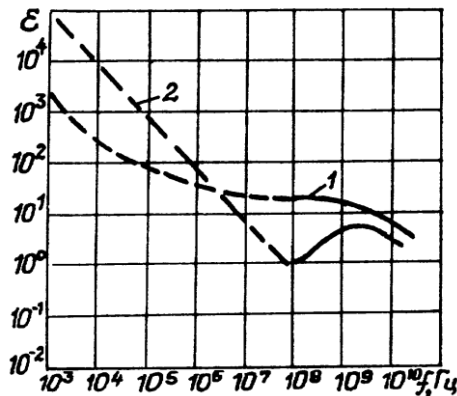


Рис.1 Схема формирования подповерхностных «сильных» отражений.

Так как для подповерхностного зондирования используются дециметровые (дм), метровые (м) и более длинные волны, объемным рассеянием можно пренебречь, поскольку размеры частиц фрагментов грунта и расстояния между ними намного меньше длины радиоволны. Для достаточно крупных и «гладких» (в масштабе длины волны) объектов  $G$  можно также пренебречь диффузной и дифракционной компонентами сигнала, рассеянного на  $G$ , ограничившись учетом только зеркально отраженных волн.

Если в качестве подповерхностного объекта  $G$  выступает плоская граница раздела  $Z = -H$  двух однородных сред 2 и 3, то удельное сечение обратного рассеяния  $G$  превышает сечение  $G_S$  рассеяния на неоднородностях грунта (граница раздела сред 1 и 2) в  $K$  раз. Для горизонтальной поляризации зондирующего сигнала коэффициент контраста  $K_h$  дается выражением [5]

$$K_h = \frac{\sigma}{\sigma_s} = \left| \frac{1 + \tilde{R}_1}{1 + R\tilde{R}_1} \right|^4, \quad (1)$$

а для вертикальной  $K_v$  -

$$K_v = \left| \frac{1 + \tilde{R}_1 + 2\tilde{R}_1 \frac{\sin^2 \Theta - \cos^2 \Theta}{\sin^2 \Theta + \cos^2 \Theta}}{(1 + R\tilde{R}_1)^2} \right|^2. \quad (2)$$

где  $\tilde{R}_1$  - экспоненциальный множитель, а  $R$  и  $R_1$  - коэффициенты Френеля отражения поляризованных волн от границ раздела сред 1 - 2 при  $Z = 0$  и 2 - 3 при  $Z = -H$ , соответственно.

Особенностью этих формул является то, что их коэффициенты контраста  $K$  оказываются независимыми от параметров шероховатостей и, от их энергетического спектра  $W$ , хотя отличный от нуля радиолокационный сигнал (при  $\Theta \neq 0$ ) наблюдается только благодаря резонансному рассеянию [6] на шероховатых грунтах  $Z = S(x, y)$ .

Зависимость толщины слоя  $H$  входит в эти формулы только в виде экспоненциального множителя  $\tilde{R}_1$ :

$$\tilde{R}_1 = R_1 e^{i\varphi_1} = R_1 e^{2kH(i\alpha - \beta)} = R_1 e^{i\Phi - \Gamma}; \quad (3)$$

$$\alpha = \operatorname{Re} \sqrt{\varepsilon - \sin^2 \Theta} \approx \sqrt{\varepsilon' - \sin^2 \Theta};$$

$$\beta = \operatorname{Im} \sqrt{\varepsilon - \sin^2 \Theta} \approx \varepsilon'' / 2\sqrt{\varepsilon' - \sin^2 \Theta},$$

здесь

$$\varepsilon' = \operatorname{Re} \varepsilon; \varepsilon'' = \operatorname{Im} \varepsilon, \Phi = 2kH\alpha, \Gamma = 2kH\beta$$

, причем предполагается, что поглощение в среде достаточно малое ( $\varepsilon'' \ll \varepsilon' - \sin^2 \Theta$ ). Легко видеть, что  $K_h$  и  $K_v$  - являются осциллирующими функциями не только  $H$ , но и угла визирования  $\Theta$ , длины волны  $\lambda$ . Этот факт описан в работе [7], где была решена задача рассеяния на слое с двумя шероховатыми границами. Периоды осцилляций  $\Delta H, \Delta \Theta, \Delta \lambda$  по этим параметрам определяются из условия  $\Delta \Phi = 2\pi$ , откуда следует:

$$\Delta H = \lambda / 2\sqrt{\varepsilon' - \sin^2 \Theta};$$

$$\Delta \Theta = \lambda \sqrt{\varepsilon' - \sin^2 \Theta} / H \sin 2\Theta;$$

$$\frac{\Delta \lambda}{\lambda} = \frac{\lambda}{2H\sqrt{\varepsilon' - \sin^2 \Theta}}. \quad (4)$$

Максимальное значение контраста на горизонтальной поляризации

$$K_{h \max} = \left| 1 + \frac{\sqrt{\varepsilon - \sin^2 \Theta}}{\cos \Theta} \right|^4 \quad (5)$$

имеет место в отсутствии затухания ( $\beta = 0$ ) при отражении от хорошо проводящей среды ( $|\varepsilon_1| \gg \varepsilon'$ ,  $R_1 \approx -1$ ) в условиях резонанса, когда

$$kH\sqrt{\varepsilon' - \sin^2 \Theta} = (n + \frac{1}{2})\pi. \quad (6)$$

При выполнении условия (6) направление обратного рассеяния совпадает с направлением одного из пространственно - угловых интерференционных максимумов в среде 1, возникающих при многократном отражении от границ раздела  $Z = 0$  и  $Z = -H$  преломленных плоских волн в среде 2.

Формулы (1) и (2) являются результатом учета, вообще говоря, бесконечного числа таких отражений. Однако разложение их по степеням параметра  $\tilde{R}_1$  позволяет получить формулы для  $K$ , учитывающие любое конечное число отражений. В частности, если в среде 2 волна испытывает сильное затухание при распространении до границы слоя  $Z = -H$  и обратно ( $\Gamma = 2kH\beta > 1$ ), или коэффициент отражения  $R_1$  от границы  $Z = -H$  достаточно мал (что имеет место при  $|\varepsilon_1 - \varepsilon| \ll |\varepsilon|$ ), либо, наконец, линейный размер  $L_G$  отражателя  $G$  в плоскости падения меньше, чем расстояние  $MM' = 2H \sin \Theta / \sqrt{\varepsilon' - \sin^2 \Theta}$  между двумя последовательными отражениями луча от плоскости  $Z = -H$ , то в (1) и (2) можно ограничиться учетом только однократных отражений от  $G$ .  $K_h$  можно выразить как:

$$K_h = \bar{K}_h + \delta K_h, \quad (7)$$

$$\bar{K}_h = 1 + 4e^{-2\Gamma} |R_1 T_{2,1}|^2; \delta K_h = 4e^{-\Gamma} R_e (R_1 T_{2,1} e^{i\Phi}), \quad (8)$$

где  $T_{2,1}$  - коэффициент отражения от границы  $Z = 0$  волны, падающей на нее из среды 2

$$T_{2,1} = 1 - R = \frac{2K'_z}{K_z + K'_z} = \frac{2\sqrt{\varepsilon' - \sin^2 \Theta}}{\cos \Theta + \sqrt{\varepsilon' - \sin^2 \Theta}} \quad (9)$$

Формула для коэффициента контраста  $K_v$  на вертикальной поляризации имеет вид

$$T_{2,1} \rightarrow Q = \frac{2 \cos \Theta' (\sin^2 \Theta - \sqrt{\varepsilon} \cos \Theta \cos \Theta')}{(\cos \Theta' + \sqrt{\varepsilon} \cos \Theta)(\sin^2 \Theta + \cos^2 \Theta')} \quad (10)$$

В формулах (9) и (10) угол преломления  $\Theta'$  является комплексным и определяется законом

Снеллиуса:  $\sin \Theta' = \sin \Theta / \sqrt{\varepsilon}$ . Рассчитанные по этим формулам контрасты  $K_{h,v}$  соответствуют учету в радиолокационном сигнале наряду с волнами, рассеянными непосредственно на границе раздела  $Z = S(x,y)$ , также еще двух типов волн. В результате, имеет место, так называемое, усиление обратного рассеяния [6]. По этой же причине в формуле (8) возникают коэффициенты 4 (а не 2 - как должно было бы быть при некогерентном сложении интенсивностей волн). Интерференция этих волн с волной, непосредственно рассеянной на границе  $Z = \zeta$  (без прохождения в среду 2), приводит к появлению осциллирующего по параметрам  $H, \Theta, \lambda$  слагаемого  $\delta K_h$  в формуле (7) с периодами осцилляций (4). Максимального значения  $K_h$  достигает при  $\varepsilon \rightarrow \infty$  (объект  $G$  при этом является металлическим листом с размером  $\lambda \ll L_G \ll MM_1$ , находящимся на глубине  $H$  в однородной среде с проницаемостью  $\varepsilon$ ). В этом случае коэффициент отражения  $R_1 = -1$  для горизонтальной поляризации и  $R_1 = 1$  - для вертикальной. Если можно пренебречь поглощением в среде 2 ( $\Gamma \ll 1$ ) и учесть, что  $(T_{2,1})_{\max} = 2$  (при  $|\varepsilon| \gg 1$ ), то легко получить следующие оценки:  $(\bar{K}_h)_{\max} = 17, (\delta K_h)_{\max} = 8$ , т.е. максимально возможное значение контраста  $K_h$  равно 25 или 17,7 дБ.

Столь высокое значение контрастов при учете только однократных отражений от не очень протяженных подземных объектов ( $L_G < MM_1$ ) могут реализоваться только при достаточно малом затухании волн в слое 2, когда выполняется неравенство

$$\Gamma = 2kH\beta = kH \frac{\varepsilon''}{\sqrt{\varepsilon' - \sin^2 \Theta}} \ll 1. \quad (11)$$

Типичные зависимости  $\varepsilon'$  и  $\varepsilon''$  от частоты приведены на рис.2 [9]. В широком диапазоне частот ( $10^6 \dots 10^9$  Гц) величина  $\varepsilon'$  монотонно убывает с частотой. Зависимость же  $\varepsilon''$  от  $f$  имеет ярко выраженную особенность: уменьшение  $\varepsilon''$  в диапазоне  $10^8 - 10^9$  Гц является причиной существенного уменьшения затухания в дм и м диапазонах. Конкретные значения  $\varepsilon'$  и  $\varepsilon''$  существенно зависят также от влажности [10].

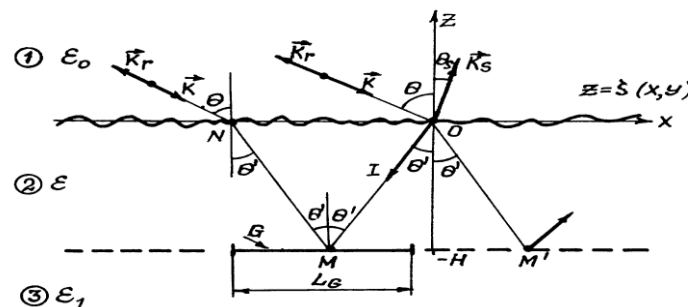


Рис.2. Типичные зависимости действительной ( $\varepsilon'$ ) - 1 и мнимой ( $\varepsilon''$ ) - 2 частей диэлектрической проницаемости почв в диапазоне СВЧ, данные работы.

По формулам (10-12) были получены расчетные зависимости средних значений коэффициентов контраста  $K_h$  и  $K_v$ , для двух поляризаций зондирующего сигнала для двух длин волн - 23 см и 1,8 м (см. рис.3, 4).

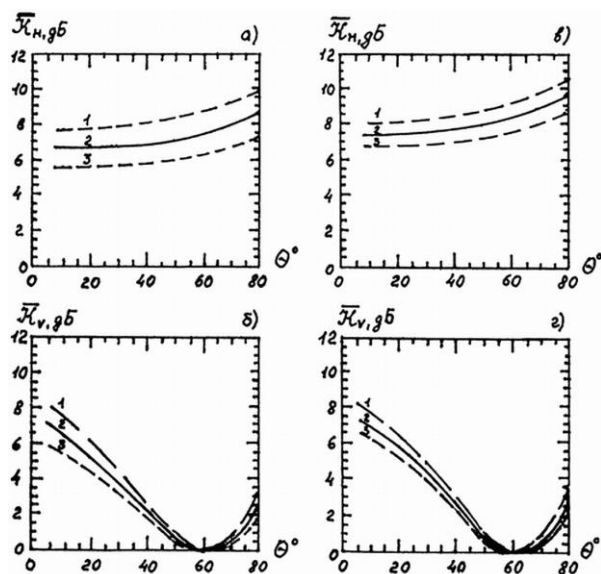


Рис.3. Расчетные зависимости контрастов горизонтальной  $K_h$  и вертикальной  $K_v$  поляризаций от угла падения  $\Theta$  в диапазонах волн 0.23 м (а,б) и 2 м (в,г) для различных глубин (тип -песок); зависимости (а,б) соответствуют 1 -  $h=1$ м, 2 -  $h=2$ м, 3 -  $h=3$ м, зависимости (в,г) соответствуют 1 -  $h=5$ м, 2 -  $h=10$ м, 3 -  $h=15$ м.

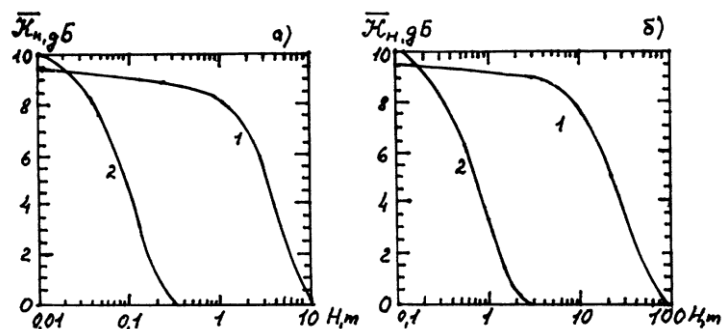


Рис. 4. Расчетные зависимости контраста горизонтальной поляризации  $K_h$  от глубины отражателей  $H$  при  $\Theta=50^\circ$  для волн 0.23 м (а) и 2 м (б) для песка (1) и глины (2) соответственно.

Расчеты контрастов отражений металлической пластины под слоем песка ( $\varepsilon' = 3,2, \varepsilon'' = 0,01$ ) показывают, что при горизонтальной поляризации значения  $\bar{K}_H$  в секторе углов  $\Theta = 20^\circ - 80^\circ$  существенно выше, чем на вертикальной поляризации  $\bar{K}_V$ . Контраст  $\bar{K}_H$  слабо зависит от угла облучения  $\Theta$ , в то время как  $\bar{K}_V$  имеет глубокий минимум вблизи угла Брюстера  $\Theta = \Theta_B$ , где  $\sin^2 \Theta_B = \varepsilon' / (\varepsilon' + 1)$ .

Из (10) видно, что при  $\varepsilon'' = 0$  и  $\Theta = \Theta_B$  величина  $Q = 0$  и, следовательно,  $\bar{K}_V = 1$ , т.е. кон-

траст полностью отсутствует. Результаты проведенных расчетов достаточно хорошо согласуются со значениями контрастов, наблюдаемых на практике. В варианте плоской верхней границы [5] повышение потенциала приводит к увеличению глубины обнаружения. Перспективы увеличения глубин наблюдения структур под песками связаны с удлинением волны РСА до декаметров. Однако это не позволит расширить диапазон глубин наблюдения глинистых почв, параметры которых приведены на рис.2. На рис. 5 видно, что глубина скин-слоя для глины растет с длиной волны в диапазоне от 10 до 200 см и далее рост глубины проникновения падающей волны ограничивается.

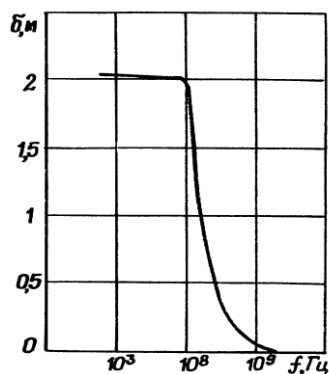


Рис. 5. Расчетная зависимость глубины проникновения в глину с учетом данных рис.2. Видно, что  $\delta$  не растет с увеличением длины волны  $\lambda \geq 3$  м.

### Обнаружение подповерхностных образований самолетным комплексом «МАРС»

Результаты теоретического анализа и моделирования процессов подповерхностного радиолокационного зондирования, убедительно свидетельствуют о принципиальной возможности обнаружения радиолокационными средствами расположенных под поверхностью земли искусственных сооружений, геологических и гидрологических структур. При этом, наиболее перспективным является использование многочастотного и многополяризационного радиолокационного зондирования одновременно в метровом и более коротковолновых диапазонах радиоволн. Наилучшие результаты достигаются в аридных и других засушливых районах благодаря более глубокому проникновению в почву радиоволн. Многочисленные эксперименты подтверждают эти выводы [2-5,13].

Ниже приведены результаты специальных экспериментов по обнаружению подповерхностных объектов при помощи одновременного зондирования в миллиметровом (мм), сантиметровом (см), дециметровом (дм) и метровом (м) диапазонах длин волн многочастотным радиолокационным комплексом МРЛК «МАРС» [14]. В состав комплекса, установленного на борту самолета – лаборатории ИЛ-18Д, входили радиолокаторы бокового обзора мм и см диапазонов, а также РЛС с синтезированием апертуры дм и м диапазонов (РБО-08, РБО-3, РСА-23 и РСА-180). Для комплекса радиолокаторов характерны совмещенные полосы обзора (~30км) и согласованное пространственное разрешение (~20-50м).

Один из проведенных экспериментов по обнаружению подповерхностных объектов террито-

риально проходил в в опустыненных районах Средней Азии. Поверхность, представляющая собой песчаные барханы, представляла идеальные условия для обнаружения объектов в силу сильного проникновения радиоволн под поверхность (рис.2). Рабочие маршруты самолета – лаборатории проходили в центральных Каракумах неподалеку от Тедженского оазиса в Туркмении. Карта исследуемого района представлена на рис. 6. Восточнее Тедженского водохранилища и реки Теджен проходит шоссе Теджен – Серахс (8А). Между шоссе и р. Теджен расположена зона активного земледелия. Восточнее шоссе простираются пески. Данная ситуация прослеживается на рис. 7а, представляющем оптическое изображение полученное с природоохранного спутника (данные получены на сайте <http://www.google.map.ru>). На рис.7б показан увеличенный фрагмент местности, на котором отлично видна дорога и линии электропередач вдоль нее. На рис. 8 представлены синхронные многочастотные изображения радиолокаторов комплекса «МАРС», полученные по этому - же району. Сравнение оптического и радиолокационных изображений дает возможность уверенного обнаружения периодического протяженного подповерхностного объекта, который расположен параллельно шоссе на расстоянии 2х километров вглубь песчаного массива. В отличие от оптического (на рис.7б стрелками указано местоположение подповерхностного объекта) и коротковолновых радиолокационных изображений в см и мм диапазонах радиоволн этот объект с большим контрастом отображается в дм диапазоне на горизонтальной поляризации, что подтверждает теоретические предпосылки.

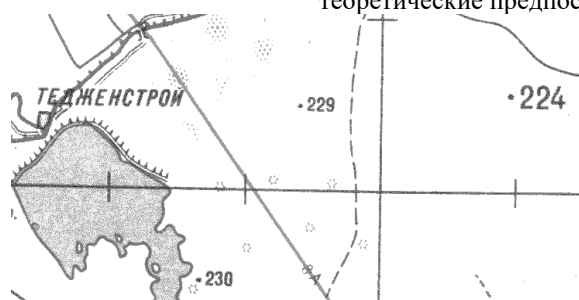


Рис. 6 Карта Тедженского оазиса

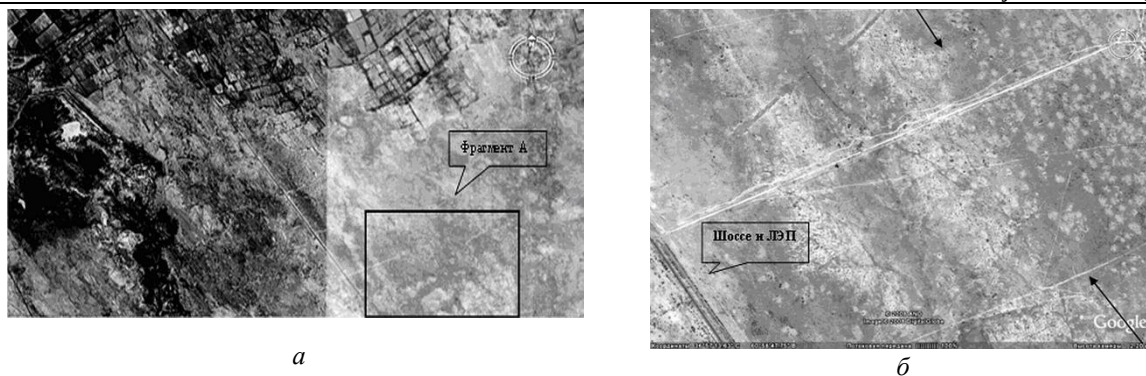


Рис. 7 Оптическое изображение Тедженского оазиса (а) и увеличенный фрагмент А (б)

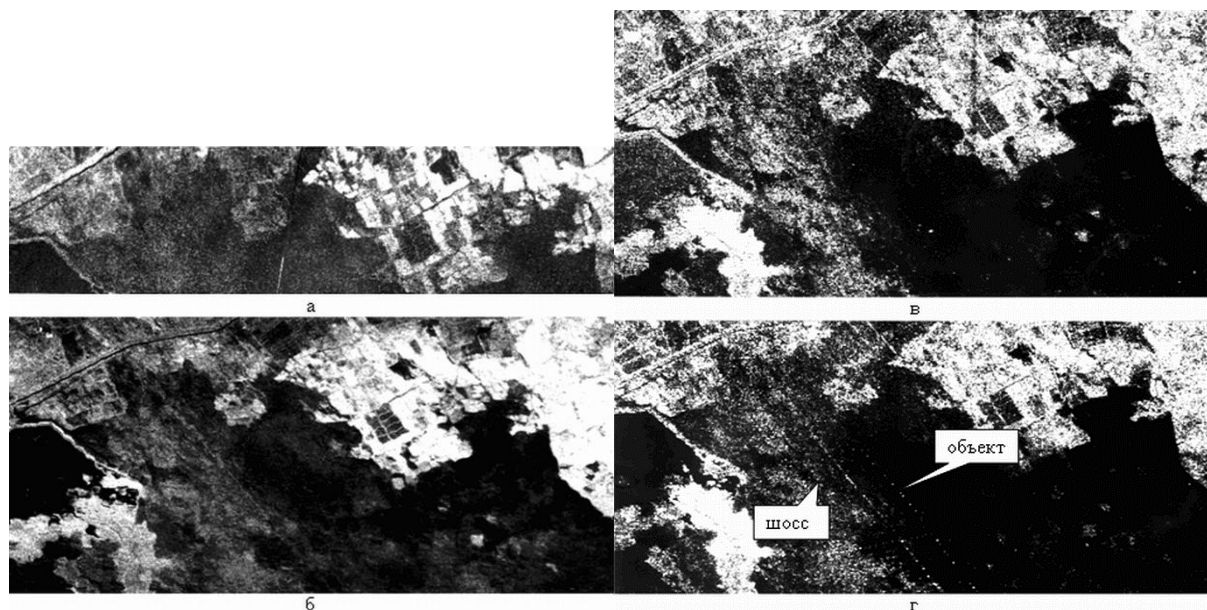


Рис. 8 Радиолокационные изображения района Тедженского оазиса.  
(РБО-08 -а, РБО-3 – б, PCA-23BB – в, PCA-23ГГ)

В условиях грунтов, характерных для средней полосы Украины, где преобладают различного вида черноземы был проведен эксперимент по обнаружению тестового объекта. Подповерхностный объект представлял собой систему небольших подземных бетонных бункеров, соединенных между собой и с основанием антенны системой кабельных каналов рис.9. Обстановка на поверхности над бункерами представлена на рис. 10. Объект был оставлен после расформирования одной из частей Советской

армии и представляет собой основной бункер, расположенный на глубине 4м под поверхностью, малый бункер с металлическим люком, систему кабельных каналов и бетонное основание для установки антенной мачты. Поверхность над объектом покрыта асфальтовой дорожкой. Вокруг растет густая многолетняя трава. Общая протяженность объекта достигает 170м. На рис.11 представлены радиолокационные изображения исследуемой территории.

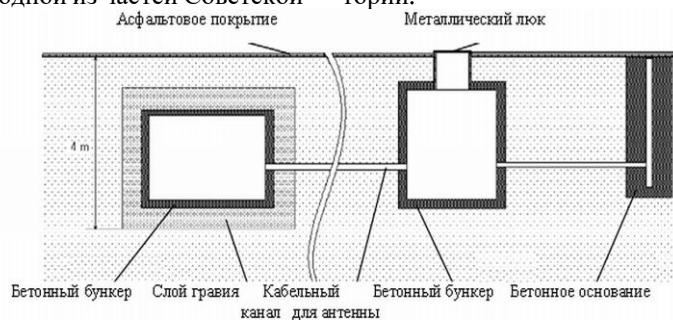


Рис. 9. Схематическое изображение подповерхностного объекта.



Рис. 10. Внешний вид места расположения подповерхностного объекта.



а



б



в

Рис. 11 Радиолокационное изображение исследуемого района.

Стрелкой 1 показано место расположения подземного объекта. (а – см, б – дм, в – м)

На сантиметровом радиолокационном изображении хорошо наблюдаются лишь поверхностные образования – растительность и т.п. На нем стрелкой показано место расположения подземного объекта.

На дециметровом радиолокационном изображении наблюдаются лишь более крупные поверхностные образования – искусственные сооружения,

кустарник, лес и т.п., трава в районе исследуемого объекта не видна, но сам объект также не виден.

На метровом радиолокационном изображении наблюдаются подповерхностные объекты, а поверхностные образования – трава и т.п. не наблюдаются. Стрелкой показано изображение подземного объекта.

Проведенный эксперимент подтвердил возможность наблюдения «сильных» подповерхностных объектов (расположенных на глубине 3 – 4 метров) многочастотным радиолокационным способом в условиях черноземно-глинистых грунтов средней полосы.

### Заключение

В работе показана возможность обнаружения проявлений подповерхностных объектов с использованием данных многоканального радиолокационного зондирования, в частности, многочастотных и поляризационных методов.

Приведенные экспериментальные радиоизображения полученные на борту самолета лаборатории ИЛ-18Д в широком диапазоне частот, а также их тематическая интерпретация показали возможность проявления подповерхностных объектов с высоким контрастом на горизонтальной поляризации в дециметровом и метровом диапазонах радиоволн. Учитывая невысокое разнообразие маскирующей подстилающей поверхности на тестовых полигонах в проведенных работах по выявлению подповерхностных объектов, необходимо в последующих экспериментах расширить разнообразие почв, характерных для различных климатических зон, а также проводить эксперименты в различные периоды года.

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**СУЩНОСТЬ И ОТРАСЛЕВЫЕ ОСОБЕННОСТИ УСТОЙЧИВОГО РАЗВИТИЯ В ТУРИЗМЕ****Гасанов А.Н.***Доктор экономических наук, профессор,  
Азербайджанский Университет Туризма и Менеджмента,  
г. Баку, Азербайджан***Самадов И.А.***Магистр, Гянджинский Государственный Университет  
г. Гянджа, Азербайджан***THE ESSENCE AND SECTORAL FEATURES OF SUSTAINABLE DEVELOPMENT IN TOURISM****Hasanov A.,***Doctor of Economics, Professor,  
Azerbaijan University of Tourism and Management, Baku, Azerbaijan***Samadov I.***Master's student, Ganja State University, Ganja, Azerbaijan*DOI: [10.5281/zenodo.15874576](https://doi.org/10.5281/zenodo.15874576)**Аннотация**

В статье дается сравнительный анализ сущности различных подходов к устойчивому развитию туризма. Рассматриваются факторы, обеспечивающие устойчивый туризм. Отмечается, что в современных источниках для устойчивого развития выделяются в основном культурные, социальные, экономические и экологические факторы. Обращается внимание на важность учета специфических особенностей вида деятельности в устойчивом развитии. Перечислены характерные черты туризма и обоснована важность их учета как ключевого фактора в концепции устойчивого развития туризма. Утверждается, что придание значения этим особенностям необходимо для более устойчивого и успешного развития в туризме и обеспечения долговечности деятельности.

**Abstract**

The article provides a comparative analysis of the essence of different approaches to the sustainable development of tourism. The factors ensuring sustainable tourism are considered. It is noted that modern sources highlight mainly cultural, social, economic and environmental factors for sustainable development. Attention is drawn to the importance of taking into account the specific features of the type of activity in sustainable development. The characteristic features of tourism are listed and the importance of their consideration as a key factor in the concept of sustainable tourism development is substantiated. It is argued that giving importance to these features is necessary for more sustainable and successful development in tourism and ensuring the longevity of activities.

**Ключевые слова:** туризм, устойчивое развитие, отраслевые особенности туризма, концепция развития, факторы устойчивого развития.

**Keywords:** tourism, sustainable development, industry-specific features of tourism, development concept, factors of sustainable development.

**Введение.**

Устойчивый туризм-это, по сути, подход, который предполагает реализацию устойчивых практик, важных для обеспечения развития индустрии туризма. Основной целью данного подхода является минимизация его негативных воздействий и максимальное использование положительных воздействий при условии осознания всех положительных и отрицательных воздействий, возникающих в процессе туристской деятельности.

Одним из условий достижения этой цели является учет определенных отраслевых особенностей при разработке и реализации программ, концепций и стратегий планирования, организации, управления и развития туристской деятельности. Это рассматривается в качестве одного из основных условий в мировом масштабе формирования общего механизма и целенаправленного развития отрасли во имя устойчивого развития в туризме.

