

BILTEK-XIV

**INTERNATIONAL SYMPOSIUM ON CURRENT DEVELOPMENTS IN
SCIENCE, TECHNOLOGY AND SOCIAL SCIENCES**

Proceedings Book



EDITOR: Dr. NGUYỄN THỊ BÍCH VÂN

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BILTEK CONFERENCE-XIV

14th INTERNATIONAL SYMPOSIUM ON CURRENT DEVELOPMENTS IN
SCIENCE, TECHNOLOGY AND SOCIAL SCIENCES

DATE AND PLACE

February 18-20, 2026

Bangkok, Thailand

ORGANIZATION

IKSAD INSTITUTE & LONDON SOVEREIGN SCHOOL



EDITOR

Dr. NGUYỄN THỊ BÍCH VÂN

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Total Accepted Papers from other Countries: 21

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BILTEK CONFERENCE- XIV

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PHOTO GALERY



PHOTO GALERY



PHOTO GALLERY

The image is a collage of three screenshots from a Zoom meeting, likely related to the BILTEK CONFERENCE-XIV.

Top Screenshot: A presentation slide titled "BILTEK CONFERENCE-XIV 14th INTERNATIONAL SYMPOSIUM ON CURRENT DEVELOPMENTS IN SCIENCE, TECHNOLOGY AND SOCIAL SCIENCES". The slide is dated February 18-20, 2026, in Bangkok, Thailand. The topic is "Spatio-temporal analysis of precipitation in the Koliba-Corubal River basin (Guinea and Guinea Bissau) between 1981 and 2024". The authors listed are Cris Emanuel WALÚ and Pr Cheikh FAYE. The slide is being presented by H-1, Cris Emanuel WALÚ.

Middle Screenshot: A gallery view of participants. The participants are arranged in a grid. The names visible are "Observer H-3" and "Hall-3-Meriç Yıl...".

Bottom Screenshot: A presentation slide titled "ANALYSIS OF WORKERS' PERCEPTION ON SAFETY MANAGEMENT POLICY OF CARGO VESSEL IN UNILINK SHIPPING INC.". The slide is being presented by H-1, Cris Emanuel WALÚ. The slide content includes a diagram showing the relationship between Safety Policy, Safety Management, and Safety Promotion, and a table of data.

PHOTO GALLERY

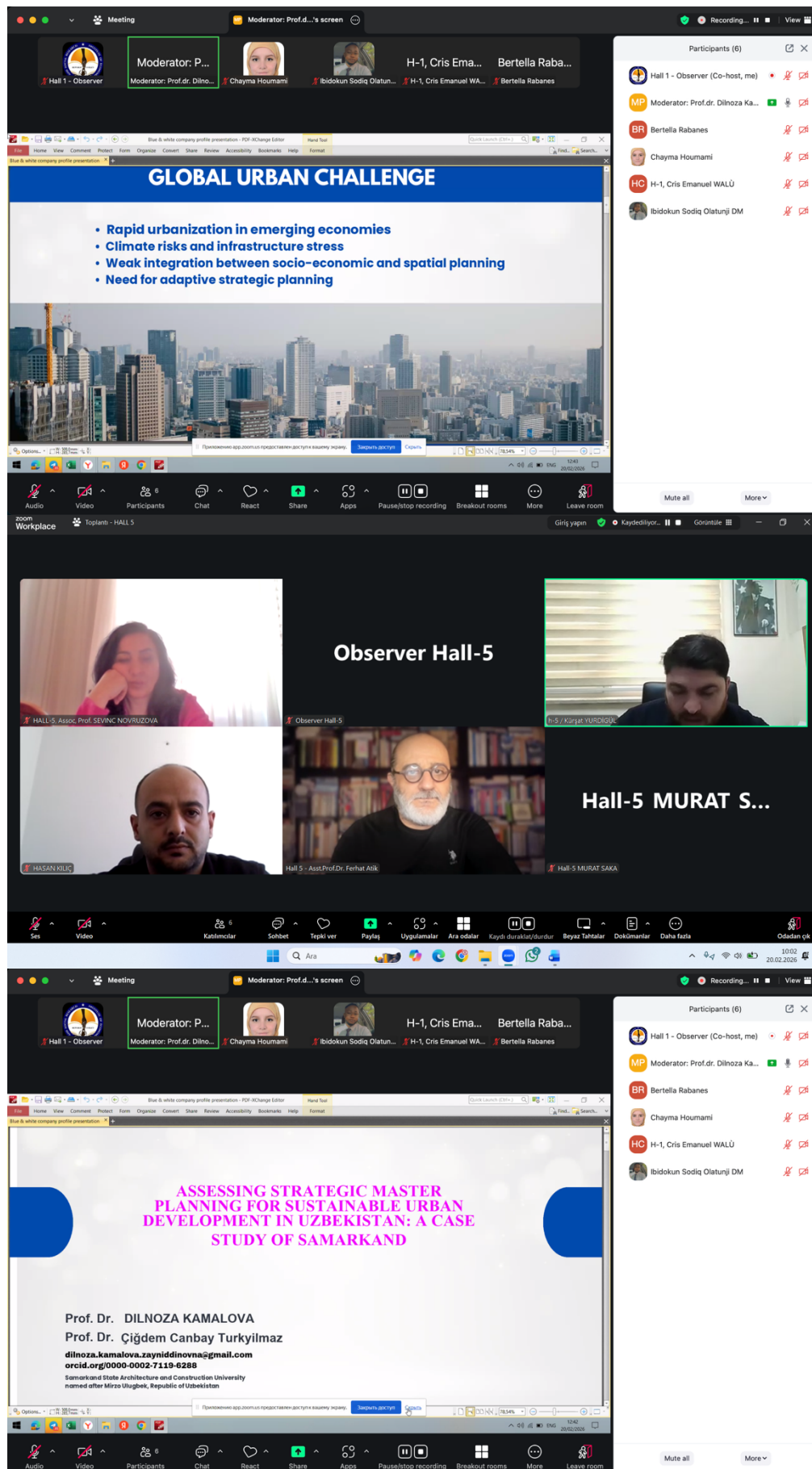
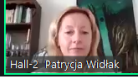


PHOTO GALLERY

Hall 2- Observer
Hall 2- Observer


Hall-2 Patrycja Widlak


Limon 11915025

Sesi Açmayı İste

Dr. Amina Mum...

Dr. Amina Mumtaz



JÓZEF PIŁSUDSKI
UNIVERSITY
OF PHYSICAL
EDUCATION
IN WARSAW

BILTEK CONGRESS-XIV

14th INTERNATIONAL CONGRESS ON CURRENT DEVELOPMENTS IN
SCIENCE, TECHNOLOGY AND SOCIAL SCIENCES

February 18-20, 2026 / Bangkok, Thailand
online & in-person

FUNCTIONAL MOVEMENT PATTERNS IN TEAM
SPORTS: ROLE IN SPORTS INJURY PREVENTION

Patrycja Widlak PhD, Anna Kopiczko Prof.,
Bartłomiej Michalak PhD, Zbigniew Tyc M.Sc., Dariusz Boguszewski Prof.
Józef Piłsudski University of Physical Education in Warsaw, Poland

This work was written with the financial support of the Ministry of Education and Science as part of the Research Project (UPB 13) at Józef Piłsudski University of Physical Education in Warsaw (Poland), title "Assessment of the Relationship Between Selected Lifestyle Factors and the Risk of Sports Injuries in a Young Adult Population"

Ses Video Katılımcılar Sohbet Tepki ver Paylaş Kaydı duraklat/durdur Daha fazla Odadan çık

Tümünü Sessize Al

Adriana Dervishaj

Hall 2- Observer

Hall 2- Observer

Hall-2 Patrycja Widlak

Limon 11915025

Dr. Amina Mum...

Dr. Amina Mumtaz

Katılımcılar (5)

H2 Hall 2... (Ortak oturum sahibi, ben)

A Adriana Dervishaj

DA Dr. Amina Mumtaz

HP Hall-2 Patrycja Widlak

Limon 11915025

Tümünü Sessize Al

Hall 2- Observer Hall-2 Patrycja... Dr. Amina Mum...

Hall 2- Observer Hall-2 Patrycja Widlak Dr. Amina Mumtaz Limon 11915025

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Outline

1. Eco-friendly approach towards the determination of cloxacillin sodium pure and in dosage forms

2. DR. AMINA MUMTAZ Senior Scientific Officer Applied Chemistry Research Centre

3. DR. AMJAD NASIM & AFIYA AMIR Punjab Group of Colleges, C # 1, New Muslim Town, Lahore

4. DR. AMINA MUMTAZ

5. DR. AMJAD NASIM & AFIYA AMIR

Slide 1 / 55

Ses Video Katılımcılar Sohbet Tepki ver Paylaş Kaydı duraklat/durdur Daha fazla Odadan çık

Tümünü Sessize Al

PHOTO GALLERY

zoom
Workplace

Toplantı

Serdarhan Duru adlı kişinin ekranı

Kaydediliyor...

Görüntüle

Giriş yapın

Eğitim

Temel Erişimden STEM Uzmanlığına

Küresel Sorun:
Temel eğitimde eşitlik sağlandı,
ancak 'Geleceğin İşleri'nde
(STEM) kadınlar geride.

%35

Dünya genelinde STEM
mezunlarında kadın oranı.

Türkiye Perspektifi

'Haydi Kızlar Okula' ile %99 okullaşma başarısı ya
Yeni hedef: Kodlama ve 21. yüzyıl becerileri.

PROJE: YARINI KODLAYANLAR

27.000+

Kız Çocuğuna Kodlama Eğitimi



Diğer Örnekler: Türk Telekom & Habitat Derneği teknoloji sınıfları.

Observer H-3

Observer H-3

HALL 3: Prof. Dr. Özlem EMİR Ç.