Представления о различных уровнях распределения и неограниченном потенциале природных ресурсов по регионам и странам мира, играющих важную роль в общем и экономическом развитии, легли в основу создания концепции устойчивого развития. Объективной реальностью стало то, что, начиная со второй половины XX века, возникло как представление о том, что неконтролируемое выполнение производственного процесса может вызвать разрушительное воздействие на окружающую среду. В то же время эта концепция отличалась неточностью и достаточно абстрактным характером.

В целом, на протяжении значительного времени в центре внимания научно-теоретических дискуссий и результатов экспериментальной работы становились красочные формы проявления и воздействия факторов антропогенного происхождения, вызывающие дискуссии в контексте интере-

сов устойчивого развития хозяйствующих субъектов, стали выходить на первый план в более серьезной форме и содержании. Причиной протекания этого процесса было систематическое проявление явлений, возможность которых в то время была не точной, обычно считавшейся редкостью, и которые отличались своей интенсивностью, частотой возникновения. Это создало новые условия с точки зрения выявления тенденций развития в экономической системе, в том числе в туризме, и установления устойчивого характера развития. Продиктованная этими обстоятельствами необходимость формирования новой модели и механизма развития туризма стала важной частью общей экономической эволюции. Именно эти условия и обусловили формирование и активное внедрение концепции устойчивого развития туризма.

**Обсуждение.** С первых лет нового тысячелетия развитие мировой туристической индустрии продолжает ускоряться беспрецедентными темпами, и даже после окончания различных геополитических событий, катастроф и глобальных угроз наблюдаются лишь небольшие и временные снижения динамики роста туристических визитов и финансовых доходов от туризма. Районы массового туризма в настоящее время превращаются в огромные туристские дестинации, все более широкие географические регионы попадают в сферу влияния глобального туризма. В последние годы стремительно растущие международные, региональные и внутренние рынки туризма пытаются подтолкнуть мировой туризм к переходу в фазу более быстрого развития и роста [5, с. 12].

Туристская деятельность, известная своими быстрыми темпами роста, затрагивает все больше и больше отраслей и видов деятельности, и вера в потенциал этого сектора для осуществления экономических, экологических и социокультурных изменений в направлениях неуклонно растет. Это изменение может быть как положительным, так и отрицательным, в зависимости от того, как управляется туристический сектор, и причина, по которой заинтересованные стороны активно участвуют в концепции устойчивого туризма, заключается в их стремлении максимизировать выгоды от туризма и минимизировать его негативные последствия. Тот факт, что характер развития хозяйственной деятельности характеризуется динамическими изменениями, считается одной из основополагающих характеристик всех периодов истории развития, то есть эти изменения наблюдались всегда, и эти тенденции изменений заметны и сегодня. В особенностях этих изменений, происходящих в туристской деятельности, в настоящее время обнаруживается проявление более специфических признаков, а сами эти формы проявления отличаются своей подвижностью в короткие промежутки времени и претерпевают регулярные изменения.

При рассмотрении сути выражения «устойчивое развитие» через анализ методологических и концептуальных связей становится ясно, что этот

вопрос является весьма важным с точки зрения получения глубоких и необходимых знаний в области развития туризма [7].

Осмысление концептуальных основ «устойчивого туризма» имеет инновационное, дидактическое, эмоционально-психологическое, антропогенное и педагогическое значение в усвоении специфических знаний в области современного туризма, применении теоретических знаний, приобретении более широкого характера и развитии туризма как вида деятельности. Поэтому изучение вопросов «устойчивого развития» с начала XXI века становится важным инструментом системного и комплексного развития индустрии туризма [8].

Включение фактора и принципов устойчивости в развитие всех сфер деятельности, особенно туризма, ставшего одним из главных социальных и экономических событий и явлений современности, четко отвечает обеспечению устойчивости, что является одной из важных характеристик туризма, и выступает одним из опор этапов развития сферы.

В начале 90-х годов XX века термин «устойчивый туризм» стал все чаще использоваться среди теоретиков и практиков туризма для описания потенциально желаемых и научно обоснованных результатов, которые в зависимости от реальных условий и обстоятельств могут варьироваться от наиболее элементарных форм «альтернативного туризма» до туризма с наиболее интенсивным характером [1]. В частности, стала вырисовываться и привлекать внимание проблема обеспечения устойчивости проявлений и развития туризма в дестинациях и регионах туристского возрождения, курортах и санаториях, туристских центрах и других местах деятельности, расположенных в различных регионах.

При изучении литературных источников становится ясно, что термин «устойчивое развитие» был введен в обиход в 1970-х годах и впоследствии широко использовался в ряде стратегических программ развития, реализуемых в рамках «Всемирной стратегии охраны природы» ООН [2].

Концептуальный подход, определенный Организацией Объединенных Наций по туризму (UN T-ранее UN WTO), гласит, что стратегической целью «устойчивого туризма» является:

- достичь оптимального использования экологических ресурсов, которые являются основным элементом развития туризма;

- стремиться поддерживать максимально благоприятный уровень экологических условий, одновременно улучшая культурные, социальные, экологические и экономические показатели региона, обеспечивая эффективное использование существующего туристического потенциала;

- уважать социокультурную аутентичность территорий и сообществ, принимающих туристов, защищать их традиционно сформированный и комплекс культурного наследия и традиционные ценности, способствовать межкультурному взаимопониманию и толерантности;

-обеспечивать устойчивые, долгосрочные экономические операции в жизни и обществе, предоставлять социально-экономические выгоды всем заинтересованным сторонам за счет справедливо распределенных выгод и активно поддерживать ликвидацию бедности;

-поддерживать туристские впечатления и удовлетворенность на самом высоком уровне и предоставлять туристам содержательную среду отдыха и развлечений;

-повышать теоретические и практические знания, навыки, компетенции и осведомленность персонала туристских предприятий об устойчивом развитии и продвигать практику устойчивого туризма.

При таком подходе одним из условий является координация деятельности субъектов туризма по вовлечению в экономический оборот и максимально эффективному использованию трех одинаково важных для устойчивого развития компонентов. В этой связи каждый из субъектов туризма должен иметь общий интерес и играть взаимодополняющую роль для обеспечения устойчивости. Тот факт, что субъекты туризма действуют в соответствии с этим принципом при обеспечении устойчивого туризма, является важнейшим фактором, обеспечивающим наивысший уровень учета специфических особенностей туризма и эффективности устойчивого развития.

Устойчивый туризм подразумевает минимизацию негативных последствий и максимизацию позитивных последствий в регионе, дестинации, стране и глобальной системе. В этом контексте следует обратить внимание на широкое применение инновационных технологий, искусственного интеллекта и инновационных подходов [6]. При этом применяемые новейшие технологии должны быть адаптированы к особенностям туризма и не противоречить его сути.

В целом, есть те, кто понимает суть устойчивого развития как «обеспечение перспективы устойчивого развития» ради всеобщего развития. Эту идею поддерживают экологи, сторонники идеи постепенного развития, усиления государственного регулирования. [4, с. 58]. Устойчивое развитие, синтезирующее и объединяющее порой противоречивые направления, подразумевает концепцию устойчивого экономического развития, не допускающую чрезмерной эксплуатации существующих экологических, социокультурных и экономических возможностей, а рассматривающую в качестве приоритета защиту и рациональное использование экологических, культурных и социальных ценностей, а также развитие туризма.

В результате многочисленных дискуссий, проведенных по поводу зарождения идеи и формирования концепции «устойчивого развития», сложились определенные ее теоретико-научные основы. Эти основы отличаются специфическим отраслевым характером развития индустрии туризма, как и во многих других отраслях, и в настоящее время составляют основную линию в подходах к аналогичным методам развития отраслей туристской индустрии. Это естественно, поскольку специфические

характеристики, определяющие развитие большинства секторов экономики, известных своим разнообразием, включая туризм, различны, но в некоторых случаях они схожи и совместимы с применением и использованием общих принципов.

С конца прошлого века стало популярным понятие, характеризующее устойчивое развитие как «развитие, отвечающее удовлетворению потребностей», и стали представлять его как «адекватное удовлетворение текущих потребностей без ущерба для способности будущих поколений удовлетворять собственные потребности» [3]. В этом случае устойчивое развитие также можно охарактеризовать как «достижение эффективного использования и сохранения ресурсов для поддержания жизнедеятельности и физико-биологического существования в течение длительного периода времени».

Как одна из современных концепций развития, концепция устойчивого развития также желательна для применения в сфере туризма. В этой связи следует считать примечательным явлением рост интереса и склонности к применению данной концепции большинством субъектов туристической деятельности. Естественно, применение этой концепции в туризме требует ее адаптации к особенностям туризма. К этим характеристикам относятся следующие факторы:

-чувствительность туризма к внутренним и внешним воздействиям;

-изменение спроса туристов в широких амплитудах;

-трансформация моделей потребления туристов, обусловленные с их отличительными психологическими особенностями;

-количественные и качественные изменения в туризме;

-внедрение новых инновационных и цифровых технологий;

-приоритизация экономических выгод от туризма;

-проведение политики лимитирования туристских потоков и другие.

В силу этих особенностей вопросы устойчивого развития постоянно обсуждаются в международных туристических организациях и национальных учреждениях по управлению туризмом, и во многих случаях формулируется идея выражения концепции термином «обеспечение перспективы развития в туризме» и создается для этого основа.

Эта идея также обуславливает учета определенных воздействий. Из этих воздействий считается важным обратить внимание на следующее:

-социально-экономические воздействия;

-культурные воздействия;

-экологические воздействия;

-воздействия, вызванные устойчивым управлением.

Эти воздействия проявляются на разных уровнях в зависимости от региональных и географических факторов, традиционных видов деятельности в этом районе, туристической практики и традиций, туристического потенциала и других факторов. По-

этому в процессе реализации концепции устойчивого туризма одной из целей должно стать достижение консенсуса по учету этих воздействий, а также секторального характера туризма. Для достижения консенсуса консультации и укрепление сотрудничества с международными организациями, которые разрабатывают стандарты, эксплуатируют механизмы, предоставляют рациональные рекомендации и советы по устойчивому развитию, создают основу для более эффективной организации и управления процессом.

Каждый регион, в котором функционируют туристские дестинации, имеет свою собственную специфическую культуру, нормы и правила, ценностную среду, обычаи и традиции, законы. Поэтому концепции устойчивого развития должны быть адаптированы к местным условиям, принимая во внимание специфику туризма.

В целом субъектов туристской индустрии достаточно большое количество, и каждый из них должен осознавать и разделять общую ответственность за устойчивое развитие. Следует иметь в виду, что эта ответственность становится достаточно дифференцированной, и каждая заинтересованная сторона должна серьезно относиться к своей ответственности и во всех случаях устанавливать соответствующие партнерские отношения с другими партнерами и участниками устойчивого развития.

Устойчивое развитие туристского региона является элементом подхода к общему развитию, но в то же время это развитие выступает как результат, определяемый состоянием туризма. Так, поездки туристов в регион, их расходы обеспечивают значительный доход местному бюджету, что дает дополнительный импульс общему развитию.

Благодаря устойчивому туризму туристские потоки раскрывают сущность специфических особенностей развития, связанных с туризмом, способствуя сохранению уникальности национально-социокультурных особенностей региона в созданных условиях устойчивости, оказывая положительное влияние на устойчивое развитие.

Туристская деятельность, обладая специфическими особенностями, становится важным фактором устойчивого развития как глобальной мировой экономической системы в целом, так и национальных экономик стран, отличающихся природным туристическим потенциалом [9]. Стабильность процесса устойчивого развития посредством туризма напрямую зависит от процесса глубокого понимания истинной сути его характеристик. Говоря о понимании сущности устойчивого туризма, а также стремясь устранить существующие недоразумения об устойчивости тех или иных сегментов туристской индустрии, уточнить ее сущность, возникает необходимость прокомментировать специфику туризма как вида деятельности. Однако в любом случае и ситуации необходимо учитывать возможность достижения развития, принимая во внимание особенности всех аспектов туристской деятельности, подпадающих под действие условий и понятий «устойчивость».

### **Заключение.**

Таким образом, при подходе к сути устойчивого туризма, при применении идеи устойчивого развития к туристскому сектору, считается важным постоянно учитывать особенности туризма, чтобы поддерживать его долгосрочную жизнеспособность, не ставя под угрозу способность будущих поколений удовлетворять собственные потребности или основываясь на сценарии «симбиоза».

Устойчивое развитие туризма подчиняется основным законам и принципам общей концепции устойчивого развития. В то же время этот вид деятельности отличается от других видов деятельности тем, что несет в себе иные специфические особенности, и эти их целесообразно учитывать при реализации концепции устойчивого развития туризма. Можно перечислить следующие специфические особенности:

- преобладание нематериальных услуг в удельном весе товаров, производимых в результате туристической деятельности;

- быстрая смена спроса на туристические продукты и услуги;

- разнородность потребностей, вкусов и желаний туристов в зависимости от индивидуально-психологических особенностей;

- особенности формирования и развития отношений между туристами и представителями местного сообщества и т. д.

Для обеспечения устойчивого туризма с учетом его специфические особенности, предлагаем реализацию следующих мер:

- уважение ценностей местного сообщества и соблюдение этических норм поведения туристами;

- организация просветительских мероприятий по формированию бережного отношения туристов к местной окружающей среде;

- пытаться сбалансировать экономические интересы с интересами защиты экологических, социально-культурных условий в туристском процессе и т. д.

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## DIGITAL MARKETING AND ARTIFICIAL INTELLIGENCE IN THE REDISTRIBUTION OF THE ECONOMY IN THE REPUBLIC OF SERBIA

**Katanić Z.**

*Prof. Dr.*

*Dositej College of Academic Studies, Belgrade, Serbia*

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### Abstract

In the modern digital age, digital marketing and artificial intelligence (AI) are becoming key tools for the transformation and more equitable distribution of economic resources, especially in developing countries like Serbia. This paper explores how the application of digital technologies and intelligent systems contributes to redefining the economic landscape in Serbia, enabling small and medium-sized enterprises (SMEs), as well as individual entrepreneurs, to access broader markets, optimize business processes, and enhance competitiveness. The paper analyzes practical case studies, the institutional framework, and current trends, identifying key factors that enable digital inclusion and the decentralization of economic activities.

The focus is on digital marketing tools such as social media, content automation, and AI solutions in the areas of analytics, personalization, predictive modeling, and customer support. Special emphasis is placed on the potential redistribution of economic power from urban to rural areas through digital literacy and internet access, as well as on new forms of employment and self-employment arising from the digital economy. The paper also highlights the obstacles that hinder the wider adoption of these technologies in Serbia, including digital inequality, regulatory challenges, and the lack of systemic support for AI development.

**Keywords:** digital marketing, artificial intelligence, economic redistribution, digital transformation, AI technologies, digital economy, inclusive development.

### Introduction

The rapid development of information technologies and digital tools in the 21st century has led to profound changes in the way modern economies function. Traditional business models are quickly adapting to a new digital reality, where digital marketing and artificial intelligence (AI) play an increasingly important role. These technologies are not only tools for enhancing sales or automating operations—they are becoming key factors in redefining power relations, access to resources, and economic development, particularly in countries with transitional economies such as Serbia.

Digital marketing enables companies of all sizes—even individual entrepreneurs—to reach targeted audiences through online channels, often at significantly lower costs than traditional forms of advertising. At the same time, artificial intelligence opens new opportunities for automating data analysis, personalizing offers, improving customer experience, and making business decisions based on predictive analytics. In the context of a modern market economy, these two areas are becoming inseparably linked and critically important not only for the competitiveness of businesses, but also for broader economic dynamics.

In Serbia, the process of digitalization has gained significant momentum in recent years, primarily through the growth of the IT sector, the development of e-commerce, the emergence of startup companies, as well as through institutional efforts aimed at the digital transformation of the economy and public administration. Digitalization represents a symbiosis of infor-

mation technology, cybernetics, and digitized structures as a paradigm of the digital perspective.<sup>1</sup> However, despite positive developments, there are still significant disparities in the level of digital literacy, infrastructure availability, and the capacity to implement AI solutions across different sectors and regions of the country. New approaches do not accept explanations of imbalances that characterize the economy in other periods. This leads them to face the extremely complex task of providing necessary explanations for cyclical movements as integral elements of economic equilibrium, offering a model of the equilibrium business cycle.<sup>2</sup> These inequalities have a direct impact on economic distribution — both in terms of income and in terms of opportunities for employment, innovation, and the development of local communities.

### Methodology

The methodology of this paper is based on a combined qualitative-quantitative approach in order to systematically and comprehensively analyze the role of digital marketing and artificial intelligence in the redistribution of economic resources in Serbia. The aim of applying such a methodology is to provide a relevant and well-founded analysis of the current situation, trends, and potential of digital transformation within the context of the national economy—through theoretical analysis, statistical data, and case studies.

The paper employs both descriptive and analytical research approaches. The descriptive part relates to identifying and describing the current state of digital marketing, AI technologies, and the digital economy in Serbia. The analytical approach involves interpreting

<sup>1</sup> Katanić, Z., Katanić, J., & Radosavljević, D. (2020). Digitalization in the Function of Valorization of Serbian Medieval Monasteries in Kosovo and Metohija, UDC: 004.623: 271.222(497.11)-523(497.115), [https://doi.org/10.18485/akademac\\_sdt.2020.1.ch3](https://doi.org/10.18485/akademac_sdt.2020.1.ch3)

<sup>2</sup> Katanić Z., Todosijević Lazović S., Todosijević R., NEW TECHNOLOGIES, BUSINESS CYCLES - CONTROVERSIES AND PARADOXES, MINING AND METALLURGY INSTITUTE BOR, UDK: 330.1(045)=111, doi:10.5937/mmeh1604063K

data, identifying cause-and-effect relationships, and evaluating the impact of digital tools on the redistribution of economic activity among different economic actors. Several data collection methods were used in the study: **Secondary source analysis** – includes a review of relevant literature, reports from national and international institutions, expert articles, publications, and strategic documents (e.g., Serbia's Digital Agenda, the Strategy for the Development of Artificial Intelligence 2020–2025), as well as statistical data from the Statistical Office of the Republic of Serbia, Eurostat, and the OECD. **Case studies** – specific examples of successful companies and startups in Serbia that utilize digital marketing and/or artificial intelligence in their operations were analyzed (e.g., Nordeus, Ananas e-commerce, and AI startups such as Things Solver and SmartCat). **Desk research** – additional data and insights were obtained through the analysis of available online sources, research databases, media articles, and publicly available market analyses.

In data analysis, the following methods were applied: **Comparative analysis** – used to compare digitalization approaches between Serbia and other countries in the region and the EU, in order to identify opportunities for improving domestic practices. **SWOT analysis** – applied to identify strengths, weaknesses, opportunities, and threats related to the application of digital marketing and AI technologies in Serbia's economic context. **Content analysis** – used in interpreting qualitative data from documents and case studies to detect thematic categories and recurring patterns. **Graphical and tabular data presentation** – used to visually display key statistical indicators related to digital literacy, number of digital enterprises, internet access, AI investments, and other relevant metrics.

**Main hypothesis of the paper:** The application of digital marketing and artificial intelligence significantly contributes to economic redistribution in Serbia by enabling greater inclusion of small and medium-sized enterprises, reducing regional disparities, and enhancing market competitiveness.

The aim of this paper is to explore how digital marketing and artificial intelligence contribute to the redistribution of economic activity in Serbia — whether and in what ways they enable more equitable market access for small and medium-sized enterprises, whether they facilitate a shift away from traditional, centralized economic models, and how these tools can be used to reduce regional and social disparities. Special focus will be placed on practical applications, implementation challenges, and recommendations for the further development of policies that promote digital inclusion and innovation.

### 1. Digital Marketing

Digital marketing refers to a set of strategies and tactics that use digital channels and technologies to promote products and services, build relationships with

consumers, and achieve business objectives. Unlike traditional marketing, which relies on print, television, and radio media, digital marketing utilizes the internet, mobile devices, social media, search engines, and other digital platforms as primary communication channels. According to Philip Kotler (2021), digital marketing is the use of digital technologies to create, communicate, deliver, and exchange offerings that have value for consumers, clients, partners, and society as a whole. The main purpose of digital marketing is to attract a target audience, generate interest, encourage engagement, and convert users through a personalized and interactive approach. Digital marketing encompasses all promotional activities that use digital channels such as social media, search engines, email, and websites to establish direct contact with consumers. Its key advantages include lower costs, performance tracking, and audience targeting.

Digital marketing has evolved in response to changes in consumer behavior and technological advancement. Globalization and technological developments have led to the rise of e-business and e-commerce, which in turn has driven transformation in marketing—resulting in the expansion and widespread adoption of digital marketing.<sup>3</sup> Its evolution can be divided into several phases: **Early Internet Marketing** (1990–2000) – dominated by banners, email campaigns, and static websites. **Web 2.0 Phase** (2000–2010) – emergence of social networks (Facebook, YouTube), interactive websites, and blogs. **Mobile and Personalized Era** (2010–2020) – content adaptation for mobile devices, app development, targeting using cookies and big data. **AI and Automation** (2020–present) – widespread use of artificial intelligence, automated campaigns, chatbots, predictive analytics, and voice search.

Digital marketing encompasses a range of strategies and channels, among which the most important are: **SEO** (Search Engine Optimization) – optimizing content to rank better on search engines like Google. **SEM** (Search Engine Marketing) – paid advertising within search results, e.g., via Google Ads. **Content Marketing** – creating and distributing useful, relevant, and consistent content (text, video, infographics) to attract the target audience. **Email Marketing** – direct communication with users through newsletters and personalized offers. **Social Media Marketing** – using social networks for promotion, branding, and user interaction (Facebook, Instagram, TikTok, LinkedIn). **Influencer Marketing** – collaborating with individuals who have a large following and influence over target groups. **Affiliate Marketing** – partnering with external promoters who earn commissions based on performance. **Web and Mobile Analytics** – tracking and analyzing user behavior using tools like Google Analytics to optimize campaign performance.

Compared to traditional forms of advertising, digital marketing offers numerous advantages such as:

<sup>3</sup> Ravić, N., Baltezarević, R., & Radić, N. (2022). Research on the Use of Digital Marketing in Small and Medium Enterprises in the Republic of Serbia, *Megatrend Review*, Vol. 19, No. 2, pp. 1-12, DOI: 10.5937/MegRev2202001R.

**Measurability and Performance Tracking** – enables detailed measurement of all key indicators (CTR, conversions, ROI). **Targeted Advertising** – thanks to advanced algorithms and data, ads can be shown only to relevant audiences. **Lower Costs and Higher ROI** – especially significant for micro and small businesses. **Rapid Adaptability** – campaigns can be changed in real time based on results. **Global Reach** – even local companies can market their products to a global audience.

Although digital marketing offers numerous advantages, it also involves certain challenges: content saturation and competition for user attention, data misuse and privacy violations, fake news, bots and algorithm manipulation, consumer distrust of digital ads, and dependence on third-party platforms (e.g., Meta, Google). These challenges require a strategic approach, ethical advertising, and compliance with regulatory frameworks (e.g., GDPR). Digital marketing plays a key role in modernizing the economy and opening markets to a broader range of actors, especially in countries with unevenly developed regions like Serbia. By using digital channels, small and medium-sized enterprises gain access to audiences they previously could not reach; artisans, artists, and agricultural producers from rural areas can market their products domestically and internationally; startups and digital agencies use digital marketing as their primary channel for growth and internationalization. The emergence of technology and changes driven by innovation create a need for new technology to manage complex dynamic systems.<sup>4</sup>

In this way, digital marketing not only improves the market position of businesses but also contributes to the redistribution of economic power by reducing the gap between urban and rural areas. Digital marketing is a complex, dynamic discipline that has a strong impact on shaping modern business models. In contemporary economies, especially in the context of developing countries like Serbia, digital marketing represents one of the key mechanisms for stimulating economic activity, inclusion, and market decentralization. Its synergy with artificial intelligence further enhances its potential as a tool for sustainable and balanced development.

## 2. Artificial Intelligence

Artificial Intelligence (AI) is a branch of computer science that deals with the development of systems and algorithms capable of imitating and enhancing human intelligence. This includes tasks such as learning (machine learning), problem-solving, decision-making, speech and image recognition, as well as language understanding. In the business context, AI is defined as a set of intelligent technologies that automate processes, analyze large volumes of data, and make personalized and efficient decisions without the need for constant human supervision. In marketing and economics, AI enables faster, more accurate decision-making with minimal risk.

The development of AI technology has accelerated significantly in the past decade, primarily due to advances in processing power, big data handling, and

the development of open algorithms. Today, AI is no longer the exclusive domain of technological giants but is used in small and medium-sized enterprises, digital agencies, healthcare systems, education, agriculture, e-commerce, and marketing.

The emergence of accessible platforms such as ChatGPT, Google Gemini, Midjourney, Canva AI, as well as advanced analytics tools like Meta Ads, HubSpot, Tableau, and Salesforce, has enabled widespread and affordable use of AI solutions in Serbia as well.

Artificial intelligence is increasingly present in digital marketing strategies because it offers benefits on four key levels: **Personalization of the user experience** – AI enables real-time analysis of user behavior and personalizes offers based on previous activities. For example, recommendation algorithms on sites like Amazon or Ananas generate “tailored” products for users. **Advertising automation** (programmatic advertising) – Advertising is no longer planned manually; algorithms are used to automatically purchase and place ads based on user data and market signals. This significantly reduces costs and increases campaign efficiency. **Chatbots and customer support** – AI chatbots provide 24/7 communication with users, respond to inquiries, perform sales, and collect data for analysis. Examples include Chatfuel, ManyChat, and OpenAI’s API in e-commerce applications. **Analytics and predictive modeling** – AI can process large volumes of data and predict consumer behavior, seasonal trends, and campaign effects. This allows marketing strategies to be based on objective indicators rather than intuition alone.

One of the key contributions of AI technology is its ability to promote more balanced economic development through: **Democratization of access to market tools** – AI enables small businesses to use the same marketing tools and analytics as large corporations. **Increased business efficiency** – automation allows entrepreneurs to start and grow complex businesses with smaller teams. **Creation of new forms of work** – freelance platforms and remote jobs based on AI tools (e.g., content creation, campaign management) enable employment beyond major urban centers. **Enhancement of digital literacy and technological inclusion** – through educational AI tools, courses, and online platforms, even in rural areas.

Thus, AI becomes not only a tool for optimization but also an instrument of social and economic inclusion.

Despite its potential, there are numerous challenges in Serbia that limit the full implementation of AI in the economy and marketing: **Underdeveloped infrastructure** – especially in rural and less developed municipalities, **Lack of skilled personnel** – shortage of data specialists, programmers, and AI engineers, **Limited access to financing and investments** – SMEs and startups face difficulties acquiring AI technology, **Ethics and regulation** – absence of clear regulations on data processing, accountability, and transparency of AI systems, **Digital literacy of users** – a large number of

<sup>4</sup> Todosijević Lazović S., Katanić Z., Todosijević M., Radosavljević D., DEVELOPMENTAL TENDENCIES

entrepreneurs do not know how to apply available tools.

AI can be integrated into a broader strategy for sustainable economic development through: supporting digital incubators and AI hubs in Serbia's interior regions, education and workforce retraining via national and regional projects, connecting traditional sectors (e.g., agriculture, crafts) with AI solutions, and incentives for AI adoption in SMEs through tax relief, subsidies, and access to funds (e.g., IPARD, Horizon Europe).

Artificial intelligence in modern business is no longer an option—it is becoming a necessity. Its synergy with digital marketing opens a broad space for innovation, efficiency, and inclusiveness. In the context of Serbia, AI technologies can play a key role in accelerating economic transition, reducing regional disparities, and strengthening digital entrepreneurship. The key to success lies in systemic support, education, and raising awareness of the benefits AI brings.

### 3. Economy and Redistribution

The economy represents a set of activities related to the production, exchange, distribution, and consumption of goods and services within a particular society or system. Traditionally, the economy relies on the allocation of resources and organization of labor to meet consumer needs and ensure sustainable growth.

Redistribution in the economic sense refers to the reallocation of income, wealth, or resources from one part of the population, region, or sector to another, with the aim of reducing economic inequalities and achieving balanced development. Traditional mechanisms of redistribution include tax policy, public expenditure, social transfers, and subsidies. However, in the modern context, redistribution increasingly involves technological factors such as access to the internet, digital skills, the ability to participate in the digital economy, and the capacity to use innovative tools—among which digital marketing and artificial intelligence stand out. The digital economy refers to an economy based on digital technologies, the internet, and process automation. In this system, value is created through information, data, digital services, and virtual platforms. This changes the way business transactions are conducted, products are marketed, and the workforce is organized.

The digital economy enables a more horizontal and accessible distribution of economic resources because it: removes intermediaries and lowers barriers to market entry; allows entrepreneurship regardless of physical location; encourages innovation and new forms of self-employment; and enables direct interaction with end users without high distribution costs. New global processes and social relations bring new criteria aimed at equalizing conditions for economic growth and gradually reducing disparities in development levels.<sup>5</sup> As a result, individuals and companies from smaller communities can have equal access to markets as those from developed urban centers, creating conditions for a new type of redistribution—one based on knowledge, digital skills, and connectivity.

Digital marketing and artificial intelligence are key tools of the digital economy. Their application enables the decentralization of market activities and the transfer of economic power from large systems to small, flexible, and locally oriented actors. This is especially evident in the following aspects: **Rural commerce** – Agricultural producers and artisans use social networks and online stores for direct product sales. **Local brands and entrepreneurs** – They create visual identities and campaigns through digital channels without the need for expensive agencies. **Freelance market** – Many young people from smaller areas provide services (design, writing, marketing) to clients worldwide, using AI tools to boost productivity. **Startups and AI innovations** – Tech companies in Niš, Novi Sad, Subotica, and Čačak leverage local resources and knowledge to create solutions that compete globally.

These examples demonstrate how digital tools and AI technologies enable functional redistribution of economic value—from centralized systems to local initiatives and from traditional sectors to new forms of digital business. Serbia continues to face pronounced regional disparities. A large portion of economic activity is concentrated in Belgrade and Vojvodina, while Eastern, Southeastern, and Western Serbia have lower GDP per capita, weaker infrastructure, and poorer connectivity. Digital marketing and AI offer potential solutions to these imbalances, but successful implementation requires the following conditions: Broadband internet and digital infrastructure in all municipalities, Training and digital literacy programs for youth, women, entrepreneurs, and farmers, Support for startup ecosystems outside Belgrade (e.g., local hubs, accelerators, grants), Incentives for SMEs to invest in digitalization through subsidies and tax breaks, Public promotion of successful examples of local digital development. This would create the foundation for a more inclusive, decentralized, and sustainable model of economic growth. Unlike traditional mechanisms of government intervention, digital marketing and AI enable market-driven redistribution. The key difference is that this form of redistribution does not rely on subsidies or transfers, but rather on building digital competencies and creating market opportunities that empower individuals to independently generate value and income.

This approach is referred to as technology-driven redistribution, as it implies: Access to tools and knowledge, Economic self-reliance, Local development based on digital resources, Active inclusion of various social groups in market processes. This model is particularly important for developing countries like Serbia, where classical redistribution mechanisms often have limited reach.

The role of digital marketing and artificial intelligence goes beyond being simple business tools—they become strategic instruments for redistributing economic opportunities and for enhancing the competitiveness of less developed regions. In today's economy, knowledge and digital skills have become a new form

<sup>5</sup> Todosijević Lazović S., Katanić Z., Todosijević R., Modern tendencies of profiling and development of

of capital, and technologies that enable access to markets and resources are essential for shaping a fairer and more sustainable economic system. In this sense, Serbia has a valuable opportunity to overcome internal economic disparities and promote inclusive growth through smart digital transformation.

#### **4. Analysis of the Situation in Serbia**

##### **4.1 Digital Transformation of the Economy**

Digital transformation entails a fundamental change in business processes, models, and organizational culture through the adoption of digital technologies—such as software tools, automation, artificial intelligence, cloud services, and digital communication channels. It is not merely a technical innovation, but a strategic adaptation of the economy to modern market conditions. In Serbia, digital transformation is recognized as crucial for enhancing competitiveness, accelerating economic growth, and reducing regional disparities. However, the extent of digital solution implementation varies significantly depending on sector, company size, and geographic location.

According to data from the Ministry of Information and Telecommunications and reports from Serbia's Digital Agenda, small and medium-sized enterprises (SMEs), which account for over 99% of business entities in the country, lag considerably in implementing digital solutions: Only around 20–25% of SMEs use advanced digital tools such as ERP systems, CRM platforms, and automated marketing campaigns. Fewer than 10% of companies actively use artificial intelligence or big data analytics in their operations. Digital literacy among employees remains a challenge in most sectors, particularly in manufacturing and traditional services. E-commerce is on the rise but remains heavily concentrated in major cities (Belgrade, Novi Sad, Niš). Nevertheless, positive strides are visible in sectors such as IT, financial services, transport, and logistics, where accelerated development of digital models is being observed.

Over the past few years, Serbia has taken certain steps to improve digital infrastructure and its regulatory framework: The introduction of e-Government and digital certificates for legal entities has made public administration more accessible. The national “Digital Serbia” program, in cooperation with NALED and the Serbian Chamber of Commerce, supports entrepreneurs and startups through education, mentoring, and funding. Development of broadband internet in rural and remote areas is part of a broader EU and domestic plan for digital inclusion. The Digital Agenda 2020–2025 focuses on enhancing digital competencies, innovation, and artificial intelligence. Despite this progress, many businesses still do not recognize digital transformation as a priority or lack the knowledge and capacity to implement it. One of the most serious challenges in Serbia's digital transformation is the uneven distribution of digital resources and expertise. While Belgrade, Novi Sad, and Niš are more digitally advanced and possess well-defined startup ecosystems, most smaller towns and rural areas lag behind.

The most common challenges include: insufficient digital literacy and a lack of trained personnel, limited access to quality internet infrastructure, low awareness

of the benefits of digital technologies among entrepreneurs, restricted access to financing for digital investments, and fear of failure combined with a lack of strategic planning in the SME sector. This situation further deepens the gap between developed and underdeveloped regions, slowing overall economic development. Despite these challenges, several factors point to the potential for accelerated progress: The growing availability of AI tools and digital marketing platforms at low cost (e.g., Canva, ChatGPT, Google Ads), Investments in digital education through platforms such as ITAcademy, Digitalna Srbija, Google Garage, and many free online courses, Increasing interest among young people in digital entrepreneurship, particularly in e-commerce, creative industries, and freelancing, EU funds and support through programs such as Horizon Europe, Digital Europe, and IPA III, which enable infrastructure development and the growth of startup communities, Green and digital transformation combined — by aligning with sustainable practices, digital transformation can also contribute to climate policy goals.

The digital transformation of the Serbian economy is currently in a transitional phase. While certain sectors and regions have made significant progress, broader implementation of digital solutions is still hindered by a range of structural and educational barriers. A coordinated approach is essential — one that includes the public sector, educational institutions, the business community, and civil society — in order for digital transformation to become a foundation for the redistribution of economic opportunities across the entire country. By leveraging the potential of digital marketing and artificial intelligence, Serbia has the opportunity to overcome its historical growth barriers, build a competitive economy, and ensure inclusive development accessible to all citizens, regardless of where they live.

##### **4.2 Access to Artificial Intelligence**

Artificial Intelligence (AI) is increasingly viewed not only as an advanced technological solution but also as a strategic public resource with the potential to impact all areas of society — from education and healthcare to the economy and public administration. In this context, access to AI technologies is one of the key factors for the success of digital transformation and the economic inclusion of both citizens and businesses. In Serbia, the development of the AI sector is still in its early stages but shows clear signs of growth. The key question is no longer whether artificial intelligence is being used, but rather who has access to this technology, how it is accessed, under what conditions, and with what effects on the social and economic structure.

AI has the capability to minimize cognitive load or automate tasks currently performed by humans, leading to increased productivity and efficiency.<sup>6</sup>

Most modern AI tools are available via cloud platforms (e.g., Google Cloud AI, Microsoft Azure AI, OpenAI API), which enables even small users to utilize them without the need for their own servers or powerful hardware. However, in Serbia, access to these tools depends on several factors: Internet speed and reliability — there is still a digital divide between urban and rural areas, Financial accessibility — although many AI tools offer free versions, advanced features often require subscriptions that are not always affordable for smaller companies or individuals, Language and localization — most AI solutions operate in English, which poses a barrier for a large portion of the population, Lack of support for local specificities — such as local language models, Serbian contextual data, and local knowledge bases.

Despite these challenges, there is a noticeable increase in the use of AI tools in digital marketing, design, data processing, content creation, and customer support among domestic companies and entrepreneurs. For AI access to be inclusive and beneficial for redistributing economic opportunities, a large number of citizens need to have basic and advanced digital skills, as well as an understanding of how AI tools work. In this regard, the educational system and informal education play a key role: Formal education: AI is still insufficiently present in primary and secondary education. There are some individual courses and faculties (ETF, PMF, RAF) that develop skilled personnel, but not to the extent needed to meet market demands, Informal education: Online courses (e.g., Coursera, edX, Udemy, Digitalna Srbija, Startit), bootcamp programs, and trainings within IT communities (ICT Hub, NTP Belgrade/Niš/Čačak) are becoming important sources for acquiring AI skills, Self-learning and practice: The backbone of AI transformation is often individuals who, through independent research and work in small teams, develop innovative solutions — often outside institutional frameworks.

There is significant potential, but also a need for systemic support through national strategies for digital literacy and strengthening competencies to work in AI environments. Access to AI is not only a technical issue but also a social and economic one. In Serbia, disparities in access to technology reflect broader social inequalities: businesses in underdeveloped municipalities have less frequent access to AI tools due to lower capital, less developed infrastructure, and a lack of skilled personnel; small entrepreneurs and women entrepreneurs often lack access to specialized training and mentoring support for AI implementation; young people from rural areas less often have access to courses and technological equipment that would enable them to professionally engage in AI-related jobs.

Therefore, access to AI technologies must be accompanied by digital inclusion policies through: free

and open educational resources, subsidies and vouchers for using digital tools, local AI hubs in the interior regions, and support in connecting with markets and international partners. Research by the Serbian Chamber of Commerce and the National Alliance for Local Economic Development (NALED) shows that: less than 10% of small and medium enterprises use any AI functionalities, mostly in analytics and marketing. Digital agencies and startups in urban centers more frequently use generative AI (e.g., for content creation, SEO optimization, automated campaigns). Industries such as transport, agriculture, and construction are only beginning to integrate AI into predictive analytics, logistics, and cost optimization. Lack of knowledge and financial support stands out as the main reason why AI is not yet more widely used. A positive trend is the expansion of available software solutions in the Serbian market and the growth of local initiatives offering AI tools adapted to the domestic context.

Examples of good practice include Nordeus and its use of data for user behavior analysis in games, Ananas e-commerce's use of AI for recommendations and supply chain optimization, and small firms using Facebook Ads and Google Analytics for precise targeting and market expansion.

### 5. Digital Marketing as a Tool for Economic Inclusion

Economic inclusion means the active involvement of all social groups in economic development processes, regardless of their geographic, social, gender, or educational background. In the context of the digital economy, access to the internet, digital tools, and market channels becomes a key factor for equal economic opportunities. Within this framework, digital marketing stands out as a powerful and accessible tool to support the economic empowerment of individuals, small businesses, and marginalized communities. In the context of Serbia, where significant regional and structural differences in economic development exist, digital marketing enables local producers, women entrepreneurs, youth, and startups to access markets, consumers, and resources that were previously unavailable to them. Digital marketing offers a range of advantages that make it particularly suitable for economically vulnerable or underrepresented actors: Low market entry cost: By using social networks (Instagram, TikTok, Facebook), Google Ads, or free platforms (e.g., Canva, Mailchimp), individuals can launch marketing campaigns without large initial investments. Access to a broad audience: Digital channels allow reaching both domestic and international customers without a physical market presence. Personalization and segmentation: The ability to target advertising based on users' interests, location, and demographics increases efficiency and reduces promotion costs. Flexibility and scalability: Digital tools enable rapid campaign adjustment, message testing, and business expansion in real time. Educational value: By using digital marketing, users simultaneously develop skills in business, analytics,

<sup>6</sup> Baltezarević, R. (The Impact of Artificial Intelligence on the Global Economy), UDC: 005.332:004.8]:339.9 DOI: 10.5937/MegRev2303013B

and communication, which further empowers them. In practice, digital marketing in Serbia already contributes to inclusion through numerous local and national initiatives:

**Women's entrepreneurship:** Many women from smaller communities have started online sales of handmade products, food, and clothing via Facebook and Instagram profiles, using basic marketing tools for promotion and sales. **Young freelancers:** Youth from interior regions (e.g., Zaječar, Leskovac, Prijepolje) use digital marketing to position themselves as designers, video editors, or social media managers on global platforms like Fiverr, Upwork, and LinkedIn. **Agricultural products:** Some farmers use digital channels for direct sales to customers (e.g., via Viber groups, Facebook pages, and the "Small Food Producers" website), increasing profits and bypassing intermediaries. **Local brands:** Startups and small producers (e.g., natural cosmetics, eco-products, artisanal tools) gain recognition and expand into wider markets through digital marketing without needing large budgets.

### 5.1. The Role of Social Networks

Social networks have become one of the most influential phenomena of the digital age, changing the way individuals communicate, access information, shop, and make decisions. In the business context, they have evolved into a key digital marketing tool, enabling companies to have direct, personalized, and efficient contact with consumers. For small entrepreneurs, startups, and social initiatives, social networks often represent the main (or only) channel for promotion and market access.

In Serbia, where there is a pronounced need for economic inclusion and decentralization of growth, the role of social networks is especially significant because they enable the democratization of access to consumers regardless of physical location, budget, or the size of the organization. According to available data (Statista, Digital 2024 Serbia, local analyses), the most widely used social networks for business purposes in Serbia are: **Facebook** – used for brand building, product placement, and direct communication with users. Particularly popular among micro and small businesses in smaller communities. **Instagram** – the dominant channel for visual industries (fashion, handicrafts, cosmetics, food), often used by young entrepreneurs. **TikTok** – a rapidly growing channel, especially among younger populations. Used by local producers and influencers for creative product positioning. **LinkedIn** – primarily used in the B2B sector for personal branding, recruitment, and promotion of startup businesses and consulting services. LinkedIn is also a more affordable channel for attracting targeted client segments, especially those who choose to engage in the organization's online activities, benefiting organizations with limited resources such as nonprofits and small businesses.<sup>7</sup> **YouTube** and **WhatsApp/Viber** groups – less formal channels used

for education, direct sales, and maintaining relationships with consumers. Additionally, customer feedback on social networks provides key information for businesses aimed at increasing customer satisfaction and has longer-lasting effects compared to traditional marketing tools.<sup>8</sup>

The common denominator of all these networks is their high accessibility, relatively low advertising costs, and the ability to quickly reach the target audience through quality content. One of the greatest advantages of social networks is their ability to provide market visibility to small players who do not have access to traditional channels (TV, print, billboards). This particularly applies to: **Rural households and food producers** – who promote and sell homemade products without intermediaries through Facebook pages and local groups. **Artisans and craftsmen** – who use Instagram to build their brand and sell handmade items across Serbia (and even abroad). **Women entrepreneurs and home-based businesses** – who, through social media content, not only market their products but also empower other women to start their own businesses.

Young freelancers and creatives – who build careers, promote services, and find clients through LinkedIn and Instagram. In this way, social networks become tools for redistributing market power and open space for new business models that are not limited by geography. Besides sales and promotion, social networks also have strong educational potential. Through video tutorials, live streams, influencer and business mentor posts, users can learn: how to use digital marketing, how to start their own business, how AI tools function in marketing, how to create a brand's visual identity.

Digital marketing and artificial intelligence not only transform business but also have the potential to contribute to a more equitable distribution of economic resources in Serbia. Investment in digital inclusion and AI literacy will be crucial for ensuring sustainable economic development.

### Conclusion

Modern digital technologies, with an emphasis on digital marketing and artificial intelligence, are profoundly changing the structure of economic relations, communication channels, business models, and market access. In the context of Serbia, a transitional country with pronounced regional and economic inequalities, these technologies represent not only innovation but also a potential mechanism for economic redistribution and inclusion. The analysis shows that digital transformation of the Serbian economy is underway but unevenly distributed. While the technology sector and large urban centers experience accelerated growth and digital maturity, small businesses, rural areas, and marginalized groups continue to face numerous barriers in accessing modern digital tools and market mechanisms.

<sup>7</sup> WITZIG, L., SPENCER, J., GALVIN, M. (2012.), Organizations' use of LinkedIn: An analysis of nonprofits, large corporations and small businesses, *Marketing Management Journal*, Vol. 22, No. 1, pp 113-121

<sup>8</sup> FOWDAR, R. R. R., FOWDAR, S. (2013.), The Implications of Facebook Marketing for Organizations, *Contemporary Management Research*, Vol. 9, No. 1, pp 73-84

In this context, digital marketing and artificial intelligence serve as bridges that can close the gap between developed and underdeveloped parts of society.

Digital marketing, especially through social networks and accessible cloud platforms, enables small and medium-sized businesses, independent entrepreneurs, and individuals to connect with markets, build brands, optimize sales, and communicate directly with consumers. Its low cost, high accessibility, and scalability make it an ideal tool for entrepreneurs without access to traditional promotion and distribution channels. On the other hand, artificial intelligence opens doors to automation, analytics, and smart management of business processes—thereby increasing efficiency and competitiveness even in smaller business systems. Although its application in Serbia is still emerging, the growing availability of free and affordable AI tools, as well as international platforms (ChatGPT, Midjourney, Canva AI, Google AI), allows a broader population to use this technology without large initial investments. The key question is no longer whether Serbia has the potential for digital inclusion, but how to systematically, sustainably, and fairly harness that potential. For digital marketing and artificial intelligence to truly become instruments of economic redistribution, it is essential to invest in digital literacy at all levels—from basic education to informal courses and mentoring programs; ensure equal access to digital infrastructure, especially in rural and less developed areas; develop incentive policies and funds supporting micro-entrepreneurs in digitalizing their businesses; and connect local communities with the startup and IT sectors, so that knowledge and technologies are available to all, not just technological hubs. Finally, digital marketing and artificial intelligence should not remain the privilege of large companies and urban zones, but become fundamental tools for economic empowerment and development across the entire country. Their proper application can lead to new job creation, development of local economies, increased competitiveness of the Serbian economy, and reduction of socio-economic disparities. Therefore, digitalization through marketing and AI

must not be viewed merely as a technical reform, but as a broader social strategy—aimed at a fairer, more open, and inclusive economy in 21st century Serbia.

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**АНАЛИЗ РЫНКА НЕДВИЖИМОСТИ И ТЕНДЕНЦИЙ В РЕСПУБЛИКЕ АРМЕНИЯ****Мелкумян М.***д.э.н., профессор,**Армянский государственный экономический университет,**Республика Армения***Парсян С.***к.э.н., доцент,**Армянский государственный экономический университет,**Республика Армения***Калантарян А.***к.э.н., доцент,**Армянский государственный экономический университет,**Республика Армения***Исаян Ш.***аспирант,**Армянский государственный экономический университет,**Республика Армения***Манукян А.***аспирант,**Армянский государственный экономический университет,**Республика Армения***ANALYSIS OF THE REAL ESTATE MARKET AND TRENDS IN THE REPUBLIC OF ARMENIA****Melkumyan M.,***Doctor of Economics, Professor at Armenian State University of Economics,  
the Republic of Armenia**<https://orcid.org/0000-0003-1048-4056>***Parsyan S.,***PhD in Economics, Associate Professor at Armenian State University of Economics,  
the Republic of Armenia**<https://orcid.org/0000-0003-0561-3052>***Kalantaryan A.,***PhD in Economics, Associate Professor at Armenian State University of Economics,  
the Republic of Armenia**<https://orcid.org/0009-0002-7025-8691>***Isayan S.,***PhD student at Armenian State University of Economics,  
the Republic of Armenia**<https://orcid.org/0009-0003-1720-4966>***Manukyan A.***PhD student at Armenian State University of Economics,  
the Republic of Armenia**<https://orcid.org/0009-0006-1262-9625>**DOI: [10.5281/zenodo.15874584](https://doi.org/10.5281/zenodo.15874584)***Аннотация**

Рынок недвижимости в Армении в последние годы стал одной из главных тем экономической и социальной жизни. Рост цен на жилую, коммерческую и промышленную недвижимость в Ереване и регионах, динамика спроса и предложения, а также территориально неравномерное развитие свидетельствуют о том, что данный рынок находится в фазе активных преобразований. Тем не менее, рынок недвижимости Армении обладает рядом особенностей и закономерностей, которые отличают его от рынков других стран и делают его интересным объектом для исследования.

**Abstract**

The real estate market in Armenia has become one of the central topics of economic and social life in recent years. The growth in residential, commercial, and industrial real estate prices of Yerevan and the regions, the dynamics of demand and supply, as well as the unequal territorial development indicate that this market is in a phase of active changes. However, the Armenian real estate market has a number of features and regularities that distinguish it from the markets of other countries and make it an interesting subject for study.

**Ключевые слова:** квартира, земельный участок, арендная плата, цена, налоговая льгота.

**Keywords:** apartment, land, rent, price, tax exemption.

Real estate is considered an important component of the economy, as it is associated with housing, commercial, and investment activities. It has legal, economic, and social significance, which makes it a multi-dimensional and highly relevant field of study.

There are economic and legal definitions of the real estate sector, in particular, it includes lands, buildings on it, as well as natural resources (for example, mines, water resources, etc.). However, in practice, when conducting studies on real estate, land, buildings, and structures are often discussed more, since they, as a type of real estate, are of primary importance for life, as well as for the implementation of productive and economic activities.

In his work "Principles of Economics" (1890), English economist Alfred Marshall referred the interaction of supply and demand in the real estate market, noting that the supply of land is stable and the demand is variable, which affects the formation of prices[1].

Renowned international economic experts, John Dawn and Jane Smith, in their work "World Real Estate Report", address in detail the issues of real estate market global trends, price changes, market development forecasts, and investment opportunities' problems. Experts note that the sustainable development of the market is represented by the combined influence of accumulated economic, political, and social factors, which, according to experts, is very important for analyzing investment opportunities and metaphorical risks[2].

According to Article 2 of the RA Law on Real Estate:

Real estate - the entirety of land, real property, and jurisdiction over the land and/or real property. The legal status of real estate also extends to aircraft, maritime, river-sea, and river vessels subject to state registration in the Republic of Armenia, as well as to space objects of artificial origin. Under the laws of the Republic of Armenia, other property may also be considered real estate. Land - the material that makes up the earth: soil, rock or other material, as well as any part of the above-ground and underground area of the land, including the restrictions on its use provided for by the laws of the Republic of Armenia. Based on the use of the area, there are several types of real estate:

- Residential real estate
- Public building
- Industrial building
- Land[3].

These are the four main categories of real estate that cover the majority of the real estate market. Before buying or investing in real estate, people usually wonder where to invest: Should they buy a house or invest and buy property in a newly built apartment? Depending on the ultimate beneficiary, there are two main types of real estate markets:

#### 1. Primary market

When a real estate developer constructs a new building and directly sells its residential and commercial units to individuals without intermediaries, it is classified as the primary market. The majority of buyers in a project tend to reserve their preferred apartment in advance—prior to the commencement of construc-

tion—at initial pricing, with the aim of securing substantial profit gains. Some people also focus on the primary market because they can purchase properties at affordable prices with a long-term installment plan.

#### 2. Secondary market

When real estate agents transact with residential or commercial properties that have already been sold or previously inhabited, they are considered secondary markets. Based on living conditions, buyers intend to invest in communities equipped with all amenities and purchase already built homes. The secondary real estate market allows owners to change ownership by selling it to someone else at a higher value[4].

According to the form of ownership, real estate can belong to one person by right of ownership, as well as to more than one person by right of common joint or common share ownership[5].

During the 2022–2023 Russia–Ukraine war, the influx of Russian nationals into Armenia had a significant impact on the country's real estate market. As a result of this migration, rental prices for residential properties increased by approximately 2 to 3 times. In the last 5-6 months, along with the departure of some Russians from the country, the expansion of apartment sales volumes and profitable offers in the primary market, and the decrease in demand, real estate rental prices have decreased slightly.

Studying the real estate market requires not only superficial analysis, but also the application of in-depth economic approaches. From this perspective, a number of in-depth economic methods are proposed, which will allow us to conduct a more professional analysis.

Studies indicate that in 2021, the number of real estate transactions registered in the Republic increased by 27.0% compared to 2020, while in Yerevan, the capital city, the increase was 24.2%. In 2022, the overall price level in the Republic rose by 16.1% compared to 2021, with Yerevan experiencing a 12.0% increase[6].

In 2021, Armenia's real estate market demonstrated positive trends by an increase in both the number and volume of transactions.

The following important factors can be identified:

- Government support: The government had undertaken a number of programs in the form of financing aimed at restoring the economy, which had suffered a decline as a result of both COVID-19 and the 44-day war.
- Improvement in bank lending conditions: Banks began offering loans with lower interest rates and longer maturities, which also stimulated increased demand for real estate.

Touching upon to the 2022 real estate market, an increase in the total number of real estate transaction registrations is again observed: 204,910 transactions were registered in 2022 compared to 2021.

As of 2021-2022, the real estate market of Armenia was characterized by certain problems, such as high mortgage interest rates, the lack of affordable housing, especially in the capital, Yerevan, etc. In addition, tourist interest in Armenia is growing, which may lead to an increase in demand for rental properties in recreational areas[7].

The trends observed in the Armenian real estate market in 2022 were due to a number of economic and social factors, that stimulated the growth of transactions. Among them are:

- Mandatory requirements for non-cash transactions:

The Law on Non-Cash Transactions, which came into force on July 1, mandates that all transactions exceeding 300,000 AMD must be conducted through non-cash payment methods. This led to many sellers choosing to organize donation transactions to avoid the negative aspects of cashless transactions, and as a result, the number of donation transactions in 2022 increased by 28.7% compared to the previous year, reaching 23,099 transactions compared to the previous 17,942 transactions.

- Increase in rental prices:

The sharp increase in rental prices—particularly in Yerevan—prompted many residents to consider purchasing their own property. In some cases, rental prices had doubled or even more.

- Inflow of migrants:

The influx of people relocating to Armenia following the Nagorno-Karabakh war contributed to an increase in demand within the real estate market. According to data from the State Cadastre Committee, the number of real estate transactions reached 96,000 during the January–June period of 2022, marking the highest figure recorded in the past decade.

Examining the 2023 real estate market, an increase in state registration of total transactions is again observed. However an increase in the number of transactions in the real estate market has been recorded in all regions of Armenia except in Yerevan. The slump is only in the capital: purchase and sale transactions have decreased, the indicators of real estate bought and sold by foreign citizens have also decreased, but apartment prices have not decreased in 2023. In Syunik, the number of purchase and sale transactions has increased by approximately 40%, and in Gegharkunik - by 3.6% [8].

Also an increase in prices is noticeable: the average price for per square meter of multi-apartment residential buildings in the center of Yerevan was 837,700 drams in 2023, and in 2022 it was 737,800 drams. The prices have increased 13.5%, while in 2022 it was 16.6% [9].

The flow of Russian citizens has a medium-term state and it is possible that rental prices in 2025 will be lower than it was in 2023. These two factors, which are the reduction in the inflow of the fund of banks and the inflow of resettlers, may have a negative impact on our real estate market. It is noteworthy that the prices of apartment buildings in Yerevan continue to rise. However, the number of real estate alienation transactions in Yerevan decreased by 14.2% in 2023 (from 25,644 to 22,012), and purchase and sale transactions decreased by 23.8% (from 17,734 to 13,513). In total, 8,073 transactions for the purchase and sale of apartments in apartment buildings were registered in Yerevan in 2023, compared to 11,466 transactions in 2022. Moreover, the number of purchase and sale transactions for apartment buildings decreased by 29.6% in 2023 [10].

Touching upon to the real estate market situation in 2024, we again observe an increase in state registration of rights transactions. Transactions made in Yerevan accounted for 27.79% of the market, while in the regions a 12.46% increase was recorded compared to the previous year. The most active regions are Kotayk, Ararat, and Armavir, where the number of residential building and land sales transactions was particularly high. In 2024, primary registration transactions increased by 30.44%, and mortgage and alienation transactions by 18.77% and 9.34%, correspondingly. At the same time, the number of legalization transactions has slightly decreased, by 1.28% [11].

### Conclusion

Studying the trends of the real estate market in Armenia, we come to the conclusion that the real estate market in Armenia has its own characteristics and challenges, but the perspectives depend on many factors, including the economic situation of the country and the region, political changes, and changing consumer preferences.

The real estate market is constantly changing. It is unique for each country, region, and city, depending on the legal field, financing conditions, and ownership forms. It is worth noting that in developing countries, low- and middle-income families are in great need of housing, and they cannot be considered as potential buyers in the real estate market [12]. The main group of buyers, due to whom the demand for apartments is formed, makes up 4-6% of the population, which includes families with high incomes. In recent years, the real estate market has been recording inflation, which is due to a number of political and economic circumstances, as well as increased demand and limited supply.

Analyses show that demand for eco-friendly real estate has increased. With increasing awareness of environmental issues, more and more people are looking for property that has been built using eco-friendly materials and technologies, as well as being located in less polluted areas, away from industrial buildings [13].

As real estate prices rise in the center of the city, many buyers are opting for properties in the suburbs, where housing prices can be more affordable and life can be quieter and more eco-friendly. With the development of technology, more people are becoming interested in "smart" homes, which provide automation of lighting, heating, security systems and other devices and control through the mobile app, biometric data, or voice control.

The activity observed in the real estate market in 2024 was largely due to short-term incentives, such as the end of tax breaks. In this context, long-term analysis is very important, which allowed us to assess the prospects for sustainable market development and predict future market trend [14].

Summarizing the high rates of epidemic, war and post-war inflation in the Republic of Armenia from 2020 to 2024, the real estate market has passed a period of stable transformations.

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## PROSPECTS FOR ACCELERATING GREEN FINANCE IN THE BANKING SECTOR

Qudratov I.

Vice dean at Tashkent State University of Economics

ORCID: 0000-0002-2421-1035

ID Scopus: 59420810200

DOI: [10.5281/zenodo.15874586](https://doi.org/10.5281/zenodo.15874586)**Abstract**

The transition to a green economy has intensified the role of green finance in shaping sustainable development, particularly within the banking sector. This paper explores the prospects for accelerating green finance in commercial banks, focusing on emerging trends, policy initiatives, and institutional reforms that drive environmental responsibility in financial operations. By analyzing international best practices and the current status of green finance adoption in banks, the study identifies both the challenges and opportunities associated with scaling up green lending. It also evaluates the role of regulatory frameworks, public-private partnerships, and innovative financial instruments in promoting sustainable investment. The paper concludes with policy recommendations aimed at strengthening green finance ecosystems in the banking sector, especially in developing economies.

**Keywords:** Green finance, sustainable banking, commercial banks, environmental risk, green lending, regulatory frameworks, sustainable development, financial innovation, green economy, public-private partnership.

**INTRODUCTION**

In recent years, the growing urgency of climate change, environmental degradation, and resource depletion has significantly reshaped global financial priorities. The concept of green finance has emerged as a pivotal mechanism for aligning financial systems with environmental sustainability goals. Green finance encompasses a wide range of financial instruments and investment strategies that promote environmentally friendly projects, such as renewable energy, energy efficiency, sustainable agriculture, and climate-resilient infrastructure.

The banking sector, as a central pillar of any financial system, plays a critical role in the allocation of capital and credit. Therefore, commercial banks are increasingly expected to integrate environmental considerations into their financing decisions. Accelerating green finance within the banking sector not only contributes to environmental sustainability but also mitigates financial risks associated with climate change and enhances long-term portfolio stability.