Serdarhan Duru

session-1 Hall-3 Hafize BÖLACI

Ses

Video

Katılımcılar

Sohbet

Asa odalar

Tepki ver

Paylaş

Uygulamalar

Kaydediliyor...

Beyaz Tahtalar

Toplantı bilgileri

Daha fazla

Odasından çık

NotebookLM

[illegible]

BILTEK CONFERENCE-XIV

14th INTERNATIONAL SYMPOSIUM ON CURRENT DEVELOPMENTS IN SCIENCE, TECHNOLOGY AND SOCIAL SCIENCES

February 18-20, 2026 - Bangkok, Thailand

Ibis Bangkok Sukhumvit 4, 41 Skhuvumit Road, Soi 4, Kolongtoey, Khlong Toei, 10110



CONFERENCE PROGRAM



Meeting ID: 844 6001 0824
Zoom Passcode: 141414

<https://us02web.zoom.us/j/84460010824?pwd=2RU1jS7kbKOnLHQ8IggprWN0RsxRdI.1>

Participant Countries: (16)

Türkiye (14), Uzbekistan, South Africa, Algeria, Tunisia, Senegal, Philippines, Morocco, Azerbaijan, Serbia, Albania, Bangladesh, Pakistan, India, Cyprus, Poland (21).

Önemli, Dikkatle Okuyunuz Lütfen

- Kongremizde Yazım Kurallarına uygun gönderilmiş ve bilim kurulundan geçen bildiriler için online (video konferans sistemi üzerinden) sunum imkanı sağlanmıştır.
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- Tüm kongre katılımcıları canlı bağlanarak tüm oturumları dinleyebilir.
- Moderatör – oturumdaki sunum ve bilimsel tartışma (soru-cevap) kısmından sorumludur.

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- Katılım belgeleri kongre sonunda tarafınıza pdf olarak gönderilecektir.
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exp. H-1, Cris Emanuel WALÙ

IN PERSON PRESENTATIONS

(Ibis Bangkok Sukhumvit 4, 41 Skhuvumit Road, Soi 4, Kolongtoey, Khlong Toei, 10110)

19.02.2026



BANGKOK LOCAL TIME

10⁰⁰ : 12⁰⁰

HEAD OF SESSION: Dr. Mustafa Latif EMEK

AUTHORS	AFFILIATION	TOPIC TITLE
Prof. Dr. Perviz Ahmedzade Dr. Ezgi Eren Assist. Prof. Dr. Burak Yiğit Katanalp Prof. Dr. Çiğdem Canbay Türkyılmaz Prof. Dr. Emrah Türkyılmaz	Samarkand State Architectural and Civil Engineering University, Uzbekistan	THE EFFECTS OF THE INTERNATIONAL ROUGHNESS INDEX ON VEHICLE EMISSIONS
John Percival Fernandez Dinesh Vallabh Simon Christopher Fernandez	Walter Sisulu University, South Africa	TOURISM STUDENTS' CHALLENGES ON ONLINE LEARNING AT A SOUTH AFRICAN RURAL UNIVERSITY
Djellouli Amir Berredjem Yamina Hattab Zhou Khechai Mohamed Barbari Fateh Abdesselam Bouguerra Sara Ncibi	Laboratory of Physics of Matter and Radiation (LPMR), Algeria Institut National Agronomique, Tunisia	REMOVING AQUEOUS WASTE WITH COST- EFFECTIVE BIOADSORBENTS
Jamaluddeen Sani Shehu Abdulrasheed Mohammed	Usmanu Danfodiyo University, Sokoto, Nigeria Waziri Umaru Federal Polytechnic, Birnin Kebbi, Nigeria	SPECTRAL DEPTH ANALYSIS OF AEROMAGNETIC DATA OF NORTH EASTERN PART OF SOKOTO BASIN FOR SEDIMENTARY THICKNESS
Sani Abdullahi Muhammad Hamza Abdullahi Bello Muhammad Muhammed Mahmud Babangida	Kano State Polytechnic, Nigeria	DESIGN AND CONSTRUCTION OF PRACTICAL MODULE FOR STAR DELTA STARTER OF AN INDUCTION MOTOR

ONLINE PRESENTATIONS

20.02.2026 / Session-1, Hall-1



BANGKOK LOCAL TIME



14⁰⁰ : 16⁰⁰



ANKARA LOCAL TIME



10⁰⁰ : 12⁰⁰

HEAD OF SESSION: Prof. Dr. Dilnoza Kamalova

AUTHORS	AFFILIATION	TOPIC TITLE
Cris Emanuel WALÛ Cheikh FAYE	Assane Seck University of Ziguinchor, Senegal	SPATIO-TEMPORAL ANALYSIS OF PRECIPITATION IN THE KOLIBA-CORUBAL RIVER BASIN (GUINEA AND GUINEA BISSAU) BETWEEN 1981 AND 2024
Dr. Julie Anne C. Quiñones	Bicol University, Philippines	ASSESSING RESOURCE DEVELOPMENT AND MANAGEMENT STRATEGIES: BUDGETING, COORDINATION AND EVALUATION PRACTICES AT DARAGA COMMUNITY COLLEGE
Sodiq O. Ibidukon Bertella G. Rabanes	University of the Visayas, Philippines	ANALYSIS OF WORKERS' PERCEPTION ON SAFETY MANAGEMENT POLICY OF CARGO VESSEL IN UNILINK SHIPPING INC.
HOUMAMI Chayma LAFRAXO Younes	Cadi Ayyad University of Marrakech, Morocco	ACCELERATING THE ADOPTION OF ADVANCED BANKING TECHNOLOGIES AMONG MOROCCAN CUSTOMERS: KEY FACTORS, BARRIERS, AND FUTURE DIRECTIONS
Prof. Dr. Dilnoza Kamalova Prof. Dr. Çiğdem Canbay Turkyilmaz	Samarkand State Architectural and Civil Engineering University, Uzbekistan	ASSESSING STRATEGIC MASTER PLANNING FOR SUSTAINABLE URBAN DEVELOPMENT IN UZBEKISTAN: A CASE STUDY OF SAMARKAND
MOHAMMED, Nana-Aisha Kudu Dr. A. M. Chado Mall. Saifullahi M.	Federal University of Technology, Minna, Nigeria	EFFECT OF DESIGN BASED LEARNING ON SENIOR SECONDARY SCHOOL CHEMISTRY STUDENTS' MOTIVATION IN MINNA, NIGER STATE

All participants must join the conference 10 minutes before the session time.
Every presentation should last not longer than 10-12 minutes.
Kindly keep your cameras on till the end of the session.

ONLINE PRESENTATIONS

20.02.2026 / Session-1, Hall-2



BANGKOK LOCAL TIME



14⁰⁰ : 16⁰⁰



ANKARA LOCAL TIME



10⁰⁰ : 12⁰⁰

HEAD OF SESSION: Ličina Braho

AUTHORS	AFFILIATION	TOPIC TITLE
Ličina Braho Ivana Radojević Milan Dekić Violeta Jakovljević	State University of Novi Pazar, Serbia	BIOLOGICAL ACTIVITIES OF MICROMERIA THYMMIFOLIA
Prof. Assoc. Dr. Adriana Dervishaj	University of Tirana, Albania	MEDIATING DEMOCRATIC STANDARDS IN SETTLING DISPUTES AT AN ACADEMIC SETTING IN ALBANIA
Hossain Ahmed Gazi Mehedi Hasan Rakib Md. Limon Khan Ramim Miah	Comilla University, Bangladesh	PHYTOCHEMICAL PROFILING AND MULTIFACETED THERAPEUTIC POTENTIAL OF HERITIERA LITTORALIS LEAF EXTRACT: IN VITRO AND IN VIVO ANTI-DIABETIC, ANTIOXIDANT, AND ANTI-INFLAMMATORY ACTIVITIES
Zakaria FAHYM Amine MOUBARIK Abdelouahed HAJJAJI	Sultan Moulay Slimane University, Morocco	FUNGAL CHITIN AND CHITOSAN VALORIZATION: EXTRACTION, CHARACTERIZATION AND EMERGING APPLICATIONS IN AGRICULTURE AND ENVIRONMENT
Amina Mumtaz Afifa Amir	Pakistan Council of scientific and Industrial Research Laboratories Complex, Pakistan	ECO-FRIENDLY APPROACH TOWARDS THE DETERMINATION OF CLOXACILLIN SODIUM PURE AND IN DOSAGE FORMS
Pratiksha Rai	Mahayogi Gorakhnath University Gorakhpur, India	NANOCARRIER-LOADED MICRONEEDLE PATCHES FOR SUSTAINED AND TARGETED TRANSDERMAL DELIVERY OF INSULIN AND SMALL-MOLECULE THERAPEUTICS
Dr. Patrycja WIDŁAK Prof. Assoc. PhD. Anna KOPICZKO Dr. Bartłomiej MICHALAK M.Sc. Zbigniew TYC Prof. Assoc. PhD. Dariusz BOGUSZEWSKI	Józef Piłsudski University of Physical Education, Poland	FUNCTIONAL MOVEMENT PATTERNS IN TEAM SPORTS: ROLE IN SPORTS INJURY PREVENTION

ONLINE PRESENTATIONS

20.02.2026 / Session-1, Hall-3

	BANGKOK LOCAL TIME		ANKARA LOCAL TIME
	14 ⁰⁰ : 16 ⁰⁰		10 ⁰⁰ : 12 ⁰⁰

HEAD OF SESSION: Prof. Dr. Özlem EMİR ÇOBAN

AUTHORS	AFFILIATION	TOPIC TITLE
Prof. Dr. Selma Söyük Dr. Hafize Boyacı	İstanbul University- Cerrahpaşa, Türkiye	WORK-RELATED EMOTIONAL EXHAUSTION IN HEALTH WORKERS
Asst. Prof. Dr. Serdarhan DURU	Ankara University, Türkiye	SOCIETY 5.0 AND WOMEN'S WELFARE: OPPORTUNITIES, RISKS AND POLICIES
Assoc. Prof. Dr. Ulaş Aday Dr. Abdulkadir Akbaş	Dicle University, Türkiye	PANCREATIC CYSTIC LYMPHANGIOMA: A RARE CASE IN A PATIENT WITH A HISTORY OF MALIGNANCY
Prof. Dr. Özlem EMİR ÇOBAN Prof. Dr. Hülya GÜL Assoc. Prof. Dr. Feray ÇAĞIRAN YILMAZ Dr. Tuba OKUTAN Assoc. Prof. Dr. Mücahit EROĞLU Asst. Prof. Dr. İlhan Fırat KILINÇER	Fırat University, Türkiye Süleyman Demirel University, Türkiye Dicle University, Türkiye	SENSORY EVALUATION OF GLUTEN-FREE PASTA FORMULATED WITH ODOR-REMOVED LYOPHILIZED FISH POWDER

ONLINE PRESENTATIONS

20.02.2026 / Session-1, Hall-4

	BANGKOK LOCAL TIME		ANKARA LOCAL TIME
	14 ⁰⁰ : 16 ⁰⁰		10 ⁰⁰ : 12 ⁰⁰

HEAD OF SESSION: Prof. Dr. Serap SALER

AUTHORS	AFFILIATION	TOPIC TITLE
Prof. Dr. Serap SALER Prof. Dr. Ali Adnan HAYALOĞLU Asst. Prof. Ali TEKİN Prof. Dr. Mehmet Zülfü ÇOBAN Assoc. Prof. Dr. Feray ÇAĞIRAN YILMAZ Prof. Dr. Hilal BULUT Prof. Dr. Özlem EMİR ÇOBAN	Fırat University, Türkiye İnönü University, Türkiye Dicle University, Türkiye	SENSORY ANALYSIS OF GRISSINI PRODUCED WITH SINGLE CELL PROTEIN (SCP) OBTAINED FROM DUCKWEED (Lemna minor L.) USING <i>Saccharomices cerevisiae</i>
Asst. Prof. Dr. Bekir Doğan	Tokat Gaziosmanpaşa University, Türkiye	COMPARATIVE CFD ANALYSIS OF TURBULENCE MODELS IN A 2D BACKWARD-FACING STEP FLOW
PhD. Gülizar Gülenay Zengin	Uşak University, Türkiye	ON STATISTICAL CONVERGENCE OF TOPOLOGICAL - HENSTOCK-KURZWEIL INTEGRAL
Dr. Selda BULUT Dr. Hakan ERDOĞAN	Fırat University, Türkiye Ankara, Türkiye	RISK PROJECTION OF TERRESTRIAL CLIMATE CHANGE IN THE CONSTRUCTION SECTOR: INTEGRATION OF PRAS AND MATRIX METHODS IN THE CASE OF ELAZIG
Dr. Meriç YILMAZ SALMAN Türker SALMAN Assoc. Prof. Dr. Mustafa Ersin PEKDEMİR	Fırat University, Türkiye	REMOVAL OF MICROPLASTICS FROM WATER USING MOF@CNT COMPOSITE
Asst. Prof. Dr. Meriç Can ÖZYURT	İstanbul University-Cerrahpaşa, Türkiye	THE IMPACT OF BACK-BREAK ON SEQUENTIAL BLAST PERFORMANCE: CONSEQUENCES OF NON-OPTIMAL DESIGN

ONLINE PRESENTATIONS

20.02.2026 / Session-1, Hall-5

	BANGKOK LOCAL TIME		ANKARA LOCAL TIME
	14 ⁰⁰ : 16 ⁰⁰		10 ⁰⁰ : 12 ⁰⁰

HEAD OF SESSION: Dr. Ferhat Atik

AUTHORS	AFFILIATION	TOPIC TITLE
Asst. Prof. Dr. Reyhan Rafet CAN Asst. Prof. Dr. Kürşat YURDİGÜL	Osmaniye Korkut Ata University, Türkiye Gümüşhane University, Türkiye	THE SPATIAL AND DEMOGRAPHIC TRANSFORMATION OF SETTLEMENT IN NORTH OSSETIA (ALANIA)
Hasan Kılıç Asst. Prof. Dr. Dinçer Atasoy	Iğdır University, Türkiye	METHODS USED BY HIGH SCHOOL MATHEMATICS TEACHERS TO DEVELOP STUDENTS' ANALYTICAL THINKING SKILLS
Dr. Ferhat Atik	Girne American University, Cyprus	MEDIA ACCELERATION AND COGNITIVE TIME COMPRESSION: RECONFIGURING PERCEPTION, ATTENTION, AND DECISION-MAKING IN THE PLATFORM SOCIETY
Asst. Prof. Dr. Murat SAKA Assoc. Prof. Dr. Tayfun ACARER	Piri Reis University, Türkiye	ESTABLISHMENT OF AN INFORMATION SYSTEM THAT WILL SHARE INSTANTANEOUS MEASUREMENTS OF CURRENT VALUES IN NARROW WATER CHANNELS WITH SHIPS
Assoc. Prof. Muradova H.R. Assoc. Prof. Novruzova S.A. Assoc. Prof. Ahmadov M.M.	Azerbaijan State University of Economics	ISSUES OF THE IMPACT OF BUSINESS DEVELOPMENT ON STRATEGIC PLANNING – THE ROLE OF MARKETING CONCEPTS IN STRATEGIC PLANNING FOR SUSTAINABLE BUSINESS DEVELOPMENT NAGORNO-KARABAKH
Ebru Pekgöz Haydar Pekgöz Prof. Dr. Emrah Türkylmaz	Samarkand State University of Architecture and Civil Engineering named after Mirzo Ulugbek, Uzbekistan	PRESERVATION OF TRADITIONAL AND ANALOG HOUSING FABRIC IN SAMARKAND: CHALLENGES AND STRATEGIES

BILTEK CONFERENCE-XIV

14th INTERNATIONAL SYMPOSIUM ON CURRENT DEVELOPMENTS IN SCIENCE,
TECHNOLOGY AND SOCIAL SCIENCES
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THE EFFECTS OF THE INTERNATIONAL ROUGHNESS INDEX ON VEHICLE EMISSIONS

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Abstract

This study aims to evaluate the effect of the surface roughness of the pavement, defined by the International Roughness Index (IRI), on the fuel consumption and the corresponding CO₂ emissions of five road segments in different climatic zones in Türkiye. Depending on traffic volume, a substantial amount of CO₂ emissions occurs during the use phase of the pavement life cycle due to rolling-resistance-related fuel consumption, underscoring the critical role of IRI in this phase.

In this context, average IRI values obtained from the Turkish General Directorate of Highways for five different road segments under varying climatic conditions were combined with traffic characteristics, including Annual Average Daily Traffic (AADT), vehicle-type distribution (light and heavy vehicles), and vehicle fuel/energy types, to estimate additional energy consumption and the associated CO₂ emissions.

Assessments conducted in five different regions of Türkiye have shown that the increase in IRI significantly raises CO₂ emissions, especially in areas with hot climates and high traffic volumes. In general, it was observed that emissions tend to increase as the IRI value increases; the highest emissions (1685-ton CO₂) and deviations (53.74-ton CO₂) from the ideal were recorded in hot climate regions, while in areas with milder and continental climates, the total emission load remained high due to high AADT despite low average IRI deviations (1.2-1.3). When evaluated by vehicle type, the additional fuel consumption and CO₂ emissions associated with increased IRI were not observed in EVs and were slightly lower in hybrid vehicles ($\approx 8.04\%$) compared to conventional ones, indicating that—given the currently small share of hybrids (4%)—an increase in their share in the future could substantially reduce total emissions.

The results imply that maintenance interventions implemented to keep IRI within acceptable limits can lead to reductions in fuel consumption-related CO₂ emissions over the road pavement lifespan.

Keywords: CO₂ emission, Use phase, Pavement, IRI.

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TOURISM STUDENTS' CHALLENGES ON ONLINE LEARNING AT A SOUTH AFRICAN RURAL UNIVERSITY

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Abstract

Higher education institutions ubiquitously are amalgamating miscellany of methods for the students to enhance their learning. Online learning is significant among them as it is very flexible, engaging and effective for the students. Despite, several studies have addressed the challenges of online learning faced by students at universities in numerous countries such as India, Indonesia, Poland, Pakistan, Malaysia and China, the studies based on the challenges on online learning faced by tourism students is highly inadequate. In addition to that, there have been a very few studies conducted on the challenges of online learning in the African continent mainly in South Africa where university students from the rural area are still combatting to overcome the challenges of accessibility to computers and Internet. Furthermore, many authors have emphasized that the subjects of tourism, travel and hospitality are more of vocational in nature and the pattern of their learning are highly different when compared with the other field of subjects such as information technology and engineering. This makes the current study more distinctive as the current research focusses on tourism students. Therefore, the objective of this study is to seek the challenges of tourism students on online learning at a rural University in South Africa. A descriptive survey design will be adopted for the research. It will assist to determine the behaviour of students in a normal setting and helps to analyse the facts of research problem. The data will be analysed statistically by the use of descriptive statistics and inferential statistics.

Keywords: Online learning, Challenges, Tourism, Students.

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REMOVING AQUEOUS WASTE WITH COST-EFFECTIVE BIOADSORBENTS

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Abstract

This study's goal was to synthesize and construct biomaterials of the cationic and anionic types. These substances were utilized as adsorbents in waters that had been contaminated by various adsorbates that were probably prevalent in the environment. In order to describe the various materials, various approaches (IRTF, DRX, MEB, BET, and ATG/DTA) will be used. Studies on the adsorption by these substances will be conducted while changing a number of variables, including pH, mass, concentration, and temperature.

Removal of effluents in aqueous media, particularly the adsorption technique, which appears to be well suited to remove pollutants due to its shown efficacy as well as for financial reasons, using inexpensive adsorbents such agricultural and industrial wastes.