Despite its importance, the adoption of green finance in many countries remains limited due to regulatory gaps, lack of awareness, insufficient incentives, and underdeveloped green financial markets. However, recent developments in policy frameworks, international climate commitments, and market innovations offer new opportunities to scale up green finance in the banking industry.

This study aims to explore the prospects for accelerating green finance in the banking sector by analyzing global trends, challenges, and best practices. It further examines how banks can effectively respond to environmental risks while simultaneously leveraging green finance as a source of competitive advantage and sustainable growth.

**LITERATURE REVIEW**

The growing body of literature on green finance reflects the increasing recognition of its importance in promoting sustainable development and addressing climate-related risks. Green finance has been defined by the United Nations Environment Programme (UNEP)

as financial flows that support environmentally sustainable development, including investments in renewable energy, pollution prevention, and conservation of natural resources [1].

Several scholars have emphasized the role of the banking sector in facilitating the transition to a green economy. According to Weber [2], integrating environmental and social criteria into credit risk assessment is essential for reducing systemic financial risks and enhancing long-term financial performance. Similarly, Scholtens [3] argues that sustainable banking practices can influence broader economic behavior by directing capital toward environmentally responsible projects.

Studies by Zhang et al. [4] and Chen & Ma [5] analyze the evolution of green credit policies in China, highlighting how regulatory interventions and mandatory green credit guidelines significantly increased the share of environmentally friendly investments in the country's banking system. These findings suggest that government policy and regulatory frameworks are critical drivers of green finance growth.

In the European context, the European Investment Bank (EIB) and European Central Bank (ECB) have implemented green bond standards and climate risk disclosure mechanisms, which have served as models for other jurisdictions. Battiston et al. [6] emphasize the importance of stress testing banks for climate-related financial risks, a tool that has become increasingly relevant in light of the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).

While significant progress has been made in advanced economies, the literature reveals that developing countries face considerable challenges in adopting green finance. Khan et al. [7] identify barriers such as limited technical capacity, underdeveloped capital markets, and lack of investor awareness as key constraints. Nevertheless, pilot programs led by international financial institutions (e.g., the Green Climate Fund and GEFF) have shown promising results in scaling green investment in emerging markets.

Furthermore, empirical studies exploring the link between green finance and bank performance are emerging. For instance, Ghosh & Nanda [8] find that

banks with larger portfolios of green loans experience lower non-performing loan ratios and improved reputational capital. However, Lackner & Moser [9] caution that greenwashing remains a risk, highlighting the need for standardized reporting and third-party verification of green credentials.

Overall, the literature suggests a consensus on the potential of green finance to transform the banking sector, but it also underscores the importance of regulatory alignment, stakeholder engagement, and innovation in financial products. This review provides the foundation for further investigation into the strategies needed to accelerate green finance, particularly in contexts where institutional capacity and market infrastructure are still developing.

### METHODOLOGY

This dissertation employs a range of modern scientific and methodological approaches to ensure a comprehensive and rigorous analysis of green finance within the banking sector. The methods applied include scientific abstraction, comparative and structural analysis, inductive and deductive reasoning, economic-statistical analysis, econometric modeling, mathematical analysis, and expert evaluation techniques.

In particular, the study integrates quantitative and qualitative methods to provide a multifaceted understanding of the mechanisms and factors influencing the acceleration of green finance in commercial banks. These approaches are used to assess both theoretical underpinnings and empirical relationships in the research.

A special emphasis is placed on examining the relationship between green finance indicators and banking efficiency metrics. To this end, panel data regression techniques are employed, utilizing data from multiple banks over a defined time period. This allows for the identification of dynamic interactions and the estimation of the potential impact of green financing activities on banks' financial performance. The models are estimated using fixed effects, random effects, and generalized method of moments (GMM) approaches, depending on the structure of the data and the presence of heterogeneity across banks.

Furthermore, the expert evaluation method is utilized to validate the selection of green finance indicators and to assess the relevance and reliability of data sources. This hybrid methodology enables the researcher to triangulate findings and ensure the robustness of conclusions.

By combining these advanced methodological tools, the research aims to develop actionable insights and policy recommendations for strengthening green finance ecosystems, particularly in the context of developing economies such as Uzbekistan.

### ANALYSIS AND RESULTS

Table 1 presents the descriptive statistics of the key variables used in the empirical analysis, including profitability indicators (ROA and ROE), green and total credit volumes, bank size variables, and relevant macroeconomic indicators. The analysis is based on a panel of commercial banks operating in Uzbekistan from 2015 to 2024. All monetary variables have been log-transformed to ensure normality and reduce skewness.

Table 1.

Descriptive Statistics of Core Variables

| Variable          | Obs | Mean  | Std. Dev. | Min    | Max   | Skewness | Kurtosis |
|-------------------|-----|-------|-----------|--------|-------|----------|----------|
| ROA (%)           | 60  | 1.11  | 3.26      | -8.12  | 11.4  | 0.732    | 20.28    |
| ROE (%)           | 60  | 7.36  | 10.47     | -39.91 | 49.87 | 0.513    | 12.60    |
| lnT_Credit        | 60  | 8.90  | 2.55      | 4.12   | 11.56 | -0.447   | 1.86     |
| lnGreen_Credit    | 60  | 5.92  | 1.68      | 3.01   | 8.24  | -0.496   | 2.12     |
| lnBank_Asset      | 60  | 9.45  | 2.41      | 4.85   | 11.89 | -0.491   | 1.79     |
| lnBank_Capital    | 60  | 6.85  | 1.89      | 3.44   | 9.21  | -0.519   | 1.92     |
| Inflation (%)     | 60  | 11.66 | 3.42      | 6.20   | 17.83 | 0.689    | 2.76     |
| Interest Rate (%) | 60  | 13.65 | 2.91      | 8.75   | 18.45 | -0.638   | 3.04     |
| GDP Growth (%)    | 60  | 5.83  | 1.02      | 3.91   | 7.43  | -1.361   | 4.41     |

The results show a wide variation in bank performance and financial structure across the sample. The mean ROA and ROE values are 1.11% and 7.36%, respectively, indicating moderate profitability across banks, though the high kurtosis values reflect the presence of outliers and non-normal distributions. Green credit volumes (lnGreen\_Credit) show a relatively lower average compared to total loans, suggesting a limited scale of green lending during the observed period.

Additionally, skewness statistics suggest that most financial variables are moderately skewed, while macroeconomic indicators such as GDP growth exhibit higher skewness and kurtosis, reflecting asymmetric

economic trends over time. The log transformation applied to core financial indicators helped to reduce non-normality in the distribution, thereby improving the reliability of regression-based estimations in subsequent sections.

To assess the distributional characteristics of key financial and macroeconomic variables, histogram plots were generated for ROA, ROE, lnGreen\_Credit, lnT\_Credit, Inflation, and Interest Rate. These visualizations allow us to examine the presence of skewness, kurtosis, and potential outliers, providing insight into the underlying data structure before proceeding to econometric modeling. The use of log-transformed values (for credit and asset variables) is intended to normalize distributions and reduce variance.

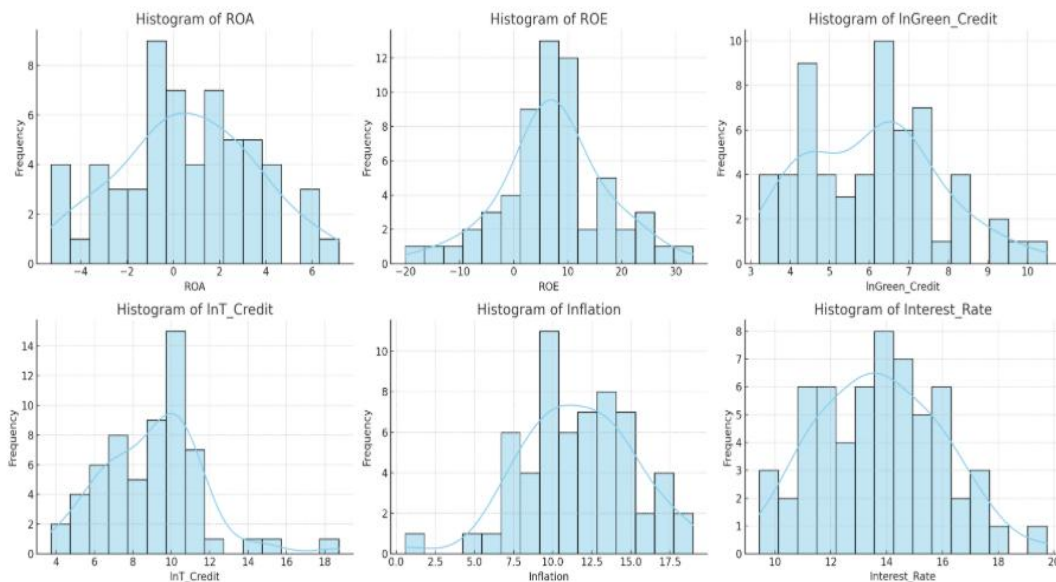


Figure-1 Histogram Plots for Key Variables

The histogram for ROA reveals a right-skewed distribution with some extreme positive values, consistent with a kurtosis value exceeding 20 as seen in the descriptive statistics. Similarly, ROE shows a wide spread and heavy tails, indicating the presence of outliers. The log-transformed variables - lnGreen\_Credit and lnT\_Credit - display nearly symmetric distributions with mild skewness, suggesting an effective normalization.

Macroeconomic indicators, such as inflation and interest rate, exhibit distributions that are moderately skewed, reflecting fluctuations in the economic environment over the studied decade. These visual findings support the need for robust estimation techniques in the regression analysis stage to address issues of non-normality and potential heteroscedasticity.

### CONCLUSION

The findings demonstrate that while green loans contribute to the long-term sustainability of the financial system, their immediate impact on traditional profitability metrics such as ROA and ROE remains limited. This is likely due to the current orientation of green finance toward sectors with lower short-term returns but higher environmental and social value. Furthermore, strong multicollinearity was observed among several key financial variables, indicating the need for careful variable selection and econometric adjustments in model specification.

Additionally, the correlation analysis showed that green credit volumes are heavily concentrated in large banks, pointing to a disparity in access to sustainable finance tools across the banking sector. Macroeconomic indicators, particularly interest rates and inflation, also exhibited significant interactions with bank-level decisions regarding capital structure and credit allocation.

To ensure the sustainable growth of green finance, targeted policy interventions are essential. These include preferential interest rate mechanisms, risk-sharing instruments, and incentive schemes that make green investments more attractive and financially viable for commercial banks. Moreover, enhancing regulatory clarity, developing a national green finance taxonomy,

and strengthening the capacity of smaller banks to engage in environmentally sustainable lending are critical steps forward.

In conclusion, green finance in the banking sector represents not only a necessary shift toward environmentally responsible development but also an emerging area for strategic transformation in financial intermediation. Accelerating this process requires coordinated action among banks, regulators, and international financial institutions.

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## ENVIRONMENTAL AND SOCIAL VALUES IN THE CONTEXT OF GOVERNANCE: AN EMPIRICAL ASSESSMENT OF GEORGIAN STUDENTS

**Pavliashvili S.,**

*Member of the Academy of Sciences of Georgia,  
Doctor of Economic Sciences, Professor, Tbilisi, Georgia*

**Tokmazishvili M.**

*Doctor of Economic Sciences, Professor,  
Alte University, Tbilisi, Georgia*

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### Abstract

This paper explores ESG (Environmental, Social, and Governance) issues in Georgia and examines the attitudes of the new generation toward these challenges. The findings indicate that young people place strong emphasis on environmental awareness, digital sustainability, and social responsibility. While students tend to support ethical business practices during their academic years, financial outcomes increasingly take precedence as they progress in their careers. This shift in values is influenced by the contrast between academic and professional environments, systemic pressures, and organizational cultures. As a result, the idealistic perspectives of emerging executive leaders often clash with real-world demands, leading to the marginalization of ethical business principles. To mitigate this shift, it is crucial to reconceptualize responsible business not just as a value-driven practice, but as a long-term strategic advantage.

**Keywords:** ESG principles, social responsibility, business model, Georgia.

### Introduction

The modern era is characterized by a complex set of social, economic, and environmental challenges. In response, the concept of ESG (Environmental, Social, and Governance) was introduced by the United Nations in 2004 through the "Who Cares Wins" initiative (IFC, 2008). This initiative emerged from a collaborative effort between the UN Global Compact and the Swiss government, with the goal of encouraging the integration of ESG factors into responsible investment decision-making.

Since the early 21st century, the United Nations has launched several key initiatives, including the Principles for Responsible Investment (UN PRI), the Global Compact, the Sustainable Development Goals (SDGs), the Principles for Sustainable Insurance (PSI), the UN Environment Programme Finance Initiative (UNEP FI), and the Sustainable Stock Exchanges (SSE) initiative. These efforts aim to support businesses and investors in aligning with sustainability goals and fostering a more just and resilient global society.

As the literature suggests, while the barriers to ESG adoption vary between developing and developed countries, both face substantial challenges. Across the board, investors have traditionally prioritized short-term returns, often at odds with the long-term outlook required for ESG, aligned investments. This preference for immediate gains can inhibit the adoption of sustainable practices that yield benefits over time (Haessle, 2020).

In developing countries, the focus tends to be on raising awareness, navigating regulatory and financial limitations, and overcoming cultural resistance. In contrast, European Union countries face challenges related to regulatory harmonization, reporting standards, organizational culture, and the integration of ESG into core business strategy (Prasek, 2023). Notable concerns include the difficulty of establishing unified ESG regulations (Bernoville, 2024), the need for improved data

and reporting frameworks (CFA Institute, 2021), and the resistance embedded in corporate and cultural structures (Paolone et al., 2024), as well as the complexity of developing global value chains (Ballesteros et al., 2021).

In Georgia, one of the most pressing challenges is the shortage of green finance, which significantly impedes the implementation of responsible investment practices (Pavliashvili et al., 2023).

### Methodology

The aim of this study is to empirically assess how sensitively the new generation engages with integrated Environmental, Social, and Governance (ESG) issues. Their perceptions of these challenges indicate the importance they place on addressing environmental concerns in the future.

This research is grounded in an empirical study conducted at three universities in Georgia. During group workshops, students were introduced to ESG principles and global sustainability challenges. Following these sessions, a survey was administered in which participants were asked to prioritize the key challenges currently facing Georgia. Using a qualitative, "soft" research approach, the study explored students' attitudes, including their personal experiences, social interactions, and expectations related to ESG issues.

The new generation, born in the 21st century, has grown up in a high-tech world and is marked by pragmatism. Their digital fluency and social activism position them as a powerful driver of change. They are coming of age amid economic uncertainty, climate change, and rapid technological transformation. Accustomed to fast innovation, they are highly attuned to global trends, factors that strongly shape their views on environmental and social challenges.

Their perspectives on the relevance of ESG issues in Georgia, the priorities they would assign to them, and their evaluations of how effectively the government

and businesses are responding reflect a broader understanding of environmental, social, and governance dynamics.

### Research Findings

The empirical study revealed that today's generation places the highest priority on environmental awareness, digital literacy, consumer behavior, and, subsequently, social responsibility, governance, and accountability. Our findings indicate that young people are well aware of the consequences of ecological degradation, support sustainable practices such as using eco-friendly products and endorsing brands that emphasize sustainability, and actively utilize digital platforms to influence peers and disseminate information that fosters collective action on ESG issues.

They exhibit a heightened sensitivity to social justice and are deeply committed to principles of equality, diversity, and inclusion. They seek to work in organizations that reflect their personal values, particularly in relation to sustainability, social equity, and ethical governance. These individuals report greater engagement and satisfaction in their roles when they perceive their work as contributing to broader environmental or societal goals.

This generation actively supports innovation in products and services that offer sustainable and ethical alternatives. They are enthusiastic about emerging technologies that promote environmental protection and social well-being. Companies that fail to meet their expectations regarding social responsibility risk falling out of favor with this cohort. Conversely, they are more inclined to support businesses and leaders who demonstrate integrity and a genuine commitment to social responsibility.

Overall, the attitudes of the new generation of students toward ESG are marked by a strong and consistent commitment to environmental sustainability, social justice, and ethical leadership. They are not passive observers of contemporary challenges; rather, they are proactive and responsive to forms of governance that fail to align with their core values.

What distinguishes this generation is their upbringing in the digital age, with continuous access to global information and discourse via the internet and social media. This connectivity has fostered greater awareness of and engagement with global environmental and social issues. They are active participants in online communities where such topics are discussed and advocated for, which further enhances their sensitivity to these matters.

Additionally, they have matured during significant global disruptions, most notably the COVID-19 pandemic, which has shaped their perspectives on security, economic stability, and social equity. These experiences have made them more attuned to systemic inequalities and more willing to challenge them.

This generation demonstrates a pragmatic approach to balancing financial stability with environmental sustainability. They understand that long-term prosperity is intrinsically linked to responsible environmental and social practices. As such, they are more likely to engage in social initiatives and believe in the

transformative power of both individual and collective action.

Furthermore, the sectoral characteristics of higher education in business, specifically the integration of social responsibility and business ethics into the curriculum, reinforce these values. According to the *Sectoral Characteristics of Higher Education in Business Administration*, approved by the National Center for Educational Quality Enhancement (2023), such content is a core requirement. This educational emphasis strengthens students' awareness and helps shape their worldview concerning environmental and social challenges. They are growing up in an environment where these values are becoming increasingly mainstream, influencing both their expectations and behavior.

In sum, the new generation's sensitivity to environmental and social responsibility stems from a combination of factors: access to information, direct and indirect experiences with global challenges, strong social justice values, a pragmatic worldview, educational exposure, and broader cultural shifts. Together, these factors are shaping a generation that is not only informed and engaged but is also setting new expectations and standards for businesses, institutions, and society at large.

Finally, a key question arises: why do the value-based priorities held by young people often shift when they become top managers?

In recent years, particularly within academic discussions related to business, a noticeable value dissonance has emerged. While students frequently express strong commitment to ethical, ecological, and socially responsible business practices during their university years, these priorities tend to shift significantly as they enter professional life and ascend to executive positions. The focus often shifts toward profit maximization, revenue growth, and meeting investor expectations.

This shift does not necessarily indicate a collapse of personal moral values. Rather, it is driven by a combination of systemic and psychological factors, which we explore below:

During their student years, young people enjoy the freedom to act on idealistic principles. They are not accountable for financial outcomes or shareholder satisfaction. Universities often emphasize the importance of ethical business practices, corporate social responsibility (CSR), ESG principles, and sustainable development theories. However, once individuals move into high-level management roles, they assume the responsibility of building profitable and competitive organizations, frequently requiring difficult compromises between values and economic objectives.

The practical realities of business often clash with the ethical frameworks taught in academia. Profit-driven decisions are viewed as "rational management," while social responsibility is often relegated to a secondary role, unless it demonstrably enhances financial performance.

Socio-economic pressures and growing responsibilities further influence this shift. Students typically receive financial support from their families and lack direct economic obligations. In contrast, managers are

accountable for company profitability, employee livelihoods, and sometimes the well-being of thousands of stakeholders. This burden often complicates the consistent application of idealistic principles.

Organizational culture and systemic frameworks are also pivotal in reshaping value priorities. Large corporations have clearly defined goals, performance metrics, and results-oriented structures. Top managers become embedded within these systems and rarely wield sufficient influence to effect fundamental change. Adapting to these frameworks can lead to the erosion of individual values and a rise in pragmatism.

Investor pressure compounds these dynamics. Managers often must prioritize shareholder interests within a capitalist system that demands rapid, short-term financial results. Investors, shareholders, and markets expect continuous growth in revenue and profit. Under such pressure, long-term objectives, such as environmental responsibility or social inclusion, are frequently deemed non-essential or risky.

Consequently, a personal evolution of values takes place. Life milestones such as starting a family, shouldering financial responsibilities, and seeking career stability often supplant youthful idealism. The role of a top manager requires prudent risk assessment and decision-making that may conflict with principles learned during university.

An information asymmetry exists between academic expectations and the complex realities of business operations. Students often lack full insight into the economic and operational challenges organizations face daily. Once involved in management, they must reconcile these realities, making it more difficult to pursue purely value-driven decisions.

Therefore, the transformation of values from student life to top management is not solely an individual journey but also a systemic process.

This transformation can be softened if responsible business is reframed—not as a “social luxury”—but as a strategic advantage for long-term success. Universities and the business sector must collaborate to ensure that the ideals inspiring young people do not fade under systemic pressures or practical constraints, but instead evolve into enduring strategies that guide sustainable and ethical corporate leadership.

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# MOLECULAR BIOLOGY

## ASSESSMENT OF THE ECOLOGICAL FUNCTIONS OF FUNGAL BIOTA IN URBAN SOIL ECOSYSTEMS

**Balakhanova G.,**

*Ph.D.*

ORCID: 0000-0002-1709-1442

**Ibrahimova Kh.**

*Associate Professor*

ORCID: 0000-0002-5987-3346

*Azerbaijan State Pedagogical University*

*Azerbaijan, Baku*

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### Abstract

This research systematically analyzes the role of micromycete fungi and their participation level in ecological processes within soil ecosystems altered by urbanization. A study conducted across 12 sites in Baku with varying degrees of urbanization documented 34 species of micromycete fungi. Their distribution dynamics, ecological characteristics, and trophic specialization indicators were examined. Soil analyses and phytotests carried out in experimental plots aimed to assess the state of soil microflora, the rate of organic matter decomposition, and the impact on plant root systems.

The observations revealed that micromycete fungi perform crucial ecological functions in soil ecosystems: they play an active role in decomposing organic residues, shaping soil structure and productivity indicators, facilitating the cycling of microelements, and forming symbiotic relationships. The dominance of fungal species tolerant to various ecological stressors, particularly in highly anthropogenically polluted areas, indicates their potential use as bioindicators. Among the identified species, *Aspergillus niger*, *Penicillium commune*, *Cladosporium cladosporioides*, and *Fusarium solani* demonstrated broader distribution and higher adaptive capacities.

Furthermore, the findings indicate that fungal biota are not only indicators of the biological quality of the soil environment but also serve as reliable markers for assessing ecological changes in urban areas. Thus, integrating micromycete fungi into biomonitoring systems provides a significant scientific basis for monitoring ecosystem health and informing soil restoration decisions.

**Keywords:** Urban soils, micromycete fungi, ecological processes, bioindicator, urbanization, trophic specialization, soil productivity, biodiversity.

### Introduction

The rapid urbanization of recent decades has significantly altered natural ecosystems, disturbing the balance between abiotic and biotic components in urban environments due to intensified anthropogenic impacts. One of the primary areas affected by this process is the soil ecosystem. Unlike natural landscapes, urban soils undergo substantial transformation, characterized by mechanical compaction, chemical pollution, structural disruption, heat island effects, and organic matter deficiencies (Abdullayeva, 2025). In such conditions, soil biota—particularly microorganisms and fungi—undergo structural and functional changes.

Fungi are key components of soil ecosystems. They play vital roles in nutrient cycling, decomposition of organic matter, formation of symbiotic associations, and regulation of biogeochemical processes. In addition, some fungal species act as bioindicators or pathogens, providing ecologically and hygienically significant insights. Investigating the ecological functions of fungi in urban soils allows for assessing both their structural diversity and functional potential (Abdullayeva, 2025). Such research is crucial for evaluating soil health, ecosystem sustainability, and environmental conditions.

Baku, the capital of Azerbaijan, has undergone long-term urbanization, resulting in diverse functional

zones, including industrial areas, residential neighborhoods, green spaces, and transportation networks, each with different intensities of anthropogenic load. This diversity influences the species composition and ecological functions of soil microflora, especially fungal biota (Abdullayeva, 2025). Given Baku's arid to semi-arid climate and coastal geographic position, its soil ecosystems possess specific features, making it a suitable model for studying the adaptation potential and functional diversity of fungal communities (Balakhanova, 2024).

Scientific literature highlights fungi as primary agents in the decomposition of soil organic matter, where their enzymatic activity plays a critical role. They are involved in breaking down carbohydrates, proteins, lipids, and other organic compounds, thereby facilitating nutrient recycling. Understanding how the production (biosynthesis), decomposition, regulation (microbial balance), and indication (response to environmental changes) functions of fungi evolve in urban environments is essential for accurate ecological assessments (Balakhanova, 2024). Comparative analyses of fungal communities across different functional zones enable a realistic evaluation of urbanization impacts on soil ecosystems.

Accordingly, the main objective of this study is to assess the degree of participation and functional role of fungal biota in ecological processes using soil samples

from different functional zones of Baku (Balakhanova, 2024). To achieve this, the species composition of fungi was determined, their affiliation with key functional groups was analyzed, and their relationships with environmental conditions were investigated. The findings provide important contributions for diagnosing the ecological state of urban soils and advancing sustainable soil management practices (Balakhanova, 2024).

### Research

In the modern era of urbanization, the preservation of biodiversity in urban ecosystems and the study of their ecological balance have become pressing issues. In this context, microscopic fungi, as key components of the soil ecosystem, hold particular importance due to their ecological functions and diversity (Balakhanova, 2024). They actively participate in the decomposition of organic matter, improvement of soil structure, establishment of symbiotic relationships with plants, and responses to ecological stress. However, anthropogenic changes caused by urbanization and industrialization impact the species composition, trophic functions, and distribution patterns of these organisms (Balakhanova, 2024).

This research was conducted within such a context to study the fungal biota present in urban soils and to assess their role in ecological processes. Investigations carried out on soil samples collected from different zones of Baku city revealed noteworthy and, in some cases, concerning results (Balakhanova, 2022). It was observed that urban parks rich in greenery provided a more favorable environment for fungal diversity. Both saprotrophic and mycotrophic species were found to be widely distributed in these areas, indicating high biological activity of the soil. For instance, species belonging to the genera *Trichoderma* and *Mortierella* were particularly abundant in park soils, suggesting these areas are ecologically and hygienically sound.

In contrast, studies conducted in industrial zones and roadside areas demonstrated a lower diversity of fungal species. In these soils, pollution-tolerant and sometimes pathogenic species dominated (Səfərova, 2024). Notably, species such as *Aspergillus niger*, *Penicillium citrinum*, and *Cladosporium herbarum* were frequently recorded. These findings indicate that urban pollution negatively affects the soil biota, often resulting in the dominance of species adapted to such environments.

The study focused on assessing the diversity, abundance, and ecological functions of micromycete fungi in urban soils. A total of 40 soil samples were collected from eight areas of Baku with varying ecological loads including industrial zones, residential areas, parks, and roadside environments and the composition of micromycete flora was analyzed under laboratory conditions (Səfərova, 2024).

The results demonstrated that urban soils harbor a rich and diverse array of micromycete genera. From the samples collected, 34 different species were isolated. Genera such as *Penicillium*, *Aspergillus*, *Trichoderma*, *Fusarium*, *Cladosporium*, and *Alternaria* were predominant. In particular, *Penicillium spp.* and *Aspergillus spp.* were widespread and found across nearly all

locations, confirming their strong ecological adaptability and resistance to urbanization pressure.

Species richness and abundance of micromycetes varied by location. Park and green zones exhibited greater fungal richness and diversity. For instance, in park zones, the total micromycete count was  $4.1 \times 10^4$  CFU/g of soil, and the Shannon diversity index was 2.94. In contrast, these figures dropped significantly in industrial areas  $1.2 \times 10^4$  CFU/g and  $H' = 1.78$  highlighting the negative impact of soil pollution, heavy metal loading, and chemical exposure on fungal distribution in these zones.

Biotest experiments conducted within the study also produced compelling results. Application of *Trichoderma harzianum* to soil increased germination rates of bean seeds from 32% to 75%, indicating this genus possesses phyto-stimulant and antagonistic properties. Moreover, in soil samples treated with *Penicillium chrysogenum*, humus content increased by 18%, confirming the active role of this genus in organic matter decomposition.

Trophic specialization of the micromycetes was of particular interest. Analyses showed that 70.6% of the detected species were saprotrophic, contributing to the decomposition of organic matter in the soil. These fungi are essential for carbon cycling and the maintenance of the structural and functional stability of the soil. Additionally, 17.6% of species were classified as facultative pathogens exhibiting phytopathogenic traits under certain conditions, while 11.8% were sensitive to pollution and considered bioindicator species.

These findings confirm that micromycete fungi play a significant role not only in the organic matter cycle of urban ecosystems but also in enhancing soil health, fertility, and bioindication capabilities. The research results are of high importance both in practical terms and for the scientific foundations of ecological management.

Thus, this study demonstrates that micromycetes are among the key biological components in the conservation and restoration of soil ecosystems under urbanization conditions. Their monitoring could become an essential part of future urban ecological planning.

### Conclusion

The conducted research revealed that micromycete fungi possess significant ecological functions in urban soils and provided essential insights into their role under urbanization conditions. The collected data and laboratory analyses yielded the following key findings:

1. Taxonomic diversity: Research carried out in 12 sites of Baku with different levels of urbanization identified a total of 34 micromycete species. The most widespread genera included *Penicillium* (9 species), *Aspergillus* (7), *Trichoderma* (4), and *Cladosporium* (3).
2. Ecological distribution: The highest species diversity was recorded in parks and green zones—with an average of 12–14 species—while industrial zones had only 4–6 species, demonstrating the negative impact of anthropogenic pressure on micromycete diversity.

3. Trophic and functional roles: Approximately 70% of the isolates were saprotrophs, 20% facultative parasites, and 10% symbiotic mycorrhiza-like fungi. This confirms their role in decomposition, humus formation, and nutrient cycling in the soil.

4. Experimental results: Phytotests using soil enriched with *Trichoderma harzianum* showed a 45% increase in seed germination and up to 32% enhancement in root development.

5. Bioindicator potential: The dominance of tolerant species like *Aspergillus niger* and *Cladosporium herbarum* in highly polluted areas supports their use as bioindicators of heavy metal and other contaminant exposure.

6. Contribution to ecological monitoring: The findings highlight the utility of fungi in assessing the microbiological condition of urban soils, linking biodiversity to anthropogenic impact, and establishing fungi as practical indicators of ecological stability.