Keywords: Characterization, Different materials, Water treatment, Bio adsorbents, adsorption.

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SPECTRAL DEPTH ANALYSIS OF AEROMAGNETIC DATA OF NORTH EASTERN PART OF SOKOTO BASIN FOR SEDIMENTARY THICKNESS

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Abstract

This paper employs spectral depth analysis to estimate the sedimentary thickness of north eastern part of Sokoto basin. Depth to basement is a germane exploration parameter particularly for areas, such as the study area, where there may be mature hydrocarbons. The aeromagnetic data over the study area, acquired from Nigerian Geological survey agency, was subjected to regional-residual separation using least square method; and the residual map was subjected to spectral analysis using Oasis Montaj software. The result revealed two distinct layers. The first layer ranges from 0.16 km to 0.94 km while the second layer lies between the depths of 1.1 km and 2.14 km. These depth results indicate that the sediments are deeply seated and hence a potential zone to host hydrocarbon.

Keywords: Depth estimation, Sedimentary thickness, Sokoto basin, Spectral Analysis.

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DESIGN AND CONSTRUCTION OF PRACTICAL MODULE FOR STAR DELTA STARTER OF AN INDUCTION MOTOR

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Abstract

The need for student practical equipment in our institution had led to a number of alternatives, which have been affordable and available. In response to this, the star delta starter of induction motor is designed to reduce high starting current and torque. The star delta starter is designed by three magnetic contactors, an overload relay, timer relay and circuit breaker. For Starter, a motor must be connected in delta mode position during a normal run. When induction motor is start in direct online. The motor winding draws a large amount of current. The starting high current can be reached in 8-10 times of the rated. So, there is need to control high starting current before starting the motor. Therefore, in a star connected system line current is equal to phase current but line voltage is equal to the root three times of phase voltage. For these reasons at first motor is connected to the star system and it reduce the high starting current. In delta connection, line voltage is equal to phase voltage and line current is equal to $\sqrt{3}$ times phase current. In run mode the motor connects in delta system so that the full voltage applied to the motor. The Starter is made by three magnetic contactors, timer relay, and a thermal overload relay or circuit breaker

Keywords: Star delta starter, magnetic contactors, thermal overload.

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SPATIO-TEMPORAL ANALYSIS OF PRECIPITATION IN THE KOLIBA-CORUBAL RIVER BASIN (GUINEA AND GUINEA BISSAU) BETWEEN 1981 AND 2024

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Abstract

Koliba -Corubal basin, located between Guinea and Guinea-Bissau, plays a crucial role in water resource management and agriculture in these regions, but it is also subject to marked climatic variations. The objective of this article is to conduct a spatio-temporal analysis of rainfall in this basin over the period 1981–2024. Using CHIRPS data, the research mapped the spatial and temporal distribution of rainfall and identified breaks in the time series. The study reveals a rainy season concentrated between May and August, accounting for nearly 87% of annual rainfall. Trend analysis highlighted a significant increase in rainfall after 1991, with a growth rate of 7.12% according to the Pettitt test. Interannual precipitation variability was analyzed using statistical tests such as the Mann-Kendall and Pettitt tests, indicating gradual changes and breaks at specific periods, particularly after 1991 and 2001. The spatial distribution of precipitation revealed notable regional variations: the northern part of the basin experienced a moderate increase, while the eastern part showed marked increases, in contrast to the more stable south. Furthermore, the basin exhibits a predominance of dry conditions, highlighting the importance of adapting water resource management and agricultural strategies to increasing climate variability.

Keywords: Rainfall, Koliba-Corubal, Climate variability, CHIRPS, Water resource management.

1. Introduction

River basins play a crucial role in water management, ecosystems, and agriculture. The Koliba-Corubal basin, located between Guinea and Guinea-Bissau, is particularly sensitive to climate variations. Although relatively small in size, it represents the primary source of freshwater for a large portion of the local population, especially in Guinea-Bissau, where access to water is limited. Water management in this region is further complicated by climatic fluctuations, changes in rainfall patterns, and the effects of climate change (Djolu et al., 2024). Understanding rainfall patterns in this basin is therefore essential for developing sustainable water management and climate change adaptation strategies.

The region has a tropical climate, with a distinct rainy season extending primarily from May to August, followed by a long dry period. However, this climate is subject to significant year-to-year variability, which can affect both water availability and agricultural productivity. Numerous studies have shown that rainfall patterns in West Africa have changed over the past few decades, with shorter rainy periods and longer droughts (Sadnabizadeh, 2023; Chagnaud, 2022; Lavaysse, 2024). These changes have major implications for water management and for local communities that depend on these resources for their livelihoods.

Rainfall data are essential for understanding these changes. However, in isolated regions like the Koliba -Corubal basin, weather station networks are often insufficient to provide reliable and

continuous data. To fill this gap, tools such as satellite-based rainfall estimation systems, like CHIRPS (Climate Information Relative Prospecting Systems), are being used. Hazards Infrared Precipitation with Station Data), are used. This system combines satellite data and ground observations to provide accurate global precipitation estimates, even in areas poorly covered by weather stations (Almeida et al., 2024). It has proven effective in tracking precipitation variability over long periods, particularly in regions where historical data are scarce (Kumar et al., 2024; Purwandani et al., 2025).

The climate of this region is strongly influenced by the West African monsoon, which regulates rainfall and temperature distribution (Nicholson, 2017). However, recent studies show that rainfall variability is also influenced by local factors such as topography, vegetation, and land use, which modify the geographic and temporal distribution of rainfall (Massart, 2025). Spatial analysis of rainfall, using geospatial and statistical methods, provides a better understanding of these regional variations and the mechanisms underlying water distribution in this river basin.

In the Koliba-Corubal basin, studies have shown that, although the rainy season is concentrated between May and August, rainfall exhibits significant variability from year to year, with prolonged dry periods and exceptionally wet years (Sambou et al., 2020). Analysis of data series reveals a general trend of increasing rainfall since 1991, with notable breaks in 1991 and 2001, suggesting significant climate change in the region (Bachir, 2024; Boursali et al., 2025). These findings are supported by Mann-Kendall and Pettitt statistical tests, which demonstrate variations in rainfall across different time scales. This information is fundamental for the future management of water resources and for strengthening the resilience of local ecosystems to these changes (Lubès -Niel et al., 1998; Karambiri & Gansaonre, 2023).

The objective of this study is to better understand rainfall variability in the Koliba-Corubal basin between 1981 and 2024. To this end, we used statistical tests such as the Pettitt test (1979) and the Mann-Kendall test (1945), which allow us to identify significant changes in rainfall time series, such as trend breaks and long-term trends (Mann and Kendall, 1945). Identifying these breaks is essential for understanding the evolution of rainfall regimes and anticipating the impacts on water resources in the region.

This study provides a detailed analysis of rainfall variability in the Koliba-Corubal basin, using satellite data and rigorous statistical tests. It offers essential information for the sustainable management of water resources and adaptation to climate change in this region of West Africa.

2. Study Area

The Koliba-Corubal catchment area is located between 11° N and 12° 30' N and between 12° W and 14° 30' W. It is shared between Guinea (84.5%) and Guinea-Bissau (15.5%), covering an area of 20,876.4 km² at the Tché-Tché hydrometric station (see figure 1).

The river originates west of Fouta Djallon, in Middle Guinea, in the Labé region. It is formed by the confluence of two rivers: the Tomine, which originates at Sangale, and the Komba, which originates at Madina. Wora. These two rivers join at Gaoual to form the Koliba. After meandering westward for over 200 km, the river marks the border between Guinea and Guinea-Bissau for a few kilometers before entering Guinea-Bissau, where it becomes the Corubal. The river then flows into the Kayanga-Geba near Xime, in a flat, marshy region where tides penetrate deep inland, forming the Geba estuary (SOFRECO, 1993; Sambou et al., 2020). Although its drainage basin is relatively small, this river is the main source of fresh water for Guinea-Bissau. The dense hydrographic network has been simplified for clarity (see Fig. 1).

The basin's vegetation includes dense forests, degraded montane forests, dry forests frequently affected by bushfires, wooded savannas, forested areas, as well as cultivated land and fallow fields

(Zoumanigui, 2003; Sambou et al., 2020). The region has a tropical climate, characterized by a single rainy season, lasting five months in the north and six months in the south, and a dry season (from April to November), during which rainfall remains low (a few millimeters). Rainfall decreases from south to north, following the flow of the West African monsoon. Average monthly maximum temperatures range from 26.0 to 33.4 °C in Labé and from 31.1 to 40.2 °C in Koundara, in August and April, respectively. Average minimum temperatures vary from 10.2 to 18.3 °C in Labé and from 15.0 to 24.2 °C in Koundara between December and May.

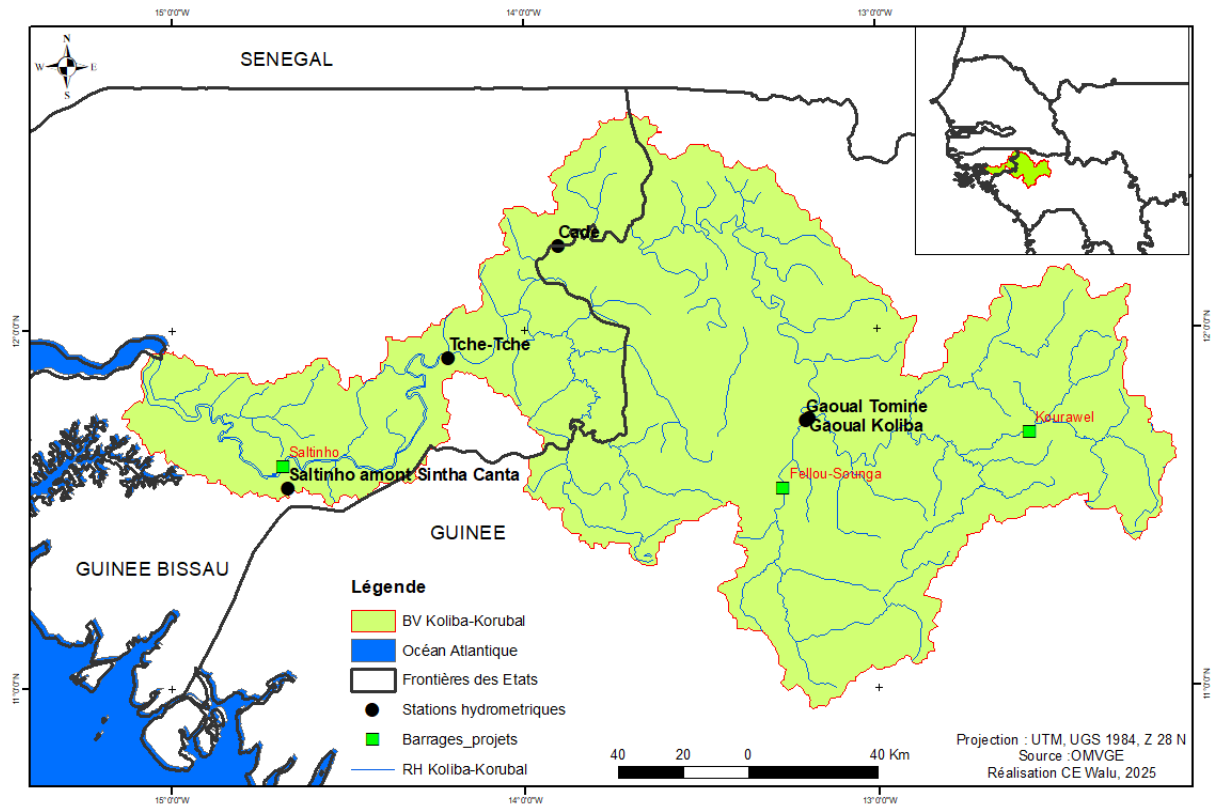


Figure 1: Koliba Corubal watershed at the stations of Tche Tche , Cade, Gaoual_Koliba and Gaoual_Tomine

3. Materials and methods

3.1. Precipitation data

The CHIRPS system (Climate) Hazards Infrared Precipitation (with Station Data) CHIRPS is a precipitation estimation method that combines satellite observations and ground-based data from meteorological stations. This system was developed to provide accurate precipitation estimates, particularly in regions where meteorological station networks are insufficient or nonexistent (Almeida et al., 2024; Kumar et al., 2024; Purwandani et al., 2025). CHIRPS data are widely used in climate, hydrological, agricultural, and disaster management studies due to their ability to provide daily and monthly rainfall information on a global scale.

CHIRPS data are generally available with a resolution of 0.05° (approximately 5 km x 5 km) and cover the period from 1981 to the present (Purwandani et al., 2025). They are particularly useful for drought monitoring, climate risk assessment, and precision agriculture. Combining satellite and ground-based data helps to compensate for biases present in satellite observations alone, especially in areas where meteorological station networks are limited or nonexistent (Almeida et al., 2024).

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CHIRPS is distinguished by its ability to provide detailed precipitation information at various time scales, including monthly, seasonal, and annual. Precipitation is estimated from the infrared (IR) index of satellites and adjusted using data from local weather stations. This allows for the generation of accurate maps and precipitation time series for large geographic areas, including remote regions where data collection networks are limited (Du et al., 2024).

CHIRPS data have been widely used to assess the impacts of climate change on rainfall patterns in various regions of the world, including Africa, where they have helped with agricultural planning and water resource management (Gwatida et al., 2023; Medina et al., 2023).

3.2. Methods used

The data processing methods used to characterize hydrological variability over the reference period rely on several statistical and geospatial approaches, aimed at analyzing and spatializing precipitation and temperature series.

3.2.1. Statistical models of variability

The initial stages of the analysis rely on characteristic models that allow us to examine the variability of precipitation and temperature. These models are applied to monthly values. And Annual climate data allows us to determine trends and changes over time. Calculating monthly and annual values makes it possible to track changes in climate parameters, focusing on the temporal variation of precipitation and temperature over the reference period. These methods help identify climate trends, such as increases or decreases in precipitation or temperature, over both seasonal and annual periods.

3.2.2. Spatial distribution of rainfall and temperatures

IDV (Interpolation of Value Data) Method: For data spatialization, the IDV (Interpolation of Value Data) method is used to distribute precipitation and temperature values across the geographic area of the study basin. This method creates a representation of the spatial distributions of the data, taking into account the variability of local conditions, thus ensuring a more accurate estimation of climatic values at each point in the basin. It therefore allows for a better understanding of how these variables are distributed across the basin and how they vary from one location to another.

Spline Method: Once the data is spatially referenced, the spline method is used to determine isohyets (lines connecting points with the same amount of precipitation) and isotherms (lines connecting points with the same temperature). This interpolation method allows for the analysis of the continuous distribution of precipitation and temperature within the basin, thus facilitating the observation of their variability and migration over different periods (by decade and by normal reference period). By plotting isohyets and isotherms, it becomes possible to visualize changes in the geographic distribution of precipitation and temperature and to determine how they have evolved over time.

These combined approaches offer a comprehensive view of climate and hydrological variability in the basin, while also enabling a detailed analysis of spatial and temporal changes in precipitation and temperature. They are essential for a better understanding of climate and hydrological dynamics and for developing adaptation and water resource management strategies.

3.2.3. Pettitt Test (1979)

A break is defined as a change in the probability distribution of the random variables governing the analyzed time series (Servat et al., 1998). According to Lubès -Niel et al. (1998), the Pettitt test was selected due to its high detection efficiency and robustness. This non-parametric test allows for the

identification of a single break, the date of which remains unknown. Equation 10 presents the Pettitt variable $U(t, N)$.

$$U_{t,N} = \sum_{i=1}^t \sum_{j=t+1}^N D_{ij} \quad (10)$$

With:

$$S = \sum_{i=1}^k \sum_{j=k+1}^n \text{signe}(x_j - x_i) \quad (11)$$

If the null hypothesis is invalidated, the break date is estimated based on the time t when the variable U_t reaches its maximum in absolute value (Soro et al., 2011). It should be noted that the test also provides an assessment of the break location based on the index k associated with the maximum of $U(k)$.

The water deficit relative to the changes reported by the Pettitt test was calculated using equation 12 (Ardoin, 2004).

$$D = \left(\frac{\bar{x}_j}{\bar{x}_i} - 1 \right) \times 100 \quad (12)$$

Or $\bar{x}_j$ is the average of the series after the break and $\bar{x}_i$ the one before the breakup.

3.2.4. Mann-Kendall Test

The Mann-Kendall test has been used to detect possible gradual changes in series of extreme variables. According to Mann (1945) and Kendall (1975), this non-parametric, rank-based test assesses whether the correlation between time and the analyzed variable is statistically significant. A set of values $(x_1, \dots, x_n)$ is considered, extracted independently from a random variable X , whose stationarity is to be examined. The Mann-Kendall statistical method is thus described as follows:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^n \text{signe}(x_i - x_j) \quad (13)$$

where n is the length of the series, $x_{i \leq n}$ and $x_{j \leq n}$ are two generic sequential data values, and the function $\text{sign}(x_i - x_j)$ is defined as follows:

$$\text{sign}(x_i - x_j) = \begin{cases} 1, & \text{si } (x_i - x_j) > 0, \\ 0, & \text{si } (x_i - x_j) = 0, \\ -1, & \text{si } (x_i - x_j) < 0. \end{cases} \quad (13)$$

The S statistic is equal to the number of positive differences minus the number of negative differences observed in the time series examined. When the null hypothesis is true, there is no correlation between the variables and time, as each data point has the same probability. The formula for the standardized Z -test is written in terms of the value of S and $\text{Var}(S)$.

$$Z = \begin{cases} \frac{S-1}{\sqrt{\text{Var}(S)}} & \text{si } S > 0, \\ 0 & \text{si } S = 0, \\ \frac{S+1}{\sqrt{\text{Var}(S)}} & \text{si } S < 0. \end{cases} \quad (14)$$

In order to measure the extent of the transformation, the Sen slope technique (Sen, 1968) was used based on Equation 14.

$$b = \text{Mediane} \left[\frac{(x_j - x_i)}{(j - i)} \right], \text{ pour } i < j \quad (15)$$

Where b is the slope between the data points x_j and x_i measured at times j and i respectively

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4. Results

4.1. Characterization of rainfall on a monthly scale

Table

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Table 1of precipitation throughout the year. These descriptors allow us to characterize the temporal and spatial variability of rainfall and to assess periods of high or low rainfall activity in the study area.

Monthly rainfall: Monthly rainfall data shows a high concentration of precipitation during the rainy season, which is primarily between May and August. May, June, July, and August see particularly heavy rainfall, reaching 68.1 mm, 194 mm, 373 mm, and 531 mm, respectively. These months account for approximately 87% of the total annual rainfall, which amounts to 1772 mm. In contrast, January, February, and December experience very low rainfall, with precipitation close to zero, indicating a pronounced dry season.

Coefficient of variation: The coefficient of variation measures the dispersion of rainfall relative to the monthly average. The months of May to August, which correspond to the rainy season, show very low coefficients (0.14 to 0.15), indicating low variability in rainfall during this period. In contrast, the months of January to April and September to December show higher coefficients, suggesting greater variability in rainfall during the dry season and the end of the rainy season.

Maximum and minimum of the series: The maximum of the series is reached in August, with 713 mm of precipitation, while the minimum is only 0.01 mm. This large interannual variability highlights the importance of fluctuating climatic conditions, affecting water availability.

Percentage rainfall coefficient: The percentage rainfall coefficient illustrates the relative contribution of each month to annual rainfall. The months of June to August are responsible for the majority of rainfall, representing 11%, 21%, and 30% of annual rainfall respectively, while January and December, with values close to zero, make virtually no contribution.