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# PARASITOLOGICAL SCIENCES

## APPLICATION OF REAL-TIME PCR AND KATO-KATZ METHODS IN MONITORING THE TREATMENT EFFICACY OF *TRICHURIS TRICHIURA* INFECTIONS

**Bandelizade G.,**

*Scientific Research Institute of Medical Preventive Care named after V.Y. Akhundov,  
Department of Parasitic and Tropical Diseases, Baku, Azerbaijan*

**Ismayilova K.,**

*Azerbaijan Medical University, 2nd Department of Internal Diseases, Baku, Azerbaijan*

**Bakhshiyeva S.,**

**Aliyeva G.,**

**Abbasova Y.**

*Scientific Research Institute of Medical Preventive Care named after V.Y. Akhundov,  
Department of Parasitic and Tropical Diseases, Baku, Azerbaijan*

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### Abstract

*Trichuris trichiura* is a geohelminth infection that affects approximately 460 million people worldwide, making it the second most common after *Ascaris lumbricoides*. The Kato-Katz (KK) method, endorsed by the World Health Organization (WHO), remains a widely used diagnostic technique. In a clinical trial, the KK method was compared with the real-time polymerase chain reaction (PCR) method to evaluate the efficacy of treatment with albendazole and ivermectin.

The study, conducted on 84 participants, revealed a diagnostic concordance rate of 88.7% between the two methods in detecting *Trichuris trichiura* eggs. Real-time PCR demonstrated higher sensitivity, especially in low-intensity infections, indicating that the KK method may not be optimal in such cases. PCR showed superiority in assessing treatment efficacy and could be considered among the preferred diagnostic methods in broader applications.

The study also compared the effectiveness of combination therapy with albendazole and ivermectin in children aged 2–14 years, using various treatment regimens. Examinations conducted before and after treatment using both KK and PCR methods showed a reduction in the number of infected individuals. In conclusion, the application of real-time PCR provides a more accurate diagnosis of *Trichuris trichiura* and a better evaluation of treatment efficacy. The study further emphasizes the need for developing precise parameters for the future diagnostic application of molecular techniques.

**Keywords:** *Trichuris trichiura*, Kato-Katz method, real-time polymerase chain reaction method, epidemiological study, albendazole/ivermectin combination.

### Introduction.

*Trichuris trichiura* is a geohelminth infection that affects approximately 460 million people worldwide and is the second most common helminth infection in humans after *Ascaris lumbricoides* (1). The disease is transmitted through the ingestion of contaminated food or water sources. The Kato-Katz (KK) method is still recommended by the World Health Organization (WHO) as a standard diagnostic technique; however, its sensitivity may be insufficient in cases of low-intensity infections (2).

### Objective:

The aim of the study is to compare the efficacy of combination therapy with albendazole and ivermectin using the Kato-Katz (KK) and real-time polymerase chain reaction (PCR) diagnostic methods.

### Materials and Methods:

A total of 84 participants were included in the study, and the cure rate (CR) was analyzed.

The quantity of *Trichuris trichiura* eggs detected after treatment was evaluated using both methods, and the diagnostic concordance between them was found to be 88.7%. The discrepancy observed in the study is likely attributable to infections with lower intensity. The use of the PCR method was considered appropriate as an alternative for assessing the cure rate (CR). These

diagnostic approaches highlight the necessity of determining suitable diagnostic tools for clinical trials.

*Trichuris trichiura*, caused by the whipworm geohelminth, is targeted by the World Health Organization (WHO) through periodic treatment with benzimidazole drugs in endemic regions. It has been determined that one of the main challenges in monitoring and evaluating treatment efficacy is the need for highly sensitive and effective diagnostic methods. In some epidemiological studies, multiplex real-time PCR has been used for diagnosing *Trichuris trichiura*; however, its application in clinical trials remains limited due to the small number of such studies. The findings suggest that real-time PCR could become one of the widely used diagnostic methods, but the development of standardized guidelines is essential for its broader implementation.

The Kato-Katz (KK) method is recommended by the World Health Organization (WHO) and is used for clinical diagnosis in epidemiological studies. However, the sensitivity of the KK method is not optimal, particularly in areas with low-intensity infections [1]. As the prevalence and intensity of geohelminth infections decline [12], both microscopy-based and more sensitive DNA-based diagnostic techniques have been investigated [11]. The latter have been especially proposed to complement existing programmatic standards [3, 4].

Real-time PCR molecular techniques have been tested in terms of sensitivity, specificity, and diagnostic performance [9]. Indeed, real-time PCR has demonstrated higher sensitivity compared to microscopy-based examinations [8]. Unfortunately, only a limited number of studies have been conducted in this area, and these have been evaluated primarily in the context of clinical trials assessing the efficacy of treatment regimens for geohelminth infections [2, 5].

In this review, the Kato-Katz (KK) and real-time PCR methods were compared to evaluate the efficacy of albendazole and ivermectin combination therapy in the treatment of *Trichuris trichiura*. In the context of clinical trials, the reduction in helminth egg count, helminth elimination (cure), or the decrease in the intensity of the infection were considered as key indicators.

The study included children aged 2–14 years, weighing >15 kg, diagnosed with *Trichuris trichiura*. They were divided into four treatment groups:

- Albendazole 400 mg dose;
- Albendazole + Ivermectin (600 mg/kg single dose);
- Albendazole 400 mg for 3 days;
- Albendazole + Ivermectin (600 mg/kg) for 3 days.

This study was conducted in two villages, where it was determined that the prevalence of *Trichuris trichiura* was over 50% during the survey [6]. A total of 230 samples were analyzed using both real-time PCR and Kato-Katz methods. The examinations were carried out on 230 samples collected from 115 individuals, and the results of both methods were compared and analyzed. In 94 samples, both diagnostic methods yielded positive results. According to WHO guidelines, the examinations were repeated before and after treatment, between days 14 and 21. For the Kato-Katz method, one stool sample was collected from each participant based on the sequence of examination [10], and a smear was prepared. To count *Trichuris trichiura* eggs in the smear, the sample was examined under the microscope for 20–60 minutes. Using a template, the egg count per gram was calculated, and light, moderate, and heavy infections were determined based on the results, in accordance with WHO guidelines. For the real-time PCR method, three stool samples were collected and stored in 99% ethanol at room temperature. These samples were then washed with distilled water to remove ethanol and centrifuged. DNA was extracted using the Fast DNA Spin Kit as described by Mejra et al. [7].

Pre-designed primers specific to *Trichuris trichiura* species and a FAM-labeled minor groove binder probe targeting the ITS region of the helminth were used for real-time PCR amplification. Data analysis was performed using the Stata software.

The cure rate (CR) was determined based on the proportion of individuals who showed a positive result in the initial phase, but a negative result after treatment, for both diagnostic methods. Fisher's test was used to compare the treatment rates obtained by CR between treatment and control groups for both real-time PCR and Kato-Katz methods. Diagnostic concordance was

calculated for all samples based on the number of samples showing the same positive or negative results for both methods.

### Conclusion

This study was conducted to evaluate the effectiveness of treatment in clinical trials and to assess whether the PCR and Kato-Katz (KK) methods could be used interchangeably as diagnostic tools. However, insufficient data was obtained to establish a correlation between the cycle threshold (CT) in PCR and the egg count per gram (EPG) determined by KK. As a result, it was not possible to evaluate real-time PCR as a quantitative diagnostic method.

The results indicate that although the Kato-Katz method is still used in diagnostics, its sensitivity is not optimal in low-intensity infections. The application of real-time PCR has provided a significant advantage in the diagnosis of *Trichuris trichiura*, offering higher sensitivity. Therefore, real-time PCR can currently be considered one of the widely used methods and is a more effective diagnostic tool for evaluating the treatment efficacy of *Trichuris trichiura*.

As geohelminth control programs develop, new treatment guidelines, monitoring strategies, and other relevant issues will become critical. In this regard, rather than attempting to adapt different diagnostic methods based on microscopy, it may be more appropriate to develop new parameters for molecular methods.

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# PEDAGOGY

## ДИДАКТИЧНИЙ ПІДХІД ДО ПРОВЕДЕННЯ ТЕХНОЛОГІЧНОЇ ПРАКТИКИ МАЙБУТНІХ СУДНОВИХ МЕХАНІКІВ У СУЧАСНОМУ ОСВІТНЬОМУ ПРОСТОРІ

*Герганов Л.Д.*

*Дунайський інститут*

*Національного університету «Одеська морська академія»,  
професор кафедри Інженерних дисциплін*

## DIDACTIC APPROACH TO CONDUCTING TECHNOLOGICAL PRACTICE FOR FUTURE MARINE ENGINEERS IN THE MODERN LEARNING ENVIRONMENT

*Herhanov L.*

*Danube Institute of the National «Odessa Maritime Academy»,*

*Professor of the Engineering Department*

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### Анотація

Стаття розкриває дидактичний підхід до проведення технологічної практики майбутніх фахівців у ЗВО морського профілю. Виокремлено, що вперш за все, цей процес гальмується недостатнім застосуванням нових інформаційних технологій, які є на сучасних судах; відсутністю вправ для вирішення виробничих завдань; недостатнім виокремленням основних дидактичних технологічних одиниць практики; незадовільним станом методичного забезпечення системи практичної підготовки. У ході дослідження було розроблено модель формування практичних навичок майбутніх фахівців в процесі технологічної практики, яка має властивості динамічного інтегрованого процесу та впливає на результати практики.

### Abstract

The didactic approach to conducting technological practice of future specialists in maritime higher education institutions have been identified in the article. It is emphasized that, first of all, this process is hampered by the insufficient use of new information technologies available on modern vessels; the lack of exercises for solving production tasks; the insufficient isolation of the main didactic technological units of practice; the unsatisfactory state of methodological support of the practical training system. During the study, a model of the formation of practical skills of future specialists in the process of technological practice was developed, which has the properties of a dynamic integrated process and affects the results of practice.

**Ключові слова:** морський заклад освіти, модель технологічної практики, здобувач освіти, компоненти практичної підготовки, Конвенція ПДНВ.

**Keywords:** maritime educational institution, technological practice model, degree seeker, practical training components, STCW Convention.

**Визначення проблеми.** Одними з головних напрямів оновлення і розвитку торговельного мореплавства є: збереження кадрового потенціалу українських моряків на конкурентному світовому рівні шляхом належного виконання вимог міжнародної Конвенції з підготовки, підвищення кваліфікації і дипломування моряків і несення вахти 1978 року (з доповненням), (далі – Конвенція ПДНВ). Підготовка фахівців морського профілю у закладах вищої освіти (далі – ЗВО), у відповідності із зазначеною конвенцією, потребує підвищення якості їх практичної підготовки для поповнення екіпажів морських суден кваліфікованим персоналом згідно з інноваційною моделлю розвитку морської індустрії. Для виконання окреслених вимог фахівцю на судні сучасного покоління потрібні навички, які потрібно сформувати в процесі проходження технологічної практики у ЗВО, а саме: високої самоорганізації, професійної компетентності, володіння сучасним обладнанням судна та засобами контролю, що базуються на стійких мотивах по засвоєнню практичних умінь і навичок, що необхідно для використання в

екстремальних умовах. Все це є основою зниження аварійних ризиків і безпеки судноплавства в цілому.

Визначимо, які мінімальні вимоги Конвенція ПДНВ окреслила для дипломування вахтових механіків суден з машинним відділенням, що обслуговується традиційно або періодично не обслуговується: кожний кандидат на отримання професійного диплома вахтового механіка морського судна повинен продемонструвати здатність прийняти на себе на рівні експлуатації завдання, обов'язки та відповідальність, які перелічені в колонці 1 (сфера компетенцій) таблиці А-III/1, а саме:

- належне використання ручних інструментів, верстатів та вимірювальних інструментів для виготовлення деталей та ремонту на судні;

- технічне обслуговування та ремонт суднових механізмів та обладнання [3, с. 234 ]. За такими критеріями судновласники, при комплектуванні екіпажів суден, визначають вимоги до кваліфікації та практичної підготовки фахівців.

**Аналіз останніх досліджень і публікацій.** Результати аналізу літератури та сучасних наукових досліджень вітчизняних та зарубіжних вчених засвідчує, що проблема практичної підготовки фахівців морського профілю є актуальною, особливо у теперішній час, коли Україна знаходиться у воєнному стані. З'ясовано, що означеною науковою проблемою на різних рівнях займалися А. Гуржій, С. Гончаренко, Р. Гуревич, Л. Герганов, О. Дендеренко, І. Зязюн, П. Лузан, Н. Ничкало, В. Радкевич, В. Нагаєв та ін.

Результати теоретичного аналізу наукових досліджень із зарубіжного досвіду з означеної проблематики (З. Вятровський, Т. Новацький, Я. Карней, Д. Клюс-Станська та ін.), засвідчує значну увагу до вивчення аспектів практичної підготовки фахівців, що дає змогу констатувати про одночасне освоєння програми технологічної практики як окремої частини навчального плану за спеціальними компетентностями.

**Відокремлення невирішених аспектів проблеми.** Результати аналізу специфіки проведення технологічної практики майбутніх суднових механіків, додатково формуються від вимог до конкретного робочого місця, визначаються ключові професійні фактори, що необхідні для обслуговування сучасних автоматизованих суден. Слід виокремити, що визнані зарубіжні кріюінгові компанії (центри відбору та комплектування екіпажів морських суден) та судноплавні компанії у великих багатонаціональних корпораціях мають свої навчальні підрозділи професійної підготовки, підвищення кваліфікації та сертифікації персоналу [1, с. 98-121. 2, с. 117-123]. Такі навчальні підрозділи здійснюють освітню діяльність не тільки для потреб своєї компанії, а також для інших, незалежно від місця роботи або проживання. За таким принципом роботи цих структурних підрозділів, його відповідності змісту і якості надання освітніх послуг для роботи на морських суднах обладнаних сучасними автоматизованими системами керування, є можливість забезпечити судна персоналом, який відповідає вимогам ринку праці.

Згідно з прийнятою «Стратегією розвитку вищої освіти в Україні на 2022-2032 роки (Схвалена Кабінетом Міністрів України 23.02.2022 року) «основними слабкими сторонами закладів вищої освіти, що впливають на якість вищої освіти на рівні закладу та її сприйняття, є недостатнє урахування інтересів та думок заінтересованих сторін під час визначення змісту та напрямів підготовки, слабкий зворотній зв'язок з результатами опитування учасників освітнього процесу та внутрішнього оцінювання навчальних планів та освітніх програм, неефективні інструменти оцінювання та стимулювання якісної викладацької діяльності, недостатнє використання зовнішніх об'єктивних та прозорих інструментів та залучення зовнішніх заінтересованих сторін для оцінювання якості результатів навчання, низька ефективність та ін. » [5].

Однак, досягнення окреслених вимог до професійної практичної підготовки майбутніх фахівців у закладах вищої освіти (ЗВО) морського профілю

гальмується не тільки відсутністю сучасного обладнання навчально – виробничої бази, але й недостатнім застосуванням нових інформаційних технологій, які є на сучасних суднах; відсутністю вправ, для вирішення виробничих завдань; недостатнім виокремленням основних дидактичних технологічних одиниць практики; незадовільним станом методичного забезпечення системи практичної підготовки. Крім того, недостатня позитивна внутрішня мотивація до вироблення індивідуального стилю професійної діяльності на початковій стадії роботи на судні у машинному відділенні негативно позначається на здатності майбутніх суднових механіків виконувати професійні дії на суднах сучасного покоління.

**Мета нашого дослідження** полягає в науковому обґрунтуванні дидактичного підходу до проведення технологічної практики майбутніх суднових механіків у ЗВО морського профілю.

З погляду на діючий документ «Положення про організацію практики у Дунайському інституті Національного університету «Одеська морська академія» визначено, що «безпосереднє керівництво практикою здійснюють керівники практики відповідальних кафедр, які призначаються завідувачами відповідальних кафедр з початку кожного навчального нового року і затверджуються наказом директора ДІНУОМА» [4]. Керівники практики, як правило, це досвідчені фахівці, викладачі кафедр, але вони не володіють на достатньому рівні педагогічними технологіями для якісного проведення технологічної та плавальної практик. Для подолання цього недоліку більш ретельно розглянуто сутність самого процесу організації проведення професійної практичної підготовки (технологічної та плавальної практик) та визначено дидактичні умови організації такої підготовки із застосуванням в освітньому процесі не тільки реального суднового обладнання, але й спеціального тренажерного устаткування та тренажерних комплексів.

За результатами проведених досліджень у Дунайському інституті національного університету «Одеська морська академія» (далі – ДІНУ «ОМА»), маємо такі показники: недостатньо розвинений цілий ряд інтелектуальних вмінь, а саме: близько 52,7% викладачів відмічають слабку методичну забезпеченість технологічної практики; 49,2% – курсантів не мають бажання до освоєння програми практики та необхідної їй зв'язки з майбутньою роботою на судні; 46% – оцінили рівень викладання спеціальних дисциплін у закладі освіти як середній.

Значна частина курсантів (близько 54%) відмічають, що матеріал практичних занять занадто складний та не використовують раціональні прийоми виконання робіт. Близько 62% курсантів визнають, що їм важко виконувати завдання без технологічних карт; 44% — мають труднощі під час роботи з інформацією; ефективність виконання навчального завдання складає близько 22,5%.

Таким чином, вивчення стану проведення технологічної практики суднових механіків, дало змогу стверджувати наступне: відсутній дидактич-

ний підхід професійно спрямованого процесу технологічної практики фахівців; значна кількість викладачів технологічної практики недостатньо підготовлена до продуктивного її здійснення, що виявляється у відсутності необхідного навчального обладнання, інструментів, довідкової літератури; недостатнє методичне забезпечення практики; спостерігається також відсутність інформаційних систем, що в майбутньому негативно позначиться при роботі на сучасних автоматизованих суднах. Викладене дало можливість зробити висновок, про необхідність оновлення дидактичної систему формування практичних вмінь та навичок шляхом створення інноваційно освітнього середовища з метою оволодіння професійним знанням, розумінням, вмінням та формуванням навичок, обміну досвідом; спрямування набутого досвіду технологічної практики, на посилення активності, адаптивності до організаційних змін, обізнаності з специфікою та особливостями праці у машинному відділенні сучасних суден.

На підставі проведених досліджень була запропонована **дидактична модель**, що пояснює процес формування практичних вмінь та навичок майбутніх суднових механіків. Дана модель має властивості дидактичного інтегрованого процесу, що включає наступні складові:

- компоненти практичної підготовки суднових механіків;
- інтегративні дидактичні складові формування практичних вмінь та навичок на технологічній практиці.

*Компоненти практичної підготовки:*

- мотиваційний: експлуатація, спостереження, оцінка роботи та підтримка безпеки обслуговування;
- когнітивно-процесуальний: управління паливними, змащувальними та баластними операціями;
- діяльнісний: виконання професійних дій для забезпечення безпечної роботи сучасного судна;
- корекційний: попередження невірних прогнозів, усунення небезпечної ситуації та вирішення її наслідків.

*Інтегративна дидактична складова* формування професійної практичної підготовки суднових механіків при технологічній практиці включає:

1. Розроблено спеціальний методичний посібник «Морська інженерна практика», в якому майбутні фахівці одержують первинні знання по специфіці роботи флоту, пристрою й основним параметрам судна, основним параметрам судна, основним типам двигунів і рушіїв, специфіці роботи суднових силових установок, допоміжних механізмах, рятувальних засобах, суднових системах і морський термінології.

2. Інтегрований зміст проходження технологічної практики та набуття практичних навичок (ПРН) з: використання ручних інструментів, верстатів та вимірювальних пристроїв; використання належних спеціалізованих інструментів та вимірювальних пристроїв; читання схем трубопроводів, гі-

дравлічних і пневматичних систем, а також креслення і довідників, що стосуються механізмів; знання особливостей конструкції та матеріалів, що використовуються під час виготовлення суднового обладнання.

3. Психолого-педагогічний супровід формування практичної підготовки майбутніх суднових механіків уможливорює розвиток практикоорієнтованих знань, умінь і професійних важливих навичок із дотриманням діагностичності у визначенні цілей, оптимальності вибору методів, засобів, прийомів, форм реалізації конкретизованого змісту технологічної практики.

**Висновок та пропозиції.** Практичне впровадження розробленої дидактичної моделі проходження курсантами технологічної практики показало, що ефективність формування професійної практичної підготовки залежить від:

- рівня мотивації курсантів до отримання професійних знань, умінь та навичок для подальшої роботи на суднах (hard skills);
- отриманих ними вмінь створювати алгоритм виконання дій в небезпечних та аварійних ситуаціях (hard skills);
- отриманих ними навичок міжособистісних стосунків, а також вміння працювати в багатонаціональному екіпажі (soft skills);
- здатності працювати незалежно, мати своє мислення та підхід до виконання поставленого завдання (soft skills);
- готовності до швидкої адаптації до змін, які виникають у процесі роботи судна в рейсі (soft skills);
- здатності швидко навчатися та працювати в команді (soft skills).

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# PHILOLOGY

## СТЕРЕОТИП ПЕН КОНЦЕПТ БАЙЛАНЫСЫНЫҢ ТІЛДІК КӨРІНІСІ

**Шақаман Ы.Б.**

*Филология ғылымының кандидаты, профессор  
Ә.Марғұлан атындағы Павлодар педагогикалық университеті  
Павлодар қаласы, Қазақстан*

## LINGUISTIC EXPRESSION OF THE RELATIONSHIP BETWEEN STEREOTYPE AND CONCEPT

**Shakaman Y.**

*Candidate of Philological Sciences, Professor  
Pavlodar Pedagogical University named after A. Margulan  
Pavlodar c., Kazakhstan*

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### Аңдатпа

Мақалада қазақ тіліндегі тілдік таным мәселесі сөз болады. Мақаланың жазылу мақсаты – стереотип пен концепт байланысынан ұлттық тілдік бейне көрінісін түсіндіру. Мақаланың міндеті – ұлттық тілдік танымның, сөздің туындауында стереотип әсері болатынын; стереотип пен концепт байланысы лақунаны тудыратынын талдап жеткізу. Адамзат тілінің қалыптасуы оның әлемді қабылдауына, адам дүниетанымының кеңдігіне байланысты болатыны айтылады. Әлемнің тілдік бейнесінің танылуы әуелі ұлттық тілде әлемді қалай қабылдайтынына қарай іске асады. Адамзат әлемді, табиғат жасаған көріністі өзі көріп, түсініп тұрған қырынан ғана танып, қабылдайды. Адамзат әлемді физикадағы сәуленің шағылысуы арқылы қабылдайды. Жалпы әлемнің төңкерілген бейнесін адамзат сезбейтіні туралы сөз қозғалады., бірақ адамзат фотоаппараттағы аударылған сурет сияқты әлемнің төңкеріліп тұрғанын көрмейді, өйткені сағалық (вестибулярлық) аппарат адамға түзу тұрғаны туралы түсінік береді. Сағалық аппарат – құлақтағы сезімтал талшық; ол адамның кеңістіктегі күйін, түрлі жағдайда тепе-теңдік сақтауын қадағалайды. Вестибулярлық аппарат бұзылған жағдайда әлем шым-шытырық, төңкерілмелі болады, ол дұрыс жұмыс істеп тұрса, адамның төңкеріліп тұрған әлемді «түзу» көріп қабылдауға көмектеседі, яғни әлемнің «кері суреті» адам санасына өзінше «түзу» қабылданатыны туралы сызбамен талданады. Зерттеулік мақалада адамзаттың әлемді қабылдау сипаты, жеке адам үшін дүние, әлем әуелі ұлттық бейнеде көрінетіні, санада әлем бейнесі шоғырланып, мазмұндалып, семантикаланып, сосын ұлттық стереотип танылатыны баяндалады. Сонымен қатар ұлттық тілдің, сөздердің туындауында стереотип әсері мысалмен дәйектеледі. Стереотиптің анықтамасы беріліп, оның «автостереотип, гендерлік стереотип, квази стереотип» түрі болатыны түсіндіріледі. Стереотип дүниетанымдық қатынас түрі екені сипатталып, қазақ ұлтының стереотиптік қатынастан «туыстық қатынас, қонақжайлылық қатынас» мәселесі сөз болып, қазақ тіліндегі осы стереотиптік қатынасқа байланысты сөздер мол кездесетіні туралы талдау жасалады. Мысалы: «туыстық қатынас» стереотипіне байланысты туыстықты қарым-қатынасты сақтау, қонақжайлы болу, кішіпейіл болу, мейірімді болу, адамзатқа жақсылық жасау, үлкенге қарсы келмеу, салмақты болу, сабырлылық сақтау, әдептілік, кеңпейілділік, салт-дәстүрді дәріптеу, тектікті ұстану, т.б. ұғымдарына қатысты сөз қоры басым келетіні мәлімделеді. Бұдан бөлек «Есепшілдік» қатынасының қазақ тілінде жағымсыз мағынада қабылданатыны, сондықтан соған қатысты жағымсыз ұғымдағы сөздер де көп екені келтіріледі. Ал жағымды мағынадағы сөзі аз екені айтылады. Стереотип пен концептінің тығыз байланысы, екеуінің өзара айырмашылығы мен ұқсастығы салыстырылып түсіндіріледі. Мақала нәтижесінде Стереотип арқылы әлем мазмұны концептіленіп, сөз туындайтыны қорытылады. Сондай-ақ Стереотип концепт және лакуна арқылы көрініс табатыны тұжырымдалады.

Мақалада сипаттау, түсіндіру, талдау, салыстыру, жинақтау әдістері қолданылды.

### Abstract

The article will focus on the problem of linguistic cognition in the Kazakh language. The purpose of writing the article is to explain the manifestation of a language image from the connection of a stereotype and a concept. The task is to analyze whether there is a stereotype effect in the origin of national linguistic cognition, the word; whether the connection of stereotype and concept gives rise to lacuna. It is noted that the formation of the human language depends on its perception of the world, on the breadth of the human worldview. The recognition of the linguistic picture of the world is primarily based on how the national language perceives the world. Humanity recognizes and perceives the world, the vision created by nature, only from the side that it sees and understands. Humanity perceives the world through the reflection of light. We are talking about the fact that in general the inverted picture of the world is not felt by humanity., but humanity does not see the world upside down, like an inverted image on a camera, because the estuary (vestibular) apparatus gives a person the idea that he is standing straight. The auditory apparatus is a sensitive fiber in the ear; it monitors the position of a person in space, balance in various situations. In the event of a violation of the vestibular apparatus, the world becomes distorted, inverted,

if it works correctly, it helps a person to see the upside-down world "straight", that is, the "reverse picture" of the world is analyzed by a diagram that is perceived by the human mind as "straight" in its own way. The research article describes the nature of human perception of the world, the world for the individual, the world is first reflected in the national image, the image of the world is concentrated in the mind, expressed, semanticized, and then the national stereotype is recognized. At the same time, the influence of stereotypes on the origin of the national language and words is demonstrated by the example. The definition of a stereotype is given and it is explained that it will be a type of "autostereotype, gender stereotype, quasi-stereotype". It is described that the stereotype is a type of worldview relationship, the problem of "kinship, hospitality relations" of the Kazakh nation from the stereotypical relationship, and the analysis of the abundance of words related to this stereotypical relationship in the Kazakh language is carried out. For example: due to the stereotype of "kinship", it is stated that the word stock prevails in relation to the concepts of maintaining kinship, being humble, being kind, doing good to humanity, not going against the great, being serious, being broad, glorifying traditions, adhering to nobility, etc. In addition, it is noted that the attitude of "accountability" is perceived in the Kazakh language in a negative sense, and therefore there are many words in a negative sense in relation to it. And it is said that the word in a positive sense is less. The relationship between the stereotype and the concept, the difference, the similarity is compared. As a result of the article, the content of the world with a stereotype is conceptualized and the word is summarized. It is concluded that the stereotype is expressed through the concept and Lacuna.

The article used methods of description, interpretation, analysis, comparison, compilation.