Maximum rainfall percentage: The seasonal maximum percentage reaches 97.6% during the rainy season, highlighting the high concentration of rainfall in a specific time of year. This phenomenon is typical of areas with distinct climatic seasons, where rainfall is heavily concentrated over a few months.

In summary, this table allows us to grasp the variability and trends of rainfall throughout the year, with a marked rainy season and a distinct dry season, thus providing essential information for water resource management and agricultural planning.

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Table 1: Characteristics of average rainfall in mm in the Koliba-Corubal basin 1981-202 4)

Descriptors	J	F	M	HAS	M	J	J	HAS	S	O	N	D	YEAR
Number of observations	42	42	42	42	42	42	42	42	42	42	42	42	42
Missing observations	0	0	0	0	0	0	0	0	0	0	0	0	0
Average	0.18	0.32	0.67	6.08	68.1	194	373	531	365	211	20.90	1.72	1772
Standard deviation	0.1	0.23	0.38	3.75	29.2	37.9	54.8	73.4	52.6	53.4	11.23	0.67	132
Coefficient of variation	0.55	0.72	0.56	0.62	0.43	0.2	0.15	0.14	0.14	0.25	0.537	0.39	0.07
Maximum of the series	0	1	2	18	129	278	550	713	493	360	72	3	2180
Minimum of the series	0.01	0	0.15	1.72	16.4	117	282	394	259	107	9.36	0.14	1527
Gap mm	0.36	0.91	1.57	16.6	113	161	268	318	234	253	62.60	2.86	653
Rainfall coefficient in %	0.01	0.02	0.04	0.34	3.84	11	21	30	20.6	11.9	1.17	0.1	100
Maximum rainfall season in %						0	0	97.6	2.38				100

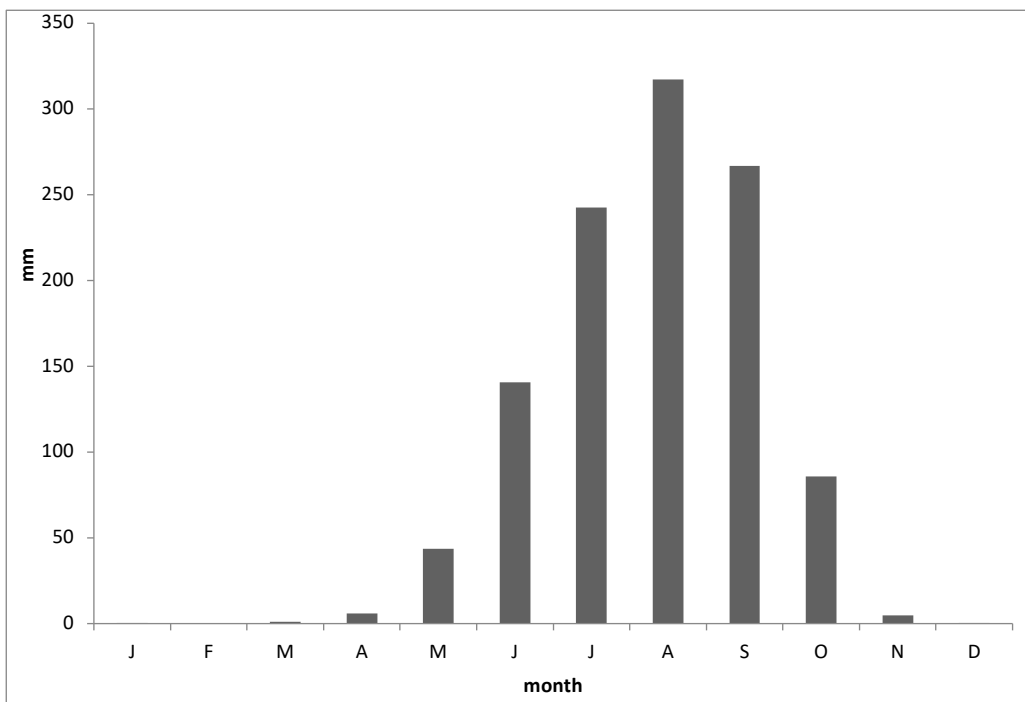


Figure 2: Monthly rainfall trends in the Koliba-Corubal basin (1981-2024)

4.2. Characterization of rainfall on an annual scale

Analysis of Mann-Kendall and Pettitt tests on annual rainfall series in the Koliba-Corubal basin (1981-2024) highlights several interesting results concerning trends and breaks in the data (**Table 2**).

The Mann-Kendall test reveals a *tau* of 0.222 and a p-value of 0.0337, indicating a significantly increasing trend in precipitation. The Sen slope is 2.688, meaning an increase of 2,688 mm per year. The Pettitt test identifies a break in 1991, with average precipitation increasing from 1,683 mm before the break to 1,802 mm after. This increase corresponds to a rate of change of 7.12%, suggesting an intensification of precipitation since that date.

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Table 2: Trend and break in the series of annual rainfall in the Koliba-Corubal basin (1981-2024)

Variable	Tau of Kendall	p -value (Mann-Kendall)	Sen slope	Break date (Year)	Average before break	Average after break	Rate of change (%) / Absolute difference (°C)
Precipitation	0.222	0.0337	2,688	1991	1683	1802	7.12

In general, these tests show a significant increasing trend for rainfall in the Koliba -Corubal basin, with specific breaks in the years 1991, 1994 and 2001.

Analysis of the SPI (Standardized Precipitation Index) in the basin shows an interesting distribution of humidity conditions over the observed periods (**Table 3** and **Figure 3**). The majority of areas in this basin are characterized by an SPI index suggesting dry conditions.

Indeed, 50% of the areas (21 years) are classified as slightly dry, followed by 9.5% (4 years) that are moderately dry. The other categories, such as "slightly wet" and "moderately wet," represent 21.4% and 14.3% of the sites respectively, suggesting periods where rainfall conditions are above average but still far from ideal for flourishing vegetation.

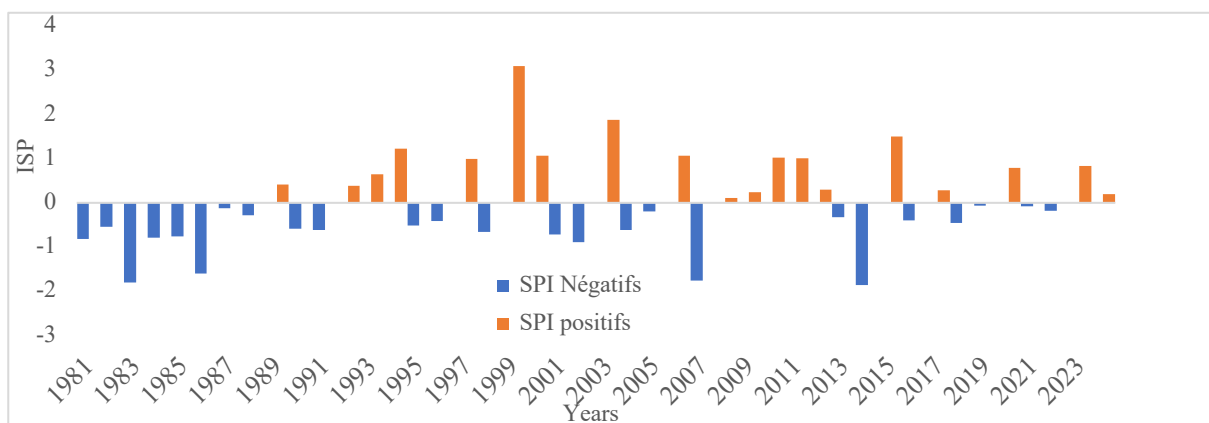


Figure 3: Standardized precipitation indices based on total rainfall in the Koliba-Corubal basin (1981-2024)

Table 3: Categories of wet and dry periods in the Koliba-Corubal basin (1981-2024)

Categories	Number	Percentage
Extremely humid	1	2.4
Severely humid	1	2.4
Moderately humid	6	14.3
Slightly damp	9	21.4
Slightly dry	21	50.0
Moderately dry	0	0.0
Severely dry	4	9.5
Extremely dry	0	0.0
Total	42	100

The extreme humidity indices, namely "extremely humid" and "severely humid," apply to only a small portion of the basin, representing just 2.4% of the stations. This distribution demonstrates that, although some areas benefit from moderate or sufficient rainfall, the majority of sites in the basin suffer from dry conditions, with significant periods of moderate to extreme drought.

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Thus, the results show a clear predominance of dry conditions (59.5%) compared to wet conditions (40.5%). These data suggest the need for water management initiatives and drought resilience strategies in the basin, particularly during periods of low rainfall.

4.3. Spatial evolution of rainfall in the basin

The analysis of the spatial distribution of rainfall in the Koliba-Corubal basin, across different geographical areas, highlights interesting trends that vary according to region and period (**Table 4**). These variations, which are particularly influenced by the evolution of rainfall over decades, are illustrated by the data from meteorological stations (Figures 4, 5 and 6).

Table 4: Spatial evolution of rainfall in the Koliba-Corubal basin (1981-2024)

Stations	Lat	Long	1981 - 1990	1991 - 2000	2001 - 2010	2011 - 2020	1981 - 2000	1991 - 2010	2001 - 2020	1981 - 2025	Rainy seaso n	Dry seaso n	Augus t
Station 1	12.5	-15	1294	1421	1439	1411	1357	1430	1425	1385	1359	26.5	450
Station 2	11	-15	2250	2510	2494	2621	2380	2502	2557	2456	2381	75.6	870
Station 5	12.5	-13.75	1248	1384	1304	1353	1316	1344	1329	1302	1257	45.2	432
Station 6	11	-13.75	2293	2475	2295	2242	2384	2385	2268	2266	2052	214	627
Station 3	12.5	-12.5	1265	1366	1372	1527	1315	1369	1450	1362	1288	74.2	437
Station 4	11	-12.5	1786	1915	1732	1816	1850	1824	1774	1773	1504	270	456

Northern Basin: In the northern part of the basin, data show a moderate increase in rainfall over the years. For example, rainfall was 1294 mm between 1981 and 1990. It increased to 1421 mm between 1991 and 2000, reaching 1439 mm between 2001 and 2010, before decreasing slightly to 1411 mm between 2011 and 2020. This shows an upward trend, but less pronounced than in other areas. This region experiences a well-defined rainy season, with rainfall of 1359 mm, while during the dry season, rainfall is low, not exceeding 450 mm. This contrast demonstrates that the northern part of the basin experiences a significant difference between seasons, with dry periods characterized by low rainfall.