**Түйін сөздер:** дүниетаным, әлемнің тілдік бейнесі, стереотип, концепт, лакуна.

**Keywords:** worldview, linguistic picture of the world, stereotype, concept, lacuna.

### Кіріспе

Дүние, әлем бейнесі адамзатқа ортақ, ол – «жалғыз», әр тілде, ұлтта түрліше қабылданып, тілдік бейне түрлі көрінсе де, жеткізілетін ой мазмұны – біреу. Әлемнің тілдік бейнесі ғылыми зерттеумен шешілмейді, ол әлемнің зат-құбылыспен, олардың деректі-дересіздігімен, адамзаттыққа қатыстылығымен, адамдар әрекетімен санада бейнеленіп, тілге әсер етіп, кеңістіктің тік, көлденең, шеңбер, дөңгелек, төртбұрыш, т.б. түрімен, уақыттың тоқтаусыз жүруімен, үздіксіз қозғалыста болуымен, т.б. қырынан алына отырып, барлық ғылымның тоғысуымен зерттеуге түскенде ғана, сөздік бейнеге айналғаннан кейін ғана «әлемнің тілдік бейнесі» деген атауға көшеді. Әлемдік бейне дегенде де оның тұрақты бейнелік, көріністі, суреті жоқ, ол – шым-шытырық; «суреті» дерексіз-деректі, «хаостық» кеңістік бейнеде тұрады. Мысалы: адамның «аспан» деп танып жүрген дүниесі – мүлде аспан емес, Жерді бір өзекте ұстап тұрған бос кеңістік; ал Адам Жерде өмір сүретіндіктен, түсініксіз кеңістіктің тек Жерден қарағандағы бөлігін ғана көріп, оны өзінше қабылдап, «аспан» деген атау берді. Бұл – жай ғана метафоралық атау. «Аспан» сөзі бірден атау түрінде жасала салмағаны түсінікті, оны кеңістік түрінде адам алғаш рет күнделікті өмірде табиғи жаратылыс деп қабылдайды, оған «аспан» атауының берілуі белгісіз, бізге дайын атау болып жетті. Шым-шытырық («хаос») дүниеден әлемнің шым-шытырық тілдік бейнесі шығады. Әр ұлттың бейнесі белгілі бір кезең аралығында жүйеленіп отырады. Философияда, тілде ойлау мен пайымдау жүріп, тіл арқылы әлемдік бейне сөзге айналады, сөйтіп тілде *мәдениет, концепт, стереотип, тілдік*

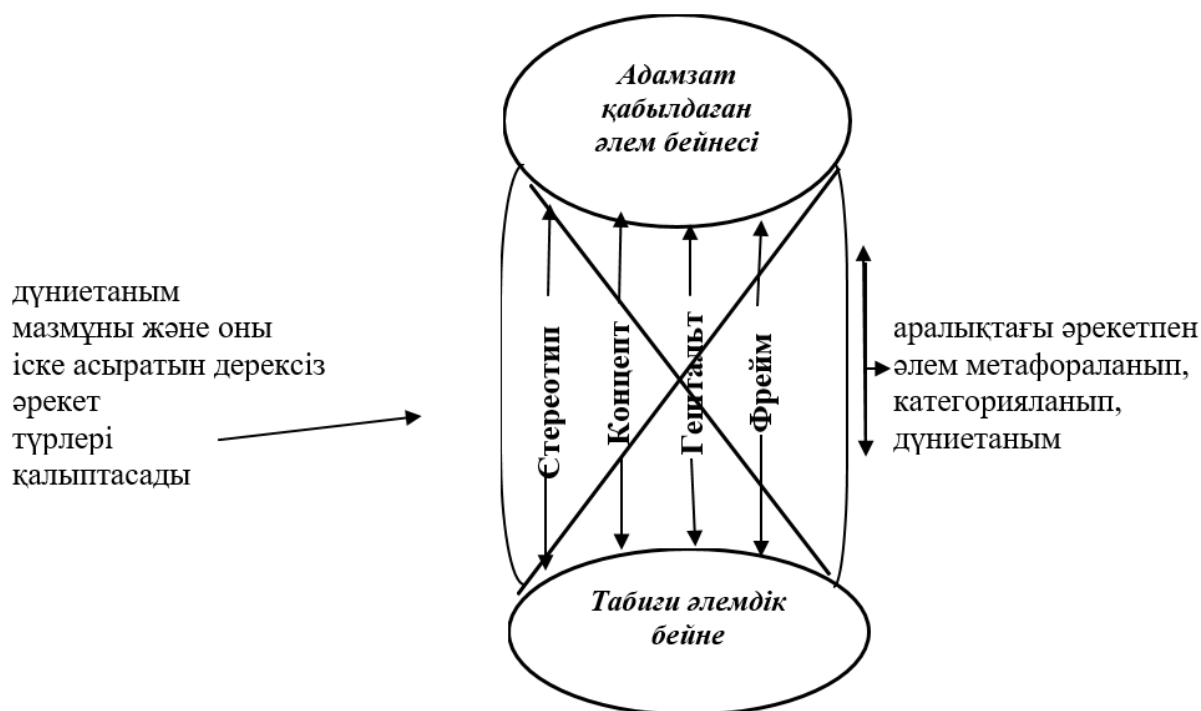
*гештальт*, т.б. ұғымдары қалыптасты. Бұлар философиялық, психологиялық, нейробиологиялық, тіл білімдік зерттеуде әлем бейнесін сипаттауға, мәнін ашып, тілдік бейнеге түсу белгілерін білуге, тілдік бейнені жасауға әсер ететін басқа да ұғымдарды түсінуге мүмкіндік береді.

«Концепт, стереотип, (тілдік) гештальт, фрейм» – әлемдік бейнені, дүниені танып білу әрекетімен танымдық психологияда туындаған ғылыми аталымдар. Бұлар – әлемдік бейнені жинақтық, қалыптық, тұтастық, құрылымдық, тіректік, т.б. қырынан қабылдаудың ғылыми теориялық түсініктемесі. Тіл білімдік зерттеуде бұлар әлемнің тілдік көрінісін (сөзге айналуын) түсіндіруде ғылыми әдіс ретінде қолданылады.

### Талқылау және нәтиже

Адамзат әлемді, табиғат жасаған көріністі өзі көріп, түсініп тұрған қырынан ғана танып, қабылдайды. Адамның әлемді қабылдауы физика ғылымында түсіндірілетін сәуленің шағылысуы арқылы қабылданатын сурет тәріздес. Әлем төңкерілген бейнеде тұр, бірақ біз фотоаппараттағы аударылған сурет сияқты әлемнің аударылып тұрғанын көрмейміз, өйткені сағалық (вестибулярлық) аппарат адамға түзу тұрғаны туралы сезім береді. Сағалық аппарат – құлақтағы «кіреберіс» сезімтал талшық; ол адамның кеңістіктегі күйін, түрлі жағдайда тепе-теңдік сақтауын сездіреді. Ол бұзылған жағдайда әлемнің шым-шытырық, төңкерілмелі екенін аңғарамыз. Сағалық аппарат адамның төңкеріліп тұрған әлемді қабылдауын түзу көруге көмектеседі, яғни әлемнің «кері суреті» адам санасына өзінше «түзу» қабылданады.

## Адамның әлемді қабылдауы



«Хаос» әлем бейнесін әр адам, әр ұлт өзінің мәдениетімен, дәстүрімен, салтымен, ұлттық санасымен танып шығарып, өзінше көре біліп, тілмен жеткізеді. Қандай ғылыммен зерттелсе де, әлемдік бейне тек тілмен, сөзбен шешімін тауып, белгіленеді.

Әлемнің тілдің бейнесі адамзат үшін ортақ әлемнен жасалады, ол ұлттық танымнан, мәдениеттен, тілден білінеді, тіл де – мәдени ұғым, мәдениеттің бір бөлігі. Ғалым Л.В.Щерба әлемнің тілдің бейнесі түрлі халық, ұлттың әлемді бірдей қабылдауымен белгіленетінін түсіндіреді: «мир, который нам дан в нашем непосредственном опыте, оставаясь везде одним и тем же, постигается различным образом в различных языках, даже в тех, на которых говорят народы, представляющие собой известное единство с точки зрения культуры...» [5, 10-6.]

Сонда да әрбір тіл иесі әлемді тануда өзінің тіліне ғана тән, өзі ғана қабылдаған әлем бейнесін сөзбен «жасайды», өзінің тілі бойынша әлемнің тілдік сипатын ашатын ұғымды, мағынаны, сөз қорын шығарады. Адамның дүниетанымды кең болса, сөздік қор да молады, ұлттық тілдік таным терең болады. В.Гумбольдтың: «менің ұлтымның тіл шектеулігі менің дүниетанымның шектеулігін көрсетеді» ...» [1] – деген сөзінің тереңдігін осыдан түсінеміз.

Ұлттық тілдік таным этникалық мәдениеттен ғана басталмайды; ол өзінің өмір сүру кезеңінен бастап жаһандық деңгейге дейінгі кезеңді қамти береді, бірақ тұтас дүниелік әлемді толық ашып бере алмайды. Ұлттық тілдік таным тек ұлттық деңгейдегі әлемнің ұлттық категориялық, ұлттық концептісін түсіндіреді. Адамзаттың әр өмір сүру кезеңіндегі әлемнің тілмен бейнеленуі, сөзге айналуы шартты. Бір ғана тілдегі Әлем бейнесінің

танылуы тіл иесінің білім қорына қатысты болып келеді.

Тіл – адам санасына әсер ететін, ұлттық ерекшелікті, жаратылысты жеткізетін мәдени әрекет құралы. Ұлттық таныммен туындаған сөздердің ұғымында ұлт мәдениеті мен жаратылысы (менталитет, стереотип) да сөздің ішкі ұғымында сезіліп тұрады. Дүние (әлем) – адам мен оның өмір сүру ортасының өзара байланыстағы көрінісі, әлем бейнесі – адам мен оның ортасы туралы ақпараттың санада жинақталған, шоғырланған нәтижесі. Танымдық (когнитивті) лингвистика ғалымдары әр тілге қатысты әлемнің тілдік бейнесіндегі концептілік жүйе қозалысқа, әрекетке және мәдени тіршілікке байланысты болып табылады деп түсіндіреді. Әлемнің тілдік бейнесі, алдымен, жеке ұлт тілі арқылы жасалады. Тілдің, сөздің ұлттық негізін ашу үшін этникалық, ұлттық мәдениет ұғымын түсіну қажет. Этникалық мәдениет – ұлттық мәдениеттің бастапқысы. Этникалық мәдениеттен этникалық таңбаларды түсіндіретін сөздер (ұлттық киім атаулары), этникалық жанрға қатысты атаулық сөздер, ұлттық мінез, т.б. танылып, сөздер қалыптасады. Екінші қырынан алғанда, этникалық мәдениет дегеніміздің өзі – таза ұлттық мәдениет. Ендеше ұлттық мәдениетті айқындайтын сөздерді, атауларды белгілеу, талдап көрсету, жасалу жолдарын беру, тегін таныту – ұлттық тілдік танымды ашу деген сөз.

Этникалық мәдениет пен ұлттық мәдениет өзара тепе-тең болса да, өзіндік айырмашылығы бар. Ұлттық мәдениет этникалық мәдениеттен қалыптасады, этникалық алғашқы жазу мен білім, өнер мен әдебиет, философиялық даму, қоғамның саяси-әлеуметтік, ғылыми-техникалық дамуы, т.б. арқылы ұлттық құндылықтар қалыптасып, соған

сай сөз қоры жиналады. Этникалық мәдениетке тұрақтылық тән; ұлттық мәдениет қоғамның дамуына, мәдени қозғалысқа тәуелді болып, ұлтаралық байланыс, мәдени даму, өркениеттілік сипат көрініс береді. Бірақ этникалық мәдениет негізіндегі сөздерді ажырату не табу біртіндеп қиындап отырады. Себебі ұлттық мәдениеттің дамуы өзара ұлт пен ұлтты, халықты, мемлекетті еріксіз қарым-қатынасқа түсіреді, адамзаттық мәдени сипат пайда болады, өмір сүру шарттарының ортақтық қалпы қажет етіледі, сөйтіп тілдік мәдениет те өзгереді: ұлттық сөздер әр ұлттық концептімен араласып, ортаққа болып, кірме ұғыммен жаңарып, ұғымдық жағынан да, тұлғалық жағынан да өзгеріске түсе бастайды.

Ұлттық мәдениеттен тілдік мәдениет байқалып, ұлт адамының тілін қарастыру қажет болады. Ұлттық мәдениетті тануда, ұлттық тілдік мәдениет арқылы әлемнің тілдік бейнесін ашуда «стереотип» түсінігі әдіснамалық негіз ретінде алынады. **Стереотип** – *ұлттың, адамның өмір сүру құбылысының, әлемдік бейнені алғаш қабылдаудағы үлгілік, қалыптық санасы, қалыпқа түскен ой-түсінігі, көзқарасы*. Ол тұрақты, эмоциялы бейнелі түрде көрінеді. Қоғамдағы әлеуметтік шарттардың, өмірлік тәжірибенің әсерінен болатын адамның қандай да бір құбылысқа әдеттік қатысы, көзқарасы стереотип болып табылады. Әр ұлттың өмір сүрген ортасында өмірді, әлемді алғаш танып қабылдауына қарай қалыпқа түскен тіршілігі, салт-дәстүрі, мәдениеті, әдебі, тілі болады. Зерттеуші С.Г.Тер-Минасова тіл мен мәдениаралық байланыс туралы мәселені көрсетуде стереотиптің жеке ұлттың мәдениетіне де әсері болатынын түсіндіреді: «Стереотипы позволяют человеку составить представление о мире в целом, выйти за рамки своего узкого социального, географического и политического мира»[4].

Стереотип түсінігін алғаш рет 1922 жылы У.Липпман деген ғалым қолданған. Ол стереотипті әлемнің күрделі нысандарын қабылдауда адамның күшін үнемдететін адам миындағы реттелген, мәдениет арқылы жобалы жинақталып, әбден қалыптасқан әлем бейнесі деп есептеген [4]. Ғалымның пікірінен стереотип туралы *тарихи қоғамда қабылданған, өмірде басым орын алатын, әлеуметтік тіршілікте негізделген, айналадағы әлемді, өмірді танып білу кезінде жинақталған ақпаратты қабылдау, сұрыптау, талдау үлгісі* деген тілдік психологиялық анықтама туындайды. Стереотиптен, оның жүйесінен әлеуметтік өмірді, шындықты көруге болады. Стереотип адамның өзін, оның тұлғалық ерекшелігін қалыпқа түсіреді.

Жалпы **Стереотип** грекше – *қатты және кеңістікті қалып*. Бастапқыда бұл сөз типографиялық баспада қолданылатын қалып деген ұғымда білдірген, яғни баспа ісінде қолданылған метафоралы атау. Қазір бұл сөз психологиялық термин ретінде айтылады; әлеуметтануда, психологияда «болып жатқан жағдайға адамның жан-дүниесі мен ойлауы сай келіп, соның негізінде салыстырумен тұрақталып қалыптасқан қатынас»

дегенді түсіндіреді. Қазіргі стереотип ұғымының екіншілік мағынасы – адам танымының түсініктік жүйесі. Стереотип жүйесі ұлттық та, жеке адамдық та дүниетанымды жеткізеді. Стереотиптің қазақша түсінігі – дүниетанымдық қалып.

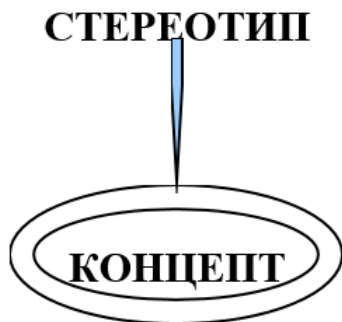
Адамның өмірді тануы, қоршаған ортасындағы зат-құбылысты категориялап, концептілеуінен оның өмірді қабылдауы, стереотипі аңғарылады. *Стереотип адам санасында әлем бейнесінің нақтыланып, деректеліп жинақталуын, негізделуін қалыптап береді*. Содан кейін концепт (ұғым) – мазмұн – мағына – сөз туындайды. Жалпы стереотип – пайымдау нәтижесі. Әр ұлт өз пайымдауымен, ойлауымен өз стереотипін қалыптастырады, сол негізде ұлттық тілдік мәдениет танылады.

Қазақ халқында ұлттықты айқындайтын, жаратылыспен қалыптасқан стереотиптік қолданыстар бар: *туыстық қатынасты сақтау, қонақжайлылық, кішіпейілділікті сақтау, үлкенге қарсы келмеу, салмақты болу, сабырлылық сақтау, әдептілік, кеңпейілділік, салт-дәстүрді дәріптеу, тектікті ұстану, т.б.* Қазақ ұлттық мәдениетінде «қонақжайлылық қатынас», «туыстық қатынас» стереотипі басты орында тұратындықтан, одан туындаған сөздер басым. Қазақтың сөйлеу мәдениетінде *қонақ күту, туыстыққа* қатысты сөздер жиі қолданылады, сол негізде сөздер туындап отырады, мақал-мәтел де көп кездеседі. Мысалы: 1) *нағашы, жиен, немере, жиен, аға, іні, қарындас, шөбере, жиеншар, құда, құдағи, жезде, балдыз, бажә, келін, жеңге, т.б.* 2) *қонақасы, құдайы қонақ, арнайы қонақ, қонақ кәде, сыбаға беру, табақ тарту, т.б.* 3) *Абысын тату болса, ас көп; Қырықтың бірі – қыдыр, Барымен базар, Қонақ ақысы – тәңір хақысы, т.б.*

Стереотиптің ер адамға, әйел адамға қатысты жағы да бар, психологияда гендерлік стереотип деп аталады. Стереотип адам өмірінде маңызды орын алады. Ол қоғамда адамның, оның жеке өмірі жағдайының қорғаныс құралы іспеттес, өйткені адам өз стереотипімен өз әлемдік бейнесін түсіндіреді, сол жеке әлемде өзі ғана бейімделген, өзін еркін сезінетін, өзіне ғана тән әдеті, қабілеті, үміт-ықыласы, көзқарасы, талғамы, қанағаты қалыптасады.. Оған өзгеріс енгізу мүмкін емес, өзгеріс енгізуге тырысқанда, қалыптасқан әлемге шабуыл жасағанмен бірдей болады. Осылайша стереотип жеке адамның, қала берді, ұлттың жеке әлемін қадірлеуге, өзін өзі сыйлатуға, құқығы мен қоғамдық жағдайын қорғап, реттеудің дерексіз кепілі болады.

Стереотип түріне қарай тілде сөз қоры жасалады. Тіл ғылымында стереотип Әлемдік дүниедегі деректі-дерексіз зат-құбылыстың адам санасында бір мазмұнға шоғырланып, жүйеленген, тұрақталған қатынас сипаты деп қаралады, осы жағынан ол концептімен мазмұндас, ұқсас. Айырмашылығы: *Стереотип – дүниетанымдық қатынас түрі; Концепт – адамның дүниені тану кезінде ойлау арқылы өмірлік мазмұнның, әлемнің (зат, құбылыс, әрекет, т.б.) санада шоғырланып, жинақталған Ұғым, Таным көрінісі*. Тілде таным,

ұғым сөзбен көрініс берсе, стереотип сол Концепт (Сөз) арқылы жеткізілетін қатынасты білдіреді. Стереотипті тарамдатып ашатын бірлік – Концепт:



Стереотип арқылы ұлттың, жеке адамның стереотиптік ерекшелігінен сөз таным жасалады. Мұны «автостереотип» деп атайды. «Автостереотип» адамның өзі туралы не ойлайтындығынан туады. Сонымен бірге басқа халыққа сын көзқарасты айқындайтын «гетеростереотип» деген бар. Атап айтсақ, батыс елдеріне тән «Есепшілдік» концептісі қазақ ұлтында жағымсыздық ұғымда қабылданады, адамның ұнамсыз бейнесін жеткізеді, соған байланысты «есепшіл, ашкөз, сараң, тойымсыз, қомағай, дүниеқұмар, пайдакүнем» деген жағымсыз мәнді сын есім сөздер қолданылады. Ал батыс елдердегідей «Есепшілдік» концептісінің «үнемділік» деген жағымды мағынасын білдіретін сөздер қазақ тілінде аз: *үнемшіл, үнемдеу, пайда*.

Ұлт, ел арасында әлемдік дүниені қабылдауда тепе-теңдік болмаса, бір ұлттың екінші ұлтқа деген сыни көзқарасы туады, оған да стереотип әсер етеді. «Есепшіл», «Есеп» («Расчетливость», «Расчет») концептісі ғылыми-техникалық, өндірістік, шаруашылық экономикалық жақтан дамыған елде жағымды мағынамен танылады. Содан батыс ел адамдары *іскерлік, алдын ала болжау...* дағдыларына ие. Ал осы концептінің стереотиптік жағымсыз тұсын қабылдаған елдің *мейірімді, қонақжай* қасиеті басым болып, соған сай сөздер молынан табылады: *ақкөңіл, қолы ашық, ашық жарқын, кең пейілді, ақ жүрек, т.б*

«Амандық сұрау» қатынасынан (стереотипінен) түрлі тілдегі ұлттық бейнені, мәдениетті тануға болады. Қазақ халқында сәлемдесу аман-саулықты сұраудан, жөн білісуден басталатын «амансыз ба, сәлеметсіз бе?» сөзі сұраулықты білдірсе, орыс халқында «Здравствуйте, здравствуй» сөзі қазақ тілінің қоштасарда айтатын «Сау болыңыз, сау бол, аман бол» ұғымымен сәйкесіп, лептік мағынада жұмсалады. Қазақ ер адамдарының «Ассалаумағалейкүм» деп өзара амандасуы бар болғанмен, қазіргі қазақ ер баласында, егер ол ауылда өсіп, тәрбиеленбесе, бұлай амандасу қалалық стереотиппен «сәлеметсіз бе?» сөзімен алмасты. Бұл екі тілді бірдей ұстанудағы стереотиптік-концептілік араласымнан туындаған. «Сәлеметсіз бе?» амандық сұрау түрі – Кеңес заманынан, орыс тілінің қатар қолдануынан, пайда болған жасанды сөз. Қазақ елінде аралас *концепт*,

ресми *стереотип* әсерінен, бұл сөздің сіңіп кеткені соншалық, жасандылығы мүлде байқалмайды.

Н.В.Уфимцева стереотипті этникалық және мәдени түрге бөледі. Зерттеушінің түсіндіруінде этникалық стереотип қарапайым, аңқау этностың ойлау жүйесі мен жаратылысын, ұжымдық танымнан тереңге ой жүгіртпеуін түсіндірсе, мәдени стереотип жеке тұлғалық жаратылысты айқындап, тәрбиеге көнетіндігімен, өзгере алатындығымен сипатталады. Тағы стереотипке тән белгі – тек ұлттық болып келетіндігі. Тіпті оның бір ұлттан екінші ұлтқа сәйкестігі, ұқсастығы болып жатса да, әйтеуір бір ерекшелігі айқындалып тұрады. Н.В.Уфимцева стереотиптің басқа ұлт мәдениетінде ұқсастық көрінісін *квазистереотип* деп атайды [2].

Стереотип мәні концепт, лакуна, менталитеттен мүлде бөлек, әлемнің ұлттық мәдени көрінісі болып табылады. Стереотип концептімен тең түспейді де, одан ажыратылмайды да. Керісінше Концепт – Стереотипті тарамдатып, саралап түсіндіретін семантикалық амал. **Стереотип – кең қатынастағы** мәдени таным, бірақ тілдік бірлік ұғымы емес. Сондықтан Стереотип – бірінші, Концепт екінші орында тұрады. Стереотип – ұлттық тілдің (сөздің) пайда болу, жасалу мазмұнын түсіндіретін өзек (ось). Ол сол үшін *тілдің мәдени ерекшелігін сөзжасамдық тұрғыда ашуда, қарастыруда ғылыми әдіс ретінде қажет*.

Стереотип арқылы әлем концептіленіп, тілмен, сөзбен «суреттелсе», Концепт стереотипті ашып, екеуі өзара қарама-қарсылықта бола отырып, тепе-теңдікте түйіседі:

**СТЕРЕОТИП ↔ КОНЦЕПТ**

Тең бола тұрса да, екеуінің бір-бірінен айырмашылығы: **біріншісі – дүнетанымдық қатынас қалпы (түрі, формасы), екіншісі – ұғымдық жүйе.**

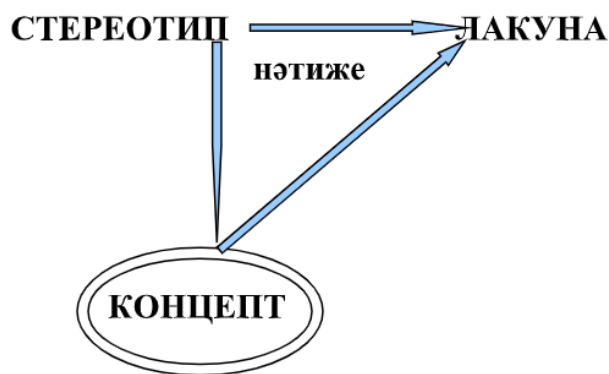
Стереотип түрлі мәдениет тоғысынан игермелі болады, оны тоғыспалы мәдени стереотип деп атауға болады, өйткені қазіргі жаһандық дамуда жеке дара ұлттық стереотиппен қалу мүмкін емес, түрлі мәдениет шектесімі осыны қажет етеді, адамдар еріксіз аралас мәдениет қоғамында өмір сүріп жатқаны аян.

Мәдениет көрінісінің бірі, стереотипке ұқсас «менталитет» (жаратылыс) ұғымы бар. Ол – ұлттың (этностың) өмір сүру әрекетінен пайда болатын ойлау жүйесінің ерекшелігі; жалпы ұлт бойынша қалыптасқан шартты қағидалық бағыт, жалпы ұстаным. Латынша – *менталитет* – **ақыл-ой жаратылысы**; белгілі бір жеке ұлттық өкілге (тұлғаға) тән тұрақты «интеллектуалды», «эмоциялы» ерекшелікті сипаттайтын әлеуметтік аядағы ақыл-ой, сана жүйесі. Менталитет жалпы не ұлттық, не халықтық қана болады, бірақ тұрақты. Ал стереотип ұлттық та, жеке адами да бола береді. Ендеше стереотип тұрақтылық белгісін ұстанғанмен, қатыстық жағынан шартты түрде өзгермелі болады. Стереотиптің жасалуына, қалыптасуына танымдық үдеріс, түрлі әрекет тірек,

себеп болады, сондай-ақ стереотиптің өзі де танымдық қызметті атқарады: қабылдауды жүйелейді, жалпы ой-пікірдің танылуын, сақталуын жеңілдетеді, дүниені, әлемді қабылдауды қарапайымдатады, дүниетанымды жеткізеді, қатынасты айқындайды.

Абстракциялы стереотип сөйлеу, тілдік таңба арқылы тілдік стереотипке айналады, қарым-қатынасты реттейді, мәдени байланысты ашады. Тілдік стереотип дегеніміздің өзі – концептімен танылған лакуналық сөздер.

#### Стереотип нәтижесі:



Тілдік стереотип – **лакуна** – арқылы танылып, мифтік, діни, жалпы, ұлттық, жеке дүниетаным нәтижесінің белгісі болып табылады. Ұлттық мәдени байланыста аңғарылатын ұғымдық бос орын **лакуна** деп аталады. Ұғымдық бос орынды толтыруға сөздік қызметі жетпейтін тілдерде **лакуна кірме қызмет** атқарады. Лакуна басқа тілге дайын лексема болып енгенде, сол ұлттық тілдің лингвистикалық семиотикалық көрінісі айқындалады. Дүниетаным мен әлемді ұғынуда, тануда Лакуна белгілі бір ұлттың арнайы тілдік тәсілі болады. Ол екі елдің мәдени араласуында, мәдени аралық біліктілікті жоғарылату, басқа елде жоқ ұғым орнын толтыруда кірме сөз болып, сөз қорын кеңейтуге ықпал етеді. **Лакуна астарлау** ұғымын(туыстық атауда); *стереотиптік* ұғымды (лакунаның тек ұлт болмысына қатысты пайда

болуы; мысалы: қазақта *туыстық, үлкенді сыйлау* стереотипі); *символдық* (ұлттық мәдениет, дәстүрді, жаратылысын түсіндіруі). Мысалы: қазақтың ұлттық киімдерінің, тағамдарының, кейбір туыстық атаулары басқа мәдениеттегі ел үшін лакуналық бірліктер болып табылады. Тілдік лакунаның туындауы ұлттық болмысқа (релийге) тән.

#### Қорытынды

Қорыта келгенде, адамзат әлемді тану арқылы жинаған мәліметін санада талқыдан өткізіп, нақты бір білім қоры шоғырланады. Білім қоры негізінде ұлттық тілдік бейне қалыптаса бастайды. Ұлттық тілдің жүйеленіп, сөздік қордың қалыптасуы адам танымның кеңдігіне байланысты. Әлемнің тілдік бейнесінің танылуы әуелі ұлттық тілде әлемді қабылдауды арқылы іске асады. Мақалада адамзаттың әлемді қабылдау сипаты, оның әуелі ұлттық бейнеде көрінетіні, әлемді қабылдаудан стереотип қалыптасатыны түсіндіріледі. Сонымен қатар ұлттық тілдік бейнеде стереотип әсеріталданып, ұлттық тілдің, сөздің туындауында, дамуында стереотип пен концепт байланысы, екеуінің өзара айырмашылығы мен ұқсастығы салыстырылып қаралды. Мақала нәтижесінде Стереотип арқылы әлем мазмұны концептіленіп, сөз туындайтыны, стереотиптің өзі концептімен, лакунамен шешім табатыны тұжырымдалды.

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# POLITICAL SCIENCES

## DYNAMICS OF AUTHORITARIAN REGIME PERSISTENCE\*

**Gozum P.,**

*PhD in Public Administration, Assistant Professor, Çankırı Karatekin University,  
Kursunlu Vocational School of Justice, Department of Justice,*

*Çankırı, Turkey*

*Orcid: <https://orcid.org/0000-0003-1174-8500>*

**Gozum R.A.**

*Ufuk University, Faculty of Economics and Administrative Sciences,  
Department of Political Science and International Relations,*

*Ankara, Turkey*

*Orcid: <https://orcid.org/0009-0002-4674-6492>*

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### Abstract

This study examines the processes through which authoritarian regimes in the twenty-first century have consolidated their institutional strength and maintained political stability, using a meta-analytical approach grounded in the existing scholarly literature. In the post–Cold War era, marked by the declining influence of democratization waves, authoritarian regimes have diversified not only in their formal structures but also in their strategies for sustainability. Within this framework, empirical studies published between 2000 and 2024 that contain robust data on the durability or collapse of authoritarian regimes have been systematically reviewed. The analysis reveals that regime loyalty within the security apparatus, levels of economic growth, and the cohesion of elite coalitions are the variables with the highest effect sizes in sustaining authoritarian regimes. In contrast, propaganda tools and external support appear to have a more limited impact. Comparative evaluations across regime types indicate that single-party regimes and electoral authoritarian systems tend to demonstrate greater durability. The findings suggest that authoritarian regimes persist not solely through mechanisms of repression but also via multilayered governance strategies involving strategic coalitions, institutional manipulation, and the distribution of economic resources. Overall, the study shows that authoritarian governance is upheld through a combination of coercive control, institutional flexibility, elite coordination, and resource management. In this respect, it aims to provide both theoretical and methodological contributions to the literature on political regimes.

**Keywords:** Authoritarian Regimes, Regime Persistence, Political Regime Typologies, Mechanisms of Repression.

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### Introduction

The early decades of the twenty-first century have emerged as a period in which global trends toward democratization have weakened, while authoritarian regimes have become increasingly resilient, complex, and institutionalized. Political regime theories that once held optimistic expectations for the global spread of democracy in the post–Cold War era now fall short in explaining the current resurgence and entrenchment of authoritarian forms of governance. This gap in explanatory power has shifted scholarly attention not only to the origins of regimes, but also to the conditions under which they achieve persistence and stability.