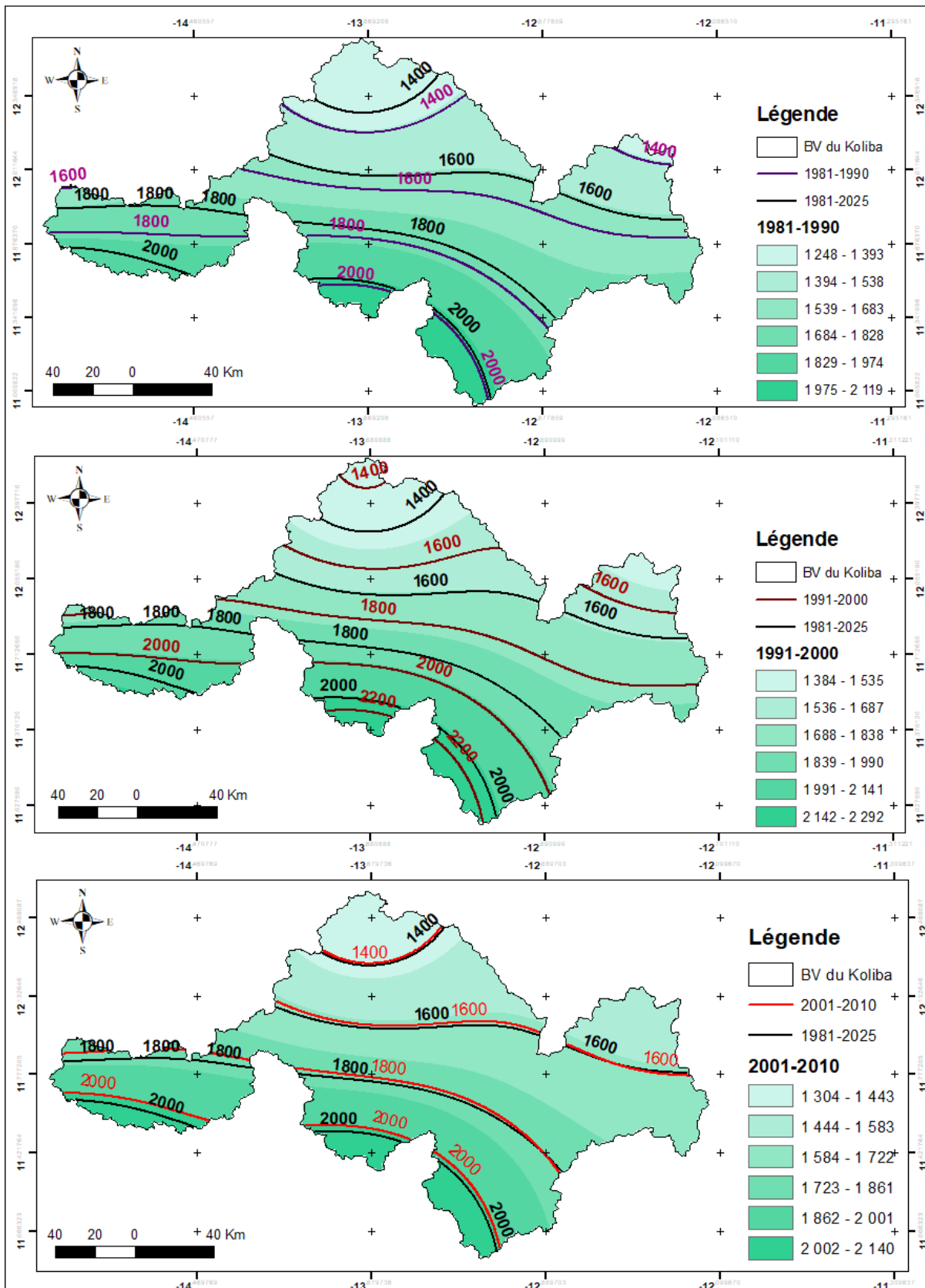
Southern Basin: The southern basin, while generally stable in terms of rainfall, exhibits notable variations, particularly in more recent periods. Data for the period 1981–1990 show rainfall of 1786 mm, increasing slightly to 1915 mm in 1991–2000. However, from 2001–2010 onward, rainfall decreased to 1732 mm, and then to 1816 mm in 2011–2020. This suggests that the southern basin has experienced some instability in rainfall over the past two decades. The rainy seasons are well-defined, with rainfall of 1504 mm, while the dry season remains relatively modest at 456 mm. Compared to the north, the southern area receives more consistent rainfall, but the variability over the years is significant.

Eastern Basin: The eastern part of the basin is distinguished by significantly higher rainfall. For example, in 1981–1990, this region already recorded 2250 mm of rainfall, increasing considerably to 2510 mm in 1991–2000. During the 2000s, this upward trend continued, reaching 2494 mm, then peaking at 2621 mm in 2011–2020. These data show that the eastern basin is particularly sensitive to intensification of rainfall, with a strong trend toward increased precipitation over the decades. The rainy season in this area is marked by exceptional rainfall of 2381 mm, while the dry season remains

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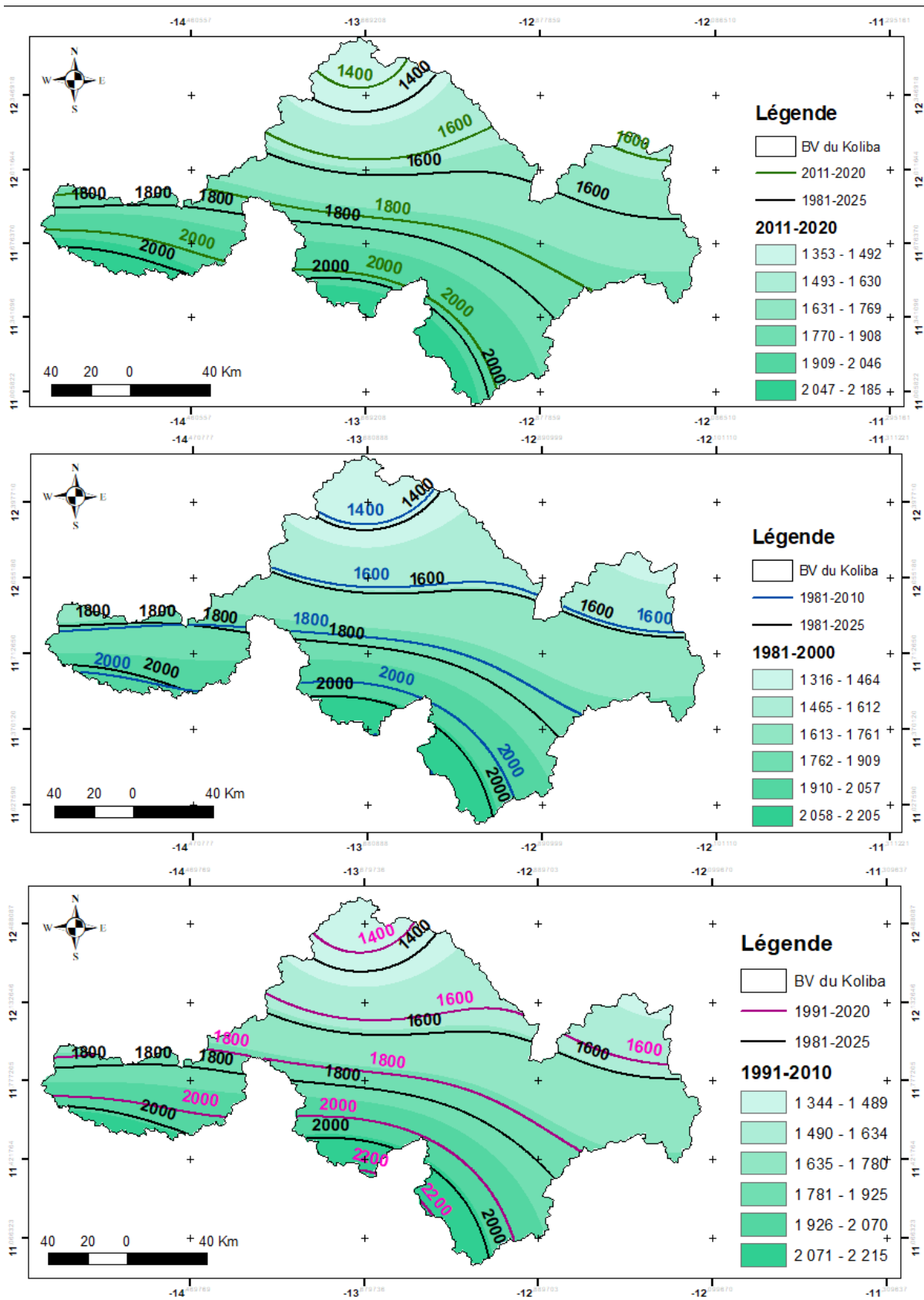
moderate at 870 mm. The sharp increase in rainfall in this region compared to other areas of the basin indicates a wetter climate and a potential impact on agricultural practices.