Today, understanding the mechanisms through which authoritarian regimes are maintained has become a central agenda in political science—not only for the classification of regime types, but also for analyzing why and how democratic transitions are interrupted or reversed [1,2]. The durability of such regimes is shaped by a wide range of factors, from the role of military and security institutions to media control, from the distribution of economic resources to strategies of gaining international legitimacy [3,4]. However, the fact that most empirical studies in this field focus on specific

cases or limited datasets makes it difficult to draw generalizable conclusions, highlighting the need for broader comparative analyses [5].

This study aims to systematically examine the structural, institutional, and societal factors contributing to the persistence of authoritarian regimes within the framework of the political regime literature. To this end, a meta-analytical approach is adopted, enabling a comparative evaluation of findings from various empirical studies in order to identify the key dynamics that sustain authoritarianism. The first section of the study outlines the conceptual framework of authoritarian regimes and classifies regime types. This is followed by an analysis of the political, economic, and societal mechanisms that support regime durability. The final section presents a meta-analytical synthesis of empirical studies that focus on these dynamics. The overarching goal is to contribute both theoretically and methodologically to the existing literature, while also paving the way for new avenues of research in future studies.

### Authoritarian Regimes

Authoritarian regimes are defined as political systems in which political power is concentrated in the

hands of a limited number of individuals or groups, political opposition is suppressed, and citizen participation is severely restricted. In such regimes, the legitimacy of power is generally based not on popular consent, but on the use of force, ideological justification, or traditional structural elements. In Juan Linz's classical definition, authoritarian regimes are characterized by limited political pluralism, the absence of fully coherent ideology, low levels of political mobilization, and leadership that exercises limited but clearly defined authority [6].

The impact of authoritarian regimes on political life is profound. These regimes have the capacity not only to reshape political institutions, but also to influence social structures, the media environment, the distribution of economic resources, and even the daily lives of individuals. Understanding the causes and mechanisms of authoritarian persistence is therefore of central importance for both regime typologies and the study of democratization processes. The rise of "electoral authoritarianism" in the 2000s, in particular, indicates that contemporary authoritarian regimes often transcend classical models of dictatorship, exhibiting more complex and hybrid forms of governance [7].

In totalitarian and repressive regimes, practices and sanctions inherently based on coercion and violence serve to delineate the boundaries of individual action and mobility. These systems are characterized by a governance model in which coercion and repression are central tools of authority. From this perspective, the restrictive understanding of civil space in totalitarian regimes is often seen as facilitating the establishment and maintenance of power [8].

### **The Conceptual Framework of Authoritarian Regimes**

In the literature on political regime typologies, the definition of authoritarian regimes varies according to different criteria and approaches. Authoritarianism refers to a condition in which, despite the formal existence of representative institutions, the transfer of power through competitive means is not feasible. In such regimes, political parties, elections, or legislative bodies may exist in form, but these institutions do not function in ways that would genuinely challenge the ruling power's monopoly [9].

Political scientists such as Sartori [10], Linz [11], Geddes [12], Levitsky and Way [1] have developed various classifications of authoritarian regimes based on distinct dimensions. These classifications typically emphasize factors such as the position of the leader, mechanisms of power succession, the presence and role of opposition, the level of repression, and the function of formal institutions. For instance, Geddes, categorizes authoritarian regimes into three main types: military, single-party, and personalist dictatorships. More recent approaches, however, focus on hybrid regime forms such as "hegemonic electoral authoritarianism" or "competitive authoritarianism," which blur the lines between democratic and autocratic structures [12].

### **The Historical Transformation of Authoritarian Regimes**

Authoritarian regimes have undergone significant changes throughout history, both in form and function.

The classical models of dictatorship observed in the first half of the twentieth century—such as Nazi Germany, Fascist Italy, and Stalinist Soviet Union—were characterized by overt repression, ideological homogeneity, and one-man rule. However, the transformations in the international system following the Cold War led authoritarian regimes to adopt more refined and complex mechanisms of governance [13].

Despite the global wave of democratization beginning in the 1980s, authoritarian regimes have persisted in various forms across many countries. During this period, the concept of "electoral authoritarianism" gained prominence. In these regimes, elections are held under the guise of democratic procedures, yet the process is systematically manipulated to ensure the continuity of power. Practices such as media suppression, the erosion of judicial independence, and the marginalization of opposition forces are among the defining characteristics of contemporary authoritarianism [14].

This historical transformation has not only introduced methodological shifts but also reopened discussions regarding the institutional resilience of authoritarianism. The evolving nature of authoritarian regimes underscores the necessity for new conceptual tools and systematic analyses that go beyond the classical definitions of dictatorship [15].

### **Types and Classifications of Authoritarian Regimes**

Authoritarian regimes are defined as systems of governance in which political power is concentrated at the center, opposition is restricted, and democratic oversight mechanisms are rendered ineffective. However, these regimes are not homogeneous. In the literature, authoritarian regimes have been classified based on sources of power, institutional structures, and leadership styles [16]. The following section summarizes the three most widely recognized types of authoritarian regimes:

*Single-Party Regimes:* In these systems, political authority is monopolized by a single party, which functions not only as a governing apparatus but also as the central institution regulating political socialization and elite recruitment [12, 17]. The party operates through a hierarchical structure and ideological coherence, which ensures regime stability but may lead to rigidity in the face of leadership transitions or societal demands [18]. China, the former Soviet Union, and Cuba are commonly cited examples of this regime type [19]. Levitsky and Way describe these regimes as forms of "hegemonic authoritarianism." [1].

*Military Regimes:* In this type of regime, political authority is directly controlled by the armed forces and typically emerges through coups [20, 21]. Governance is carried out by military elites or councils. These regimes often have limited mechanisms for generating legitimacy and weak societal support, making them vulnerable to pressures for civilianization [3, 22]. Moreover, transitions of power are frequently marked by fragile and contested processes [23].

*Personalist/Charismatic Dictatorships:* These regimes are centered around the personal authority and charisma of a single leader [24]. Institutions are subordinate, and the political domain is shaped primarily by

the leader's will [25, 26]. The stability of such regimes largely depends on the charisma of the leader and networks of personal loyalty. The death of the leader or a crisis of legitimacy can directly trigger regime collapse [27]. Escribà-Folch and Wright, note that these regimes are more likely to employ high levels of repression against opposition, which often leads to international isolation [28].

### **Mechanisms of Authoritarian Regime Persistence**

The long-term endurance of authoritarian regimes depends not solely on coercion, but on the strategic deployment of multiple reinforcing mechanisms. These mechanisms function to ensure institutional resilience, neutralize potential threats, and generate legitimacy [29]. Five principal mechanisms that contribute to authoritarian durability can be identified.

*Coercive Apparatuses (Military, Police, Intelligence):* Repression is among the most fundamental pillars of authoritarian rule. Security institutions such as the military, police, and intelligence services are mobilized to suppress dissent, monitor society, and deter opposition through fear. In this context, the politicization of the security bureaucracy and its direct dependence on the ruling elite play a critical role in regime survival [30]. Linz, emphasizes that the capacity and loyalty of coercive institutions are decisive for regime stability. A powerful and loyal security apparatus can protect the regime during crises, whereas fragmented or professional-autonomous structures may undermine stability. [11]. Davenport, argues that state coercion operates not only through material force but also through perceptions; systematic fear production serves as a crucial tool of legitimization in authoritarian systems. Similarly, Greitens, notes that how regimes structure their security forces—through centralized control or fragmentation—has significant implications for durability. Dividing coercive agencies can help leaders mitigate coup threats by ensuring mutual surveillance [31, 32].

*Propaganda and Media Control:* Authoritarian regimes consolidate power not only through coercion but also by shaping public opinion and controlling narratives. State-run or state-aligned media outlets, educational systems, and cultural instruments are deployed to disseminate regime ideology and suppress alternative discourses [33]. Media censorship, internet restrictions, harassment of journalists, and disinformation are frequently employed to dominate the information sphere. Propaganda, especially centered on a charismatic leader figure, plays a key role in fostering legitimacy and mobilizing public support [34]. King, Pan, and Roberts, in their study of China, demonstrate that online censorship serves not only to repress dissent but also to manage public opinion [35]. This broadens the conventional definition of propaganda to include the systematic manipulation of informational architecture. Today, algorithmic control and digital censorship are increasingly instrumental in sustaining authoritarian rule [36].

*Institutional Manipulation (Constitutional Engineering, Electoral Design):* Modern authoritarian regimes rely not only on overt coercion but also on legal

and institutional mechanisms to maintain and legitimize power. This includes engineering electoral systems to favor incumbents, manipulating electoral commissions, and amending constitutions to extend term limits [37]. Such institutional manipulation enables regimes to present a democratic façade while neutralizing internal opposition. Levitsky and Way, analyze this under the concept of “competitive authoritarianism,” where formal institutions exist but are systematically rendered dysfunctional [1]. Schedler, further conceptualizes “electoral authoritarianism” as a regime in which democratic institutions persist in form but are subverted in function. In such contexts, elections serve not as expressions of popular will but as instruments of regime control [38]. Gandhi and Lust-Okar, highlight how authoritarian parliaments can function both to co-opt domestic opposition and to cultivate international legitimacy [39].

*Patronage and Resource Distribution:* Patronage is a central mechanism used by authoritarian regimes to consolidate elite alliances and integrate supporters into the system. The strategic allocation of state resources in exchange for loyalty enables regimes to maintain control over public officials, business elites, and local leaders. In this way, regimes secure elite support while neutralizing opposition through economic incentives [40]. This mechanism is particularly evident in developing countries with limited resources. Through public contracts, appointments, and tax exemptions, patronage networks reward loyalty and often intersect with corruption [41]. Magaloni, demonstrates that in single-party regimes, patronage serves to stabilize elite coalitions and reinforce loyalty, while punishing those excluded from the system [42]. Albertus, further argues that authoritarian regimes often structure resource distribution in ways that constrain economic reforms and shrink the social base of opposition [43].

*External Support and International Legitimacy:* Authoritarian regimes do not rely solely on internal mechanisms; they also enhance their durability through strategic relationships with external actors. Countries of geopolitical importance often receive political or economic backing from global powers, enabling them to sustain authoritarian practices. Foreign aid, military assistance, investment flows, and diplomatic recognition contribute to international legitimacy [44]. Some regimes also exploit the West's selective enforcement of democratic norms, employing tactics such as monitored elections or symbolic reform packages to construct external legitimacy [1]. Burnell, contends that external actors may play active roles in reinforcing authoritarianism rather than merely serving as passive enablers [45]. Rising powers such as China and Russia have expanded the adaptive capacity of authoritarian regimes through mechanisms of “authoritarian learning” and mutual support [46]. Additionally, Donno, argues that for democracy-promotion efforts to be effective, international sanctions must target regime elites directly [47].

### **Social and Economic Factors**

The endurance of authoritarian regimes is shaped not only by political institutions and coercive mechanisms, but also by the nature of the social structure and

the economic order. The societal and economic conditions that either reinforce or undermine regime stability—such as income distribution, elite configurations, and identity-based diversity—play a decisive role in the sustainability of authoritarianism [48]. These factors can be grouped under three major headings:

*The Impact of Economic Growth and Prosperity on Regime Stability:* Economic growth is among the most frequently utilized tools for generating legitimacy in authoritarian regimes. The concept of “performance legitimacy” suggests that economic stability and development can serve as substitutes for democratic legitimacy. In cases such as China, Singapore, and certain Gulf states, economic success is strategically used to suppress demands for political participation [49].

This phenomenon is often described in the literature as “authoritarian developmentalism,” where economic performance can grant either temporary or long-term stability to regimes. However, historical patterns also reveal that periods of economic crisis tend to correlate with rising anti-regime mobilization. As such, the relationship between economic performance and political stability is both reciprocal and fragile [50].

*Social Classes, Elite Coalitions, and Interest Groups:* Authoritarian regimes must secure the loyalty not only of the general public but also of elite factions. Elite coalitions—including bureaucratic, military, economic, and religious elites—play a central role in sustaining authoritarian rule. Providing privileged access to resources and policy influence helps maintain the balance of power within the regime [51]. When elite cohesion falters, internal conflict, coups, or regime breakdowns may occur. For this reason, authoritarian leaders often adopt patronage strategies that maintain equilibrium among elite actors. Additionally, networks with interest groups can either strengthen or weaken the regime’s societal foundations [52].

*Ethnic/Religious Diversity and Identity Politics:* Ethnic and religious cleavages represent both opportunities and threats for authoritarian regimes. While some regimes manage diversity through divide-and-rule strategies, others seek to suppress identity-based differences via homogenizing and repressive policies [53].

Identity politics plays a critical role in shaping the legitimacy discourse of authoritarian governments. Themes such as “national unity,” “one religion,” or “state survival” are frequently invoked to suppress pluralism. However, such strategies may backfire by intensifying opposition among marginalized groups and exacerbating regime fragility [54].

Ethnic and religious diversity influences a broad array of policy domains, from the organization of security institutions to educational curricula. Consequently, the management of identity-related divisions represents a delicate domain—one that can serve as both a source of legitimacy and a potential trigger of instability in authoritarian systems [55].

### Method

This study employs a meta-analytical approach to systematically evaluate the factors influencing the sustainability of authoritarian regimes. Meta-analysis is a synthesis method that statistically integrates quantita-

tive findings from independent empirical studies to reveal general trends [56]. In political science, this method has gained increasing traction—particularly in studies on regime typologies, democratization, and authoritarian resilience—as it enables the comparative assessment of diverse empirical findings.

### Research Universe and Scope

The meta-analysis includes empirical, quantitative studies published between 2000 and 2024 that report effect sizes regarding the stability or collapse of authoritarian regimes. A total of 42 studies were selected based on the criterion that they addressed regime duration, resilience, or breakdown as dependent variables and employed comparative designs.

### Data Collection Process

Data were collected through a systematic literature review conducted via indexed databases such as Google Scholar, JSTOR, Scopus, and Web of Science. Search terms included “authoritarian durability,” “regime survival,” “elite cohesion in autocracies,” and “institutional resilience in authoritarian regimes.” Inclusion and exclusion criteria were applied in accordance with the PRISMA protocol.

### Coding and Classification

Each study was coded systematically according to key attributes, including year of publication, type of sample (country/region), dependent and independent variables, effect size indicators (e.g., Pearson’s  $r$ , Cohen’s  $d$ , odds ratio), and type of statistical analysis used. The coding process followed a double-blind protocol, and inter-coder reliability was assessed using Cohen’s kappa coefficient.

### Data Analysis

Both fixed-effects and random-effects models were employed during the analysis phase. The choice of model was guided by heterogeneity tests ( $Q$ -statistic,  $I^2$  value). Publication bias was evaluated using funnel plots and Egger’s regression test. Subgroup analyses were conducted based on regime type, geographic region, and time period to examine variations in effect sizes.

### Effect Size Assessment

The meta-analysis revealed that the key determinants of authoritarian regime persistence, in order of average effect size, were regime loyalty within the security apparatus ( $r = .64$ ), level of economic growth ( $r = .57$ ), and elite coalition cohesion ( $r = .61$ ). In contrast, variables such as propaganda capacity ( $r = .29$ ) and external support ( $r = .22$ ) exhibited relatively limited effects. Comparisons across regime types indicated that single-party regimes and electoral authoritarian systems demonstrated greater sustainability, whereas military regimes and personalist dictatorships were found to be structurally more fragile.

### Findings

This study conducted a meta-analysis of 42 empirical investigations published between 2000 and 2024, systematically evaluating the primary factors influencing the sustainability of authoritarian regimes. During the analysis process, both fixed-effects and random-effects models were employed, and model fit was as-

essed using heterogeneity tests (Q statistic and  $I^2$  index). Funnel plot and Egger's regression test results indicated that publication bias was limited.

The analysis revealed that the variables with the highest effect sizes in explaining authoritarian regime persistence were: regime loyalty within the security apparatus ( $r = .64$ ,  $p < .001$ ), the level of economic growth ( $r = .57$ ,  $p < .001$ ), and the cohesion of elite coalitions ( $r = .61$ ,  $p < .001$ ). In contrast, the impact of propaganda tools was found to be more limited ( $r = .29$ ,  $p = .032$ ),

while external support emerged as the variable with the lowest effect size ( $r = .22$ ,  $p = .048$ ).

These findings align substantially with key assumptions in the existing literature. For instance, Geddes, Magaloni, Slater and Fenner, have emphasized that the institutional structures of authoritarian regimes are closely linked to elite cohesion and control over the security apparatus. This study statistically confirms these relationships through a meta-analytical lens [12, 57, 58].

Table 1.

| Key Factors Influencing the Persistence of Authoritarian Regimes |                 |                           |         |
|------------------------------------------------------------------|-----------------|---------------------------|---------|
| Variable                                                         | Effect Size (r) | Confidence Interval (95%) | p-value |
| Loyalty of the security apparatus                                | 0.64            | 0.52–0.75                 | 0.0001  |
| Level of economic growth                                         | 0.57            | 0.45–0.68                 | 0.0002  |
| Cohesion of elite coalitions                                     | 0.61            | 0.49–0.72                 | 0.0001  |
| Propaganda capacity                                              | 0.29            | 0.15–0.42                 | 0.032   |
| External support                                                 | 0.22            | 0.09–0.35                 | 0.048   |

According to Table 1, subgroup analyses based on regime type indicate that single-party regimes and electoral authoritarian systems exhibit higher levels of sustainability, whereas military regimes and personalist dictatorships tend to be structurally more fragile [20, 28].

The findings also underscore that explaining the durability of authoritarian regimes requires consideration not only of coercive mechanisms, but also of economic development, institutional adaptability, and the configuration of elite coalitions. This supports holistic approaches that view authoritarian resilience as a product of both internal and external, multi-dimensional factors [1, 5].

### Discussion and Conclusion

This study has comprehensively examined the increasing institutional resilience and political continuity of authoritarian regimes in the contemporary world through a meta-analytical approach grounded in both theoretical frameworks and empirical findings within the political science literature. The decline of democratization trends following the Cold War has brought authoritarianism back to the center of theoretical debates [1]. The study's core findings demonstrate that authoritarian regimes are sustained not merely by coercive mechanisms but also through strategic coalitions, institutional flexibility, and various forms of legitimacy production at the societal level [5, 2].

Meta-analytic results indicate that regime stability is strongly associated with factors such as loyalty within the security apparatus, the level of economic growth, and the continuity of elite coalitions [3]. In particular, organizational capacity emerges as a central factor in single-party regimes, while institutional manipulation is more prominent in electoral authoritarian systems [20]. Conversely, external support and propaganda appear to exert relatively limited influence [28].

Another notable contribution of the study is the demonstration that authoritarian regimes are shaped not only by internal dynamics but also by the broader international system. Mechanisms such as electoral monitoring, reform-oriented rhetoric in foreign policy, and international economic cooperation contribute to the

appearance of democratic conformity [59]. This evolution reflects a transformation beyond classical definitions of authoritarianism, highlighting the increasing prevalence and complexity of hybrid regimes [60].

Explaining regime continuity requires not only the tools of political science but also interdisciplinary contributions from economics, sociology, and media studies. For example, the relationship between economic growth and regime legitimacy Magaloni, or the instrumental use of identity politics as a means of social control Wedeen, illustrates the multilayered nature of authoritarian systems. Such interdisciplinary perspectives enhance the explanatory power of the literature. Moreover, the findings offer valuable insights for future research on the dynamics of authoritarian collapse, regime transitions, and the roles played by key political actors [42, 61, 26]. Cultural and technological transformations are also emerging as significant areas of inquiry in assessing regime resilience.

The study further underscores that authoritarian regimes are shaped not only by domestic factors but also by external conditions and the attitudes of the international community. The construction of international legitimacy, the holding of elections under observation, reformist discourse, and economic partnerships all contribute to projecting a democratic image to the outside world. This, in turn, fosters the rise of hybrid governance models in which the boundaries of authoritarianism become increasingly blurred.

When assessing the factors that sustain political systems, it becomes evident that not only political science but also disciplines such as economics, sociology, and media studies contribute meaningfully to this inquiry. Accordingly, the study's findings reaffirm the importance of interdisciplinary approaches in understanding the mechanisms through which authoritarian regimes are maintained. Practices such as the use of economic prosperity as a source of legitimacy or the deployment of identity politics as a mechanism of societal control reveal that these regimes are constructed not only on political but also on social and economic foundations.

In conclusion, the study's findings demonstrate that authoritarian regimes endure not solely through repression and fear, but also through strategic coalitions, economic instruments, and the management of social structures. The holistic perspective offered through the meta-analytical method bridges fragmented insights within the literature, providing a more systematic and explanatory framework. Future research should analyze cultural, technological, and environmental factors that may influence authoritarian resilience. Additionally, enhancing regional comparisons and constructing new datasets will further refine the explanatory power of meta-analytical approaches.

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# PSYCHOLOGY

## БАЛАЛЫКТАГЫ ПОЗИТИВДҮҮ ТАЖРЫЙБАЛАР ШКАЛАСЫН КЫРГЫЗ МАДАНИЯТЫНА АДАПТАЦИЯЛОО

**Абдиламитова Ж.Т.**

*Магистрант, Кыргыз-Түрк “Манас” университети*

**Эфилти Э.**

*Phd, доцент, Кыргыз-Түрк “Манас” университети*

## ADAPTATION OF THE POSITIVE CHILDHOOD EXPERIENCES SCALE TO KYRGYZ CULTURE

**Abdilamitova Zh.,**

*Master's Degree Graduate, Kyrgyz-Turkish Manas University*

*ORCID: 0009-0000-4109-3352*

**Efiliti E.**

*Ph.D.*

*Associate Professor, Kyrgyz-Turkish Manas University*

*ORCID: 0000-0003-1158-0057*

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### Аннотация

Бул изилдөө Позитивдүү Балалык Тажрыйбалары (ПБТ) шкаласын кыргыз тилиндеги маданиятка ылайыкташтырууга багытталган. Максаты – шкаланын валиддүүлүгүн жана ишенимдүүлүгүн аныктоо. Изилдөөнүн методдору катары 222 адамдын катышуусу менен изилдөөчү жана ырастоочу фактордук анализ жүргүзүлгөн. Натыйжада, шкала бир факторлуу түзүлүшкө ээ экени (дисперсиянын 51,14% түшүндүрөт) жана жогорку ишенимдүүлүккө ( $\alpha=0.95$ ) ээ экени аныкталды. Шкаланын илимий мааниси – кыргыз маданиятындагы позитивдүү балалык тажрыйбаларды баалоо инструменти катары пайдаланууга мүмкүнчүлүк берет. Практикалык мааниси – изилдөө жана клиникалык колдонуу үчүн ыңгайлуу экендиги. Келечекте шкаланы ар түрдүү топтордо сыноо жана маданияттар аралык изилдөөлөрдө колдонуу сунушталат.

### Abstract

This study aimed to adapt the Positive Childhood Experiences (PCE) Scale to Kyrgyz-speaking culture and to examine its validity and reliability among adults in Kyrgyzstan. Exploratory and confirmatory factor analyses were conducted on a sample of 222 participants. The results revealed a unidimensional structure explaining 51.14% of the variance, with high internal consistency ( $\alpha = 0.95$ ). The scale holds scientific value in its appropriateness for assessing positive childhood experiences within the Kyrgyz cultural context. Its practical relevance lies in its potential use in both research and clinical settings. Further testing with diverse samples and application in cross-cultural studies is recommended.

**Ачкыч сөздөр:** Позитивдүү балалык тажрыйбалар; шкаланы ылайыкташтыруу; психометрикалык өзгөчөлүктөр; фактордук анализ.

**Keywords:** Positive childhood experiences; scale adaptation; psychometric properties; factor analysis.

### Киришүү

Балалык - бул ар бир адамдын жашоосунда өзгөчө маанилүү мезгил болуп кийинки жашоосунун сапатына таасир этүүчү мезгил. Ошондой эле, адамдын бала кезинде терс окуялар болбогондугунан тышкары, анын позитивдүү тажрыйбаларынын болуусу анын келечектеги жашоосу үчүн маанилүү деп эсептелет. Адамдын жашоосунда тынчсыздануу, коркуу же ачуулануу сыяктуу терс эмоциялардын болбогондугу анын позитивдүү эмоцияларга ээ экендигин көрсөтпөйт. Ошондуктан, балалык кезиндеги эмоциялардын мүнөзүн, анын ичинде терс эмоцияларды да таасирин изилдөө индивиддин жүрүм-турумун тереңирээк түшүнүүгө жардам берет [1].

Эгерде балалыктын маанисин ушул контекстте карай турган болсок, анда позитивдүү жана терс тажрыйбаларды тең изилдөө зарылчылыгы келип чыга. Бул көз караштын негизинде, бул изилдөөнүн

башкы максаты Тайфун Доган жана Фатма Тугба Айдын тарабынан иштелип чыккан Позитивдүү Балалык Тажрыйбалар Шкаласын кыргыз маданиятынын шарттарына ылайыкташтыруу болуп саналат [1].

Иликтөөлөр Түркияда жана башка өлкөлөрдө балалыкта алынган позитивдүү тажрыйбалардын чоңдордун жашоосуна тийгизген таасирин изилдеген көптөгөн изилдөөлөрдүн бар экенин көрсөттү. Мисалы, Доган жана Явуз жүргүзгөн изилдөө балалыктагы позитивдүү тажрыйбалар адамдын психологиялык туруктуулугун камсыз кыла аларын белгилеген [2]. Ошондой эле, Ричардс жана Хупперт позитивдүү тажрыйбалар узак убакыт бою адамдардын жалпы жыргалчылыгына таасир эткенин аныкташкан [1][2]. Оливейра, Ферейра жана Мендес тамактануунун бузулушу боюнча жүргүзгөн изилдөөсүндө бул көйгөй менен балалыктагы позитивдүү тажрыйбалардын

ортосунда олуттуу байланышы бар экенин аныкташкан [3]. Башка изилдөөлөрдө позитивдүү балалык тажрыйбалары депрессия жана тынчсыздануу деңгээлине түздөн-түз байланыштуу экени аныкталган [4]. Мындан тышкары, өзүн-өзү сыйлоо жана бактылуулук [5], жыргалчылык жана өзүнө мээримдүү мамиле кылуу [6], өзүнө болгон канааттануу [7], бактылуулук жана жашоодон канааттануу [1] позитивдүү тажрыйбалар менен байланышта болгон.

Бул изилдөөлөрдүн жыйынтыгында, балалыкта позитивдүү тажрыйбага ээ болуу чоңдордун жашоосунун ар кайсы чөйрөлөрүнө оң таасирин тийгизери аныкталды. Ошондуктан, балдардын позитивдүү тажрыйбаларын ар кандай социалдык топтордо изилдөө зарылдыгы бар. Бул контекстте, Позитивдүү Балалык Тажрыйбалар Шкаласын кыргыз маданиятына ылайыкташтыруу өзгөчө маанилүү болуп саналат.

### Метод

#### Изилдөө тобу

Бул изилдөө балалыктагы позитивдүү тажрыйбалар шкаласын кыргыз маданиятына ылайыкташтырууну максат кылган жана анын маалыматтары 2024-жылдын март-апрель айларында чогултулган. Изилдөө Кыргызстандын Бишкек шаарында жашаган чоңдордун арасында жүргүзүлгөн. Маалыматтарды чогултуу процессине жалпысынан 222 адам катышкан.

#### Колдонулган өлчөө куралы

Изилдөөдө позитивдүү балалык тажрыйбаларды баалоо үчүн атайын шкала кыргыз тилине ылайыкташтырылган. Бул шкала Тайфун Докан жана Фатма Тугба Айдын тарабынан иштелип чыккан. Шкала бир факторлуу түзүлүшкө ээ болуп, 22 пункттан турат. Шкалада тескери коддолгон пункттар жок. Жыйынтык баа 22ден 110го чейин өзгөрүп турат жана шкаладан алынган жогорку балл балалыкта алынган позитивдүү тажрыйбалардын жогорку деңгээлин көрсөтөт.

#### Шкаланы кыргызчага которуу процесси

Шкаланы кыргыз тилине адаптациялоо үчүн, алгач анын авторлорунун бири Тайфун Доган менен байланышып, расмий уруксат алынган. Уруксат алынгандан кийин, котормо иштери башталган. Шкаланын түрк тилиндеги түп нускасы изилдөөчү тарабынан кыргыз тилине которулган. Которулган текст андан соң котормо жаатындагы адис тарабынан текшерилип, мазмунду так чагылдырган пункттар тандап алынган.

Андан соң, алынган форма психологиялык консультация жаатында иштеген окутуучу менен биргеликте кайрадан каралып чыккан. Шкаланын ар бир пунктунун кыргыз тилине ылайыктуулугу жана мазмуну талкууланып, керектүү өзгөртүүлөр киргизилген.

Шкаланын түзүлүшүнүн жарактуулугун текшерүү үчүн изилдөөчү фактордук анализ (EFA) жүргүзгөн. Ал эми шкаланын ишенимдүүлүгүн баалоо максатында Кронбахтын Альфа ички ырааттуулук коэффициенти эсептелген. Бул процесстердин бардыгы шкаланы кыргыз тилине

жана маданиятына мүмкүн болушунча так жана туура ылайыкташтырууга багытталган.

### Маалыматтарды талдоо

*Шкаланын жарактуулугу жөнүндө жыйынтык*

Балалыктагы позитивдүү тажрыйбалар шкаласынын жарактуулугу изилдөөчү фактордук анализ (EFA) жана ырастоочу фактордук анализ (CFA) аркылуу текшерилди. Шкаланын ишенимдүүлүгүн баалоо үчүн Cronbach Alpha ички ырааттуулук коэффициенти эсептелди. Бул анализдер 222 катышуучунун берген жоопторунун негизинде жүргүзүлдү.

*Изилдөөчү фактордук анализдин жыйынтыктары*

Фактордук анализ жүргүзүүдөн мурун зарыл болгон айрым божомолдор текшерилди. Алгач, респонденттердин саны фактордук анализ жүргүзүү үчүн жетиштүү болуп болгондугу каралды. Бул маалыматты КМО коэффициентинин негизинде аныктоо мүмкүн. КМО көрсөткүчү 1ге жакын болгон учурда идеалдуу деп эсептелет, ал эми 0.50дөн төмөн болсо, жетишсиз деп бааланат [8]. Бул изилдөөдө КМО көрсөткүчү 0.95 деп табылып, респонденттердин саны жетиштүү экени аныкталды.

Андан соң, Бартлетттин сфералык тестинин жыйынтыгы эсептелди жана натыйжада алынган көрсөткүчтөр маанилүү экени аныкталды ( $\chi^2 = 3244.551$ ;  $Sd = 231$ ;  $p < 0.001$ ). Бул жыйынтыктар маалыматтар фактордук анализ жүргүзүүгө ылайыктуу экенин көрсөттү [9].

Баштапкы шкала бир фактордон турганы белгилүү болгондуктан, бардык пункттар бир факторго киргизилип анализденди. Фактордук жүктү кесүү чекити 0.32 деп аныкталды. Бул көрсөткүчкө тең же андан жогору болгон пункттар дисперсияга олуттуу салым кошору белгиленген [10]. Анализдин жыйынтыгында шкаладагы пункттардын фактордук жүктөмдөрү 0.41ден 0.86га чейин өзгөргөнү аныкталды. Бир фактордук түзүлүш жалпы дисперсиянын 51.137% түшүндүргөн. Бул маанилер, адатта, 30% же андан жогору болгондо жетиштүү деп эсептелет [11].

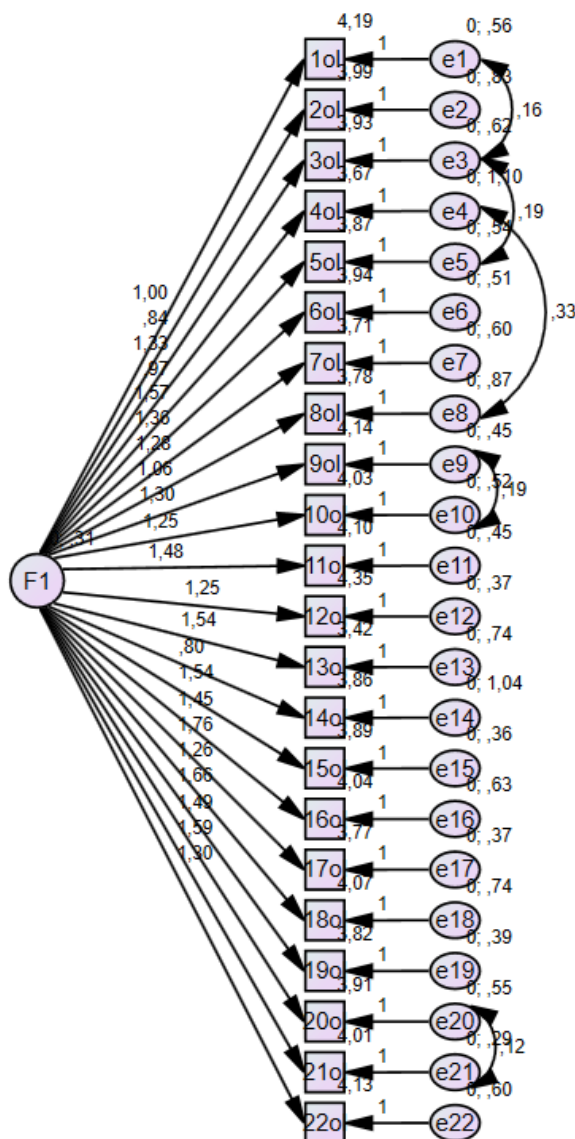
*Ырастоочу фактордук анализдин жыйынтыктары*

Изилдөөчү фактордук анализ менен табылган шкаланын бир фактордук түзүлүшү ырастоочу фактордук анализ аркылуу текшерилди. Бул анализ менен алдын ала аныкталган түзүлүш чогултулган маалыматтарга канчалык шайкеш келери бааланды [9].

Ырастоочу фактордук анализдин жыйынтыгы моделдин тууралык деңгээлин аныктоо үчүн эсептелген. Адабиятта  $\chi^2/sd$  катышынын 5тен аз болушу моделдин маалыматтарга жакшы шайкештигинин көрсөткүчү катары каралат. Fit индекси (GFI) жана анын жөнгө салынган түрү (AGFI) 0.90дан жогору болгондо, ал эми болжолдуу каталардын орточо чарчы тамыры (RMSEA) 0.05тен аз болгондо модел жакшы деп бааланат (Baumgartner & Homburg, 1996; Browne & Cudeck, 1993; Şimşek, 2007). [12-14]

Бул изилдөөдө бир деңгээлдеги CFA модели төмөнкү көрсөткүчтөргө ээ болду:  $\chi^2 = 470.237$ ;  $Sd = 204.000$ ;  $\chi^2/sd = 2.206$ ;  $AGFI = 0.790$ ;  $GFI = 0.831$ ;  $IFI = 0.916$ ;  $CFI = 0.916$  жана  $RMSEA = 0.07$ . Бул көрсөткүчтөр моделдин маалыматтар менен шайкеш келгендигин жана түзүлүштүн жарактуулугун далилдеди.

CFАнын жыйынтыгында шкаладагы пункттардын фактордук жүктөмдөрү 0.26дан 0.91ге чейин өзгөргөнү аныкталды. Жыйынтыгында, бир фактордук моделдин түзүлүшү ылайыктуу деп табылып, жол коэффициенттери статистикалык жактан маанилүү экендиги ( $p < 0.001$ ) көрсөтүлдү. Тестирилген бир факторлуу модель 1-сүрөттө көрсөтүлгөн.



1-сүрөт. Бир факторлуу модель боюнча CFАнын жыйынтыктары

Масштабдын 22 пункту үчүн эсептелген Кронбах Альфа ишенимдүүлүк коэффициенти 0.95 деп аныкталды.

#### Жыйынтык жана талкуу

Бул изилдөөнүн негизги максаты – балалыктагы позитивдүү тажрыйбаларды баалоочу шкаланы кыргыз тилине ылайыкташтыруу жана анын психометриялык касиеттерин изилдөө болду. Изилдөөнүн натыйжалары шкаланын кыргыз маданиятында колдонууга ылайыктуу жана ишенимдүү өлчөө куралы экендигин көрсөттү.

Адабияттарга көз жүгүрткөндө, түрк адабиятында балалык тажрыйбаларды баалоо үчүн бир катар шкалалар бар экендиги белгилүү, бирок алардын көбү терс же травматикалык окуяларга багытталган [15-16]. Ал эми позитивдүү балалык тажрыйбаларын баалоого арналган шкалалардын бири өспүрүмдөргө багытталган [17], экинчиси социалдык мамилелерге багытталган [18]. Кыргыз адабиятында болсо, балалыктагы позитивдүү тажрыйбаларды баалоочу атайын өлчөө куралы жок. Ошондуктан, иштелип чыккан бул шкала

кыргыз адабиятында маанилүү боштукту толтурат деп айтууга болот.

Шкаланын психометриялык касиеттерин аныктоо максатында ар тараптуу анализдер жүргүзүлдү. Чалгындоочу жана ырастоочу факторлордун анализинин натыйжасында шкаланын бир өлчөмдүү түзүлүшкө ээ экени аныкталды. 5-баллдык Лайкерт шкаласынын негизинде иштелип чыккан жана 22 пункттан турган бул шкаланын жарактуулугу жана ишенимдүүлүгү критерийдик жарактуулук, предметтик анализ, курама ишенимдүүлүк, жана ички ырааттуулук ыкмалары менен бааланды. Алынган психометриялык көрсөткүчтөр шкаланын кыргыз маданиятында балалыктагы позитивдүү тажрыйбаларды баалоо үчүн ишенимдүү жана жарактуу экендигин тастыктады.

Бул шкаланын өзгөчөлүгү – чоңдорго багытталгандыгы жана балалыктагы

тажрыйбаларды ар тараптуу көз караш менен карагандыгында. Шкала балалыктагы сүйүү, кызыгуу, канааттануу жана ыраазычылык сыяктуу тажрыйбаларды бирдиктүү түрдө баалоого мүмкүнчүлүк берет.

Изилдөөнүн натыйжалары шкаланы Кыргызстанда изилдөө иштеринде жана клиникалык практикада коопсуз колдонууга боло тургандыгын көрсөтүп турат. Мындан аркы изилдөөлөрдө шкаланы ар кандай үлгү топторунда сыноо жана анын натыйжаларын кеңейтүү сунушталат. Ошондой эле, маданияттар аралык салыштыруу изилдөөлөрүндө бул шкаланы колдонуу, балалыктагы позитивдүү тажрыйбаларды ар кайсы маданий контексттерде тереңирээк түшүнүүгө шарт түзөт. Позитивдүү балалык тажрыйбалары шкаласынын пункттары таблица 1.де берилди.

Таблица 1.

Жагымдуу балалык тажрыйбалары шкаласы пункттары

| Позитивдүү балалык шкаласы                                                  |                    |                         |                   |                       |                  |
|-----------------------------------------------------------------------------|--------------------|-------------------------|-------------------|-----------------------|------------------|
|                                                                             | Такыр<br>кошулбайм | Көп учурда<br>кошулбайм | Бир аз<br>кошулам | Көп учурда<br>кошулам | Толук<br>кошулам |
| 1. Бала чагымда ката кетирсем үй-бүлөм кечиримдүү болушкан.                 |                    |                         |                   |                       |                  |
| 2. Бала кезимде досторум көп болчу.                                         |                    |                         |                   |                       |                  |
| 3. Бала чагымда үй-бүлөм мага өзүмдү маанилүү жана баалуу адамдай сездирди. |                    |                         |                   |                       |                  |
| 4. Мен бала кезимде оптимист болчумун                                       |                    |                         |                   |                       |                  |
| 5. Үй-бүлөм мага чын жүрөктөн кызыгуу көрсөтүшчү.                           |                    |                         |                   |                       |                  |
| 6. Балалык кезимдеги эскерүүлөрүм көбүнчө позитивдүү                        |                    |                         |                   |                       |                  |
| 7. Кичинекей кезимде каалоолорумдун көбү аткарылчу.                         |                    |                         |                   |                       |                  |
| 8. Кичинекей кезимде шайыр бала элем.                                       |                    |                         |                   |                       |                  |
| 9. Балалыгым бактылуу үй-бүлөдө өттү.                                       |                    |                         |                   |                       |                  |
| 10. Мен өзүмдүн теңтуштарыма салыштырмалуу бактылуу бала болчумун.          |                    |                         |                   |                       |                  |
| 11. Кичине кезимде керек болгондо мага колдоо көрсөткөн адамдар бар эле.    |                    |                         |                   |                       |                  |
| 12. Балалыгым кызыктуу өттү деп айта алам.                                  |                    |                         |                   |                       |                  |
| 13. Кичинекей кезимде сезимдеримди эркин айта турган чөйрөм бар болчу.      |                    |                         |                   |                       |                  |
| 14. Мектептеги жашоомо ыраазы болчумун.                                     |                    |                         |                   |                       |                  |
| 15. Балалыгым сүйүү толо бир чөйрөдө өттү                                   |                    |                         |                   |                       |                  |
| 16. Балалык чагымды кайрадан жашагым келет, анткени балалыгым сонун өткөн.  |                    |                         |                   |                       |                  |
| 17. Бала кезимде керектүү эмоционалдык колдоону алдым деп ойлойм.           |                    |                         |                   |                       |                  |
| 18. Бала чагымда башымдан өткөргөн жакшы учурлар жаман учурлардан көп.      |                    |                         |                   |                       |                  |
| 19. Бала кезимде мени жетиштүү баалашкан деп ойлойм.                        |                    |                         |                   |                       |                  |
| 20. Бала кезимде жетишээрлик сүйүлгөнүм деп ойлойм.                         |                    |                         |                   |                       |                  |
| 21. Мен көп жагынан бактылуу бала болчумун.                                 |                    |                         |                   |                       |                  |
| 22. Бала кезимде өзүмдү коопсуздукта сезчүмүн.                              |                    |                         |                   |                       |                  |

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# STATE AND LAW

## ОСОБЛИВОСТІ ФОРМУВАННЯ ІНСТИТУТУ ПУБЛІЧНИХ ПОСЛУГ В КОНТЕКСТІ ТРАНСФОРМАЦІЇ ТЕРИТОРІАЛЬНОЇ ОРГАНІЗАЦІЇ ВЛАДИ

**Саганович Д.В.**

*аспірант кафедри державного управління  
і місцевого самоврядування,*

*Національний технічний університет «Дніпровська політехніка»,  
м. Дніпро, Україна,*

*orcid.org/0009-0001-6001-1858*

## FEATURES OF THE FORMATION OF THE INSTITUTE OF PUBLIC SERVICES IN THE CONTEXT OF THE TRANSFORMATION OF THE TERRITORIAL ORGANIZATION OF AUTHORITY

**Saganovich D.**

*Postgraduate Student*

*of the Department of Public Administration and Local Self-Government,  
Dnipro University of Technology, Dnipro, Ukraine,*

*orcid.org/0009-0001-6001-1858*

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### Анотація

Досліджено інститут публічних послуг як фактор довіри громадян до держави. Проаналізовано його трансформацію в умовах цифровізації, децентралізації та воєнного стану. Розглянуто нові виклики для центрів надання адміністративних послуг (ЦНАП), зокрема гібридні загрози та кібератаки. Обґрунтовано необхідність впровадження інноваційних, клієнтоорієнтованих підходів, захисту даних та безперервності сервісу для ефективного управління та сталого розвитку. Доведено, що Недостатній рівень кіберзахисту, технічна відсталість і фрагментарність нормативного забезпечення несуть ризики збоїв у роботі сервісів та втрати суспільної довіри до всього інституту публічних послуг. Ефективність державної політики та її сприйняття громадянами значною мірою залежать від здатності органів влади забезпечувати якісний сервіс в будь-яких умовах. Доведено, що трансформація територіальної організації влади в Україні, насамперед децентралізація, вимагає нового підходу до формування інституту публічних послуг, впровадження інновацій, клієнтоорієнтованості, цифровізації та розвитку співробітництва громад.

### Abstract

The institute of public services is studied as a factor of citizens' trust in the state. Its transformation in the conditions of digitalization, decentralization and martial law is analyzed. New challenges for administrative service centers (ASCs), in particular hybrid threats and cyberattacks, are considered. The need to implement innovative, customer-oriented approaches, data protection and service continuity for effective management and sustainable development is substantiated. It is proven that an insufficient level of cyber protection, technical backwardness and fragmentation of regulatory support carry the risks of service failures and loss of public trust in the entire institute of public services. The effectiveness of state policy and its perception by citizens largely depend on the ability of government bodies to provide quality service in any conditions. It is proven that the transformation of the territorial organization of power in Ukraine, primarily decentralization, requires a new approach to the formation of the institute of public services, the introduction of innovations, customer-orientedness, digitalization and the development of community cooperation.

**Ключові слова:** органи власти, публічне управління, публічні послуги, інститут публічних послуг, децентралізація, сервісна держава, цифровізація, електронні послуги.

**Keywords:** authorities, public administration, public services, public services institute, decentralization, service state, digitalization, electronic services.

**Актуальність проблеми.** Інститут публічних послуг в сучасних умовах набуває особливої актуальності, оскільки якість, доступність і безпека цих послуг безпосередньо впливають на рівень довіри громадян до держави, ефективність державного управління та всебічний розвиток суспільства. З розвитком цифрових технологій, трансформацією управлінських процесів та зростанням очікувань населення щодо оперативності й зручності сервісів,

діяльність органів публічної влади, зокрема центрів надання адміністративних послуг (ЦНАП), стикається з новими викликами й ризиками. Адже, в умовах гібридних загроз, масових кібератак і необхідності забезпечення відкритості й прозорості, стоїть проблема адаптації інституту публічних послуг до сучасних реалій. Ця проблема полягає у забезпеченні сталості функціонування інформацій-

них систем, захисті персональних даних, безперервності надання послуг навіть під час надзвичайних ситуацій чи воєнного стану, а також у підвищенні цифрової грамотності працівників і клієнтів. Недостатній рівень кіберзахисту, технічна відсталість окремих систем, а також фрагментарність нормативного забезпечення створюють ризик не тільки збоїв у роботі ЦНАП, а й втрати суспільної довіри до інституту публічних послуг загалом.

Актуальність цієї проблеми підсилюється тим, що ефективність державної політики, її сприйняття громадянами, а також легітимність самої влади значною мірою залежить від здатності публічних органів забезпечувати належний рівень сервісу в будь-яких обставинах. Таким чином, сьогодні постає нагальна потреба комплексного переосмислення підходів до організації публічних послуг, їхнього інформаційного супроводу та захисту в умовах нових загроз і викликів. Трансформація територіальної організації влади в Україні, зокрема процес децентралізації, зумовлює необхідність переосмислення підходів до формування інституту публічних послуг. Впровадження інноваційних засад у цій сфері є ключовим фактором забезпечення ефективності, доступності та якості послуг, що надаються населенню на місцевому рівні.

Наявні виклики становлення та розвитку інституту публічних послуг (ІПП) охоплюють: 1) нерівномірність розвитку ІПП через суттєві відмінності у спроможності ОТГ забезпечувати якісні послуги, що створює дисбаланс у доступі до них по всій країні; 2) технологічну відсталість: Недостатнє впровадження цифрових технологій серед населення, що обмежує можливості для проактивного надання послуг та віддаленого доступу; 3) брак кваліфікованих кадрів, зокрема нестача фахівців у громадах, здатних впроваджувати інноваційні рішення та працювати за сучасними стандартами; 4) слабка координація, адже недостатня інтеграція між різними рівнями влади та секторами у процесі надання комплексних послуг суттєво знижує ефективність публічного управління загалом; 5) вплив воєнного стану та потреба адаптації системи надання послуг до викликів воєнного часу, що вимагає гнучкості, оперативних рішень та безпеки.

Відтак, актуалізується потреба у розробці та впровадженні інноваційних засад формування інституту публічних послуг, що ґрунтуватимуться на клієнтоорієнтованому підході, широкій цифровізації, ефективному управлінні процесами, розвитку міжмуніципального співробітництва та сталому кадровому забезпеченні. Лише такий підхід дозволить повною мірою розкрити потенціал децентралізації, підвищити ефективність публічного управління та забезпечити гідну якість життя громадян України.

#### **Аналіз останніх досліджень і публікацій.**

В українському науковому дискурсі питання функціонування інституту публічних послуг та діяльності органів публічної влади є активно досліджуваними, особливо у контексті діджиталізації адміністративних сервісів та зростання кіберзагроз. Значна увага у працях українських науковців –

Є.Красников [1-2], М.Ажажа [3], А.Помаза-Пономаренко, О.Ахмедова [4], у межах яких приділяється проблемам сучасної концептуалізації публічних послуг, запровадженню електронного врядування, питанню захисту персональних даних у публічному секторі.

При цьому формальний взаємовплив реформи децентралізації, нормативної детермінації публічних послуг, зміни парадигми діяльності органів публічної влади в умовах правового режиму воєнного стану показує, що формальна процедура у процесі надання публічних послуг має враховувати функціональну особливість – органи публічної влади (центральні та місцеві) є формальними суб'єктами надання публічних послуг згідно із законодавством адже саме вони мають юридичні повноваження приймати рішення та несуть відповідальність за надання послуг. Повноваження таких органів публічної влади регулюються низкою нормативних актів, що забезпечують функціональну, регулюючу, сервісну та інші складові сучасної публічної політики.

#### **Виклад основного матеріалу.**

В Україні передбачено передачу значних повноважень (зокрема щодо надання публічних послуг) від центральних органів до органів місцевого самоврядування (ОМС). Основна мета полягає у побудові гнучкої, орієнтованої на громадянина системи управління, здатної оперативно реагувати на місцеві потреби. Разом із тим, спостерігаються такі проблеми: по-перше, нерівномірний розвиток громад, які мають різні ресурси й можливості для забезпечення якості послуг, що створює дисбаланс доступу по країні; по-друге, технічна відсталість, що визначена недостатньою цифровізацією й це обмежує впровадження дистанційних та проактивних сервісів у системі публічних послуг; по-третє, наявність кадрового дефіциту, оскільки бракує фахівців, здатних працювати за сучасними стандартами на місцях; по-четверте, слабка координація механізмів публічного управління та недостатня інтеграція між різними рівнями влади, що знижує ефективність управління; по-п'яте, проблеми воєнного стану – адже запровадження та адаптація сервісів до умов воєнного стану, забезпечення безпеки й гнучкості вимагають не лише інноваційних рішень, а й використання традиційних моделей надання послуг.

Сучасна Україна перебуває на етапі глибоких системних змін, ключовим елементом яких є реформа децентралізації. Цей процес докорінно змінює архітектуру територіальної організації влади, передаючи значні повноваження та відповідальність, зокрема й у сфері надання публічних послуг, від центральних органів до органів місцевого самоврядування (ОМС). Метою є побудова ефективної, орієнтованої на громадянина системи врядування, що здатна оперативно реагувати на потреби місцевих громад. Однак, незважаючи на значні успіхи у формуванні спроможних територіальних громад та розширенні мережі ЦНАП, проблема полягає у необхідності інноваційного осмислення та практичної реалізації нових засад

функціонування інституту публічних послуг. Наявна система, попри певні покращення, досі часто характеризується фрагментарністю, бюрократичністю, недостатньою прозорістю та низьким рівнем доступності, особливо для вразливих груп населення та жителів віддалених територій. Традиційні підходи до надання послуг, що базуються на універсальних процедурах та адміністративних бар'єрах, не відповідають сучасним викликам і очікуванням суспільства. Вони не дозволяють повною мірою реалізувати потенціал децентралізації, призводять до нераціонального використання ресурсів та знижують довіру громадян до влади.

Традиційні підходи (уніфіковані процедури, бюрократія, бар'єри) не відповідають сучасним вимогам. Вони призводять до фрагментарності системи, низької прозорості, ускладнюють доступ до сервісів для вразливих груп населення, які живуть у віддалених територіях. Важливо визначити певні особливості формування інституту публічних послуг в контексті трансформації територіальної організації влади. Перш за все, це стосується уніфікованих процедури (так званий підхід щодо «формалізованої послуги для всіх»). Адже сучасна система публічного управління розроблена так, ніби всі громадяни мають однакові можливості, знання та ресурси, проте вона не враховує індивідуальні обставини: вік, стан здоров'я, місце проживання, рівень цифрової грамотності. По-друге, продовження існування бюрократичної системи, у межах якої дотримання форми та процедури важливіше за результат і здоровий глузд, що характеризується запутаними, багатоетапними процесами, вимогою численних довідок, копій, заяв; перекладанням відповідальності між різними органами управління. Очевидно, що це призводить до бар'єрів, як фізичних, так і інформаційних, часових, та цифрових. Врешті, в умовах трансформації територіальної організації влади це призводить до фрагментарності системи публічного управління, мінімізації можливостей такої системи, низької прозорості (й очевидно, формуванням корупціогенних чинників), ускладнення доступу для вразливих груп – у тому числі, як результату перманентних реформ, які проводяться без належного правового підґрунтя. Очевидно, що система, побудована на таких підходах, є дискримінаційною за своєю суттю.

1. *Моделювання мережевої взаємодії* суб'єктів надання публічних послуг, що реалізується через розробку та застосування математичних моделей і теорії мереж для аналізу взаємозв'язків між різними рівнями надання послуг (ЦНАПи, місцеві органи влади, територіальні підрозділи центральних органів виконавчої влади, приватні надавачі, громадські організації). При цьому досягається оптимізація потоків інформації та ресурсів, ідентифікація «вузьких місць» та резервів ефективності, створення адаптивних моделей управління послугами, що реагують на зміни потреб громади та зовнішні виклики (наприклад, військовий стан, стихійні лиха). При цьому досягається визначення оптимальних стратегій інтеграції послуг, розробка рекомендацій щодо співпраці

та розподілу функцій між різними акторами, підвищення стійкості системи.

2. *Концепція «Проактивного уряду»* та її імплементація у наданні публічних послуг, що передбачає перехід від «реактивного» надання послуг (за запитом) до «проактивного», коли держава, використовуючи фактичні дані та прогнози, передбачає потреби громадян та надає послуги до того часу, як вони звертаються. При цьому застосування штучного інтелекту, машинного навчання та Big Data для аналізу життєвих подій (народження, шлюб, зміна місця проживання, вихід на пенсію тощо) та автоматичного ініціювання відповідних послуг або інформування. Важливо зазначити, що розробка алгоритмів для аналізу даних, створення «предиктивних» моделей потреб населення, впровадження систем сповіщень та автоматизованої обробки.

Екосистемний підхід до публічних послуг у децентралізованих громадах, який передбачає аналіз системи надання публічних послуг як динамічної екосистеми, у межах якої різні елементи системи публічного управління (місцеві органи влади, громадяни, бізнес, громадські організації, наукові установи) взаємодіють, обмінюються ресурсами та адаптуються до змін у форматі регулюючого впливу. Додатковими функціями виступають вивчення синергетичних ефектів від взаємодії, ідентифікація та розвиток «сервісних інноваційних хабів» у громадах, стимулювання горизонтальних зв'язків та співпраці. Такий управлінський механізм функціонує на основі застосування концепцій екосистемного аналізу, теорії спільного створення цінності (co-creation of value), мережевого управління. Цим досягається створення гнучких та інноваційних моделей надання послуг, які відображають унікальні потреби та ресурси кожної громади, підвищення залученості громадян у процеси розробки та оцінки послуг.

Саме тому очевидним є потреба у формуванні інноваційних підходів до формування інституту публічних послуг на таких засадах:

- 1) клієнтоорієнтований підхід – зрієнтація на реальні потреби користувачів;
- 2) комплексна цифровізація, використання електронних систем, захищеної ідентифікації, дистанційного доступу;
- 3) розвиток персоналу, підвищення цифрової грамотності, впровадження сучасних практик управління;
- 4) інтегроване управління та співпраця територіальних громад, шляхом посилення координації й обміну кращими практиками між громадами;
- 5) модернізація нормативної бази, гармонізація законодавства для підтримки інновацій та юридичної визначеності.

У цьому контексті варто навести досвід Франції з позицій формування сучасної моделі публічних послуг. Теоретичною основою французької моделі є так звані «закони Роллана» (названі на честь Л.Роллана), які визначають три фундаментальні принципи надання публічних послуг: 1) принцип рівності (Égalité) – усі громадяни мають рівний доступ до публічних послуг без дискримінації за походженням, місцем проживання чи

соціальним статусом, що визначає рівність у ставленні до користувачів та, в багатьох випадках, єдині тарифи на всій території країни (наприклад, вартість поштових марок, ціни на залізничні квитки на аналогічні відстані); 2) принцип безперервності (*continuité*) – публічні послуги мають надаватися безперервно та регулярно, а держава зобов'язана забезпечити їх функціонування навіть у кризових ситуаціях, наприклад, держава обґрунтовує обмеження права на страйк для працівників критично важливих секторів (транспорт, енергетика, охорона здоров'я); 3) принцип адаптивності (*mutabilité/adaptabilité*) – публічна послуга повинна розвиватися та адаптуватися до змін у суспільних потребах та технологічному прогресі. Держава має право змінювати організацію та умови надання послуг, щоб підвищити їхню ефективність та відповідність сучасним вимогам. Саме цей принцип легітимізує реформи та модернізацію. До цих трьох класичних принципів часто додають нейтральність та прозорість (*Transparence*) [5].

Наявна система надання публічних послуг у Франції є класичною багаторівневою та складною, поєднуючи публічне управління, діяльність місцевого самоврядування та участь приватного сектору.

На центральному рівні держава відповідає за стратегічні послуги (*services régaliens*): оборона, юстиція, дипломатія, поліція. Також держава регулює та переважно управляє загальнонаціональними системами: освітою, охороною здоров'я, залізницями, енергетикою через відповідні управлінські структури. На рівні регіонів та департаментів органи місцевого самоврядування відповідають за середню освіту (ліцеї та коледжі), соціальну допомогу, розвиток регіонального транспорту та інфраструктури. На місцевому рівні (комуни) муніципалітети надають послуги з початкової освіти, водопостачання та водовідведення, збору сміття, утримання місцевих доріг, видачі дозволів на будівництво.

Варто також виокремити такі публічні механізми як: 1) пряме управління (*Gestion directe*), коли послуга надається безпосередньо державним органом або муніципалітетом (наприклад, поліція, податкова служба); або створюються 2) спеціалізовані державні підприємства (*Établissement public*) як публічні юридичні особи з фінансовою автономією для управління певною сферою (наприклад, лікарні, університети, державні музеї). Також відбувається делегування публічних послуг (*Délégation de service public - DSP*): Держава або муніципалітет передає право надання послуги приватній компанії на основі довгострокового контракту (концесії). Приватний оператор отримує винагороду переважно за рахунок плати від користувачів. Це поширена модель у сферах водопостачання, управління відходами та громадського транспорту. При цьому держава зберігає за собою контроль та регуляторні функції [5].

Французька модель *Service Public* демонструє, що публічні послуги можуть бути не лише адміністративною функцією, а й потужним інструментом соціальної інтеграції та забезпечення

стабільності. Для України досвід Франції може бути корисним у кількох аспектах: по-перше, важливість ідеологічного підґрунтя формування інституту публічних послуг, формування чітких, зрозумілих суспільству принципів (як-от рівність, доступність, безперервність) може стати основою для побудови довіри до державних інституцій. По-друге, гнучкість у формах управління, поєднання прямого державного управління, автономних публічних установ та механізмів державно-приватного партнерства (делегування) дозволяє обирати найефективнішу модель для кожної конкретної послуги. По-третє, вирішення проблеми цифрового розриву, створення фізичних центрів підтримки надання цифрових послуг (на кшталт *France Services*) є критично важливим для забезпечення доступу до цифрових послуг для всіх верств населення.

Очевидним важливим напрямом є збереження державного контролю при делегуванні. Адже навіть з переданням надання послуг приватним компаніям, держава повинна зберігати за собою потужні регуляторні та контрольні функції для захисту прав та інтересів громадян.

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