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Figure 4: Spatial evolution of rainfall by decade in the Koliba-Corubal basin (1981-2024)



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Figure 5: Spatial evolution of rainfall by decade and normals in the Koliba-Corubal basin (1981-2024)

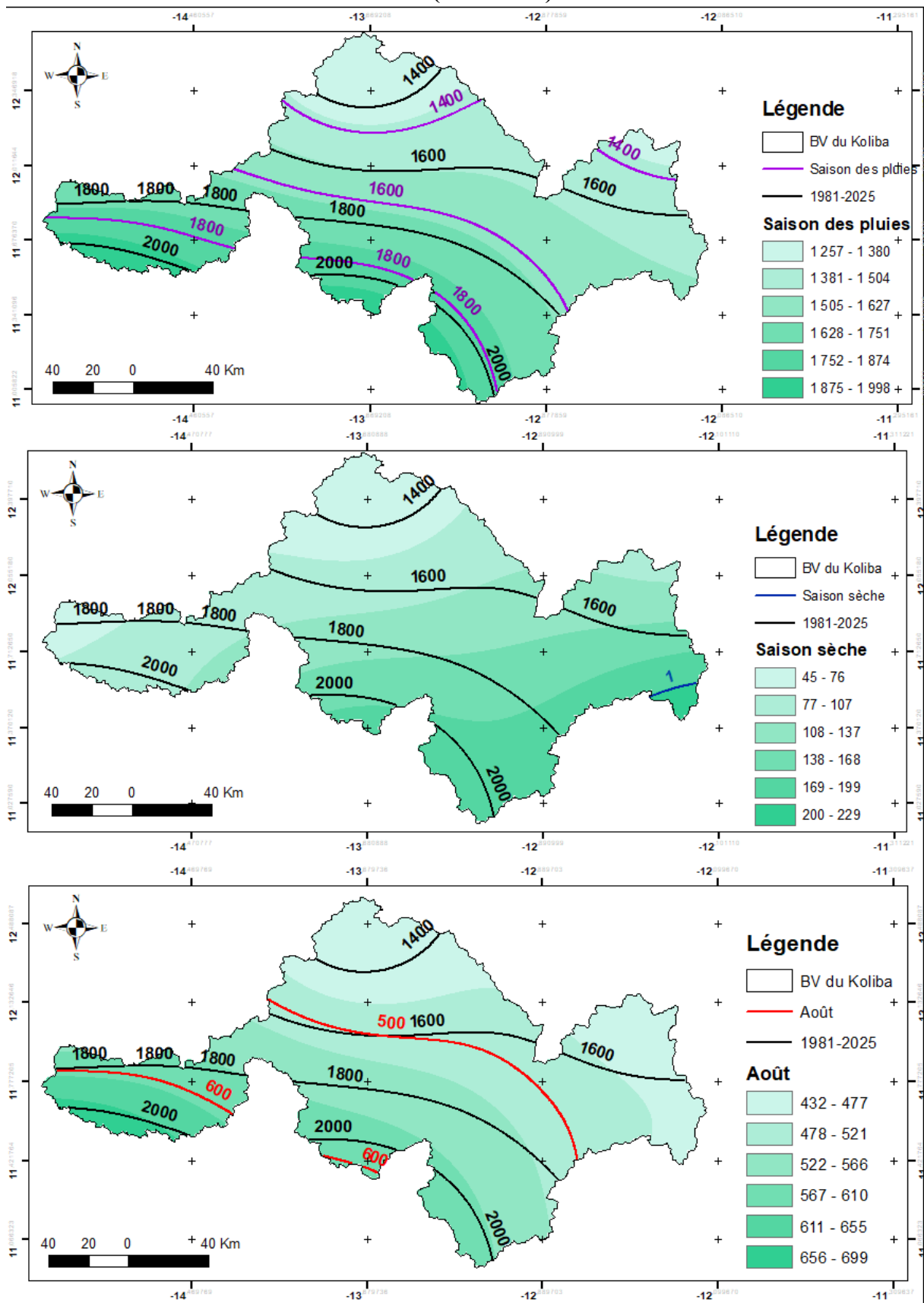


Figure 6: Spatial evolution of rainfall on a monthly and seasonal scale in the Koliba-Corubal basin (1981-2024)

Western Basin: The western part of the basin exhibits significant variability in rainfall, reflecting regional climate instability. Rainfall ranged from 2293 mm in 1981–1990 to 2475 mm in 1991–2000, before decreasing slightly to 2295 mm in the period 2001–2010 and to 2242 mm in 2011–2020. This shows considerable fluctuations compared to other regions, which could be linked to local factors or specific climate variations. During the rainy season, the west records 2052 mm of rainfall, while during the dry season, rainfall is relatively low at only 627 mm. This area therefore experiences more pronounced variations than other regions, with more severe periods of drought.

In general, meteorological station data show an overall increase in rainfall across the Koliba-Korubal basin, with distinct variations across different regions. The north shows a moderate increase in rainfall, with significant differences between seasons, while the south remains relatively stable, although some fluctuations have been noted. The **east**, on the other hand, is characterized by a sharp increase in rainfall, with particularly high values during the rainy season. Finally, the west exhibits high variability, with rainfall fluctuating over decades, which can impact agricultural activities and water resource management in the region. These geographical differences in rainfall distribution should be considered when adapting natural resource management and sustainable development policies in the Koliba-Korubal basin.

Koliba -Corubal watershed (Figure 7), illustrating the distribution of annual rainfall over different time periods. Isohyets are lines that connect points that have received the same amount of rainfall over different periods, namely 1981–1990, 1991–2000, 2001–2010, 2011–2020, and 1981–2025. Colors on the map are used to distinguish these periods, with red lines for the period 1981–1990, purple lines for 1991–2000, blue lines for 2001–2010, green lines for 2011–2020, and brown lines for the projected period 1981–2025.

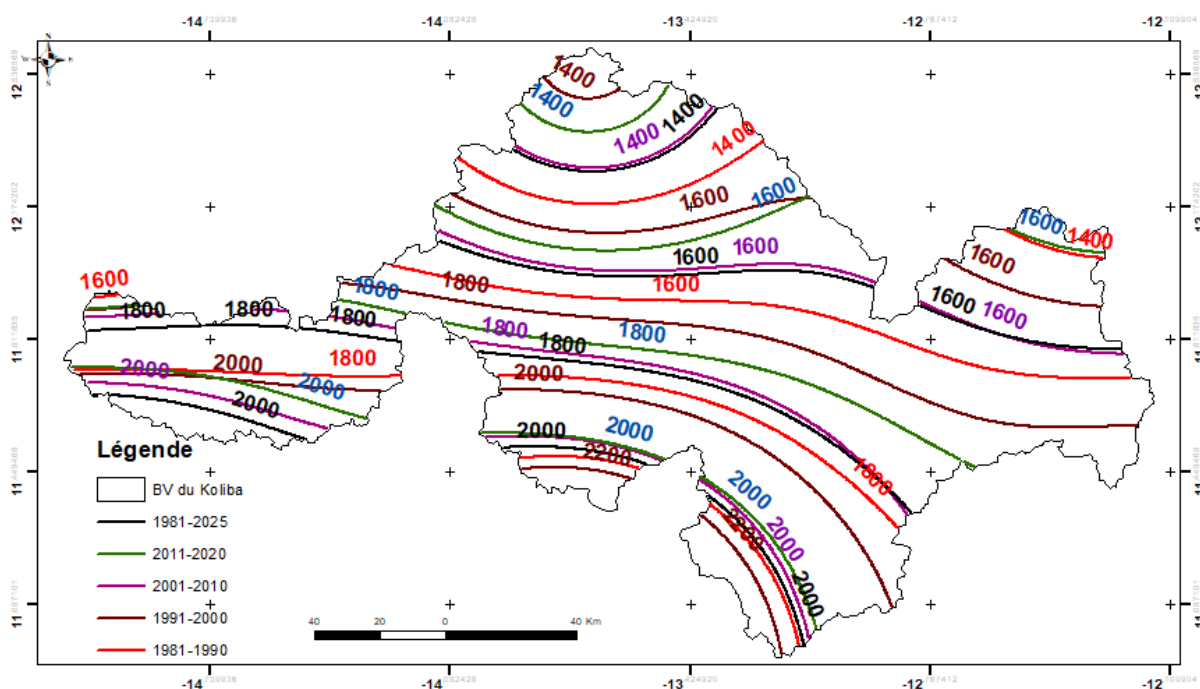


Figure 7: Migration of isohyets in the Koliba-Corubal basin (1981-2024) on a decadal scale

Observation of isohyets reveals variations in rainfall over the Koliba watershed region over the years. It is noted that some areas, particularly the northern and eastern regions, show a trend towards increased rainfall, as evidenced by the higher altitude curves (for example, 2000 mm of rainfall). Conversely, other areas, especially in the south, show a decrease in rainfall, with isohyets that are more widely spaced.

Koliba-Corubal watershed map indicates a spatial shift in precipitation zones over the studied periods. The highest isohyets (indicating greater precipitation) generally shift northward and eastward, suggesting an intensification of rainfall in these regions. This phenomenon could be linked to climate change or variations in rainfall patterns. The precipitation gradient, measured by the distance between isohyets, shows a higher concentration of rainfall in certain areas, with wetter and drier periods following distinct cycles.

This information is essential for assessing the region's climate change and its potential impacts on water management, agriculture, and biodiversity. The map also shows seasonal and interannual variations, which are crucial for anticipating drought and flood trends in the area.

5. Discussion

Analysis of rainfall in the Koliba-Corubal basin, covering the period from 1981 to 2024, has revealed several interesting trends and notable anomalies. The data show that the majority of rainfall occurs during the rainy season, from May to August, a period during which approximately 87% of annual rainfall is recorded. This phenomenon is typical of tropical regions, where a well-defined wet season is followed by a long dry period, with particularly low rainfall from November to April. However, interannual variability in rainfall is marked, which is reflected in the wide dispersion of data from year to year. This variability was analyzed using statistical tools, such as the Pettitt test, which identified breaks in the rainfall time series, including a particularly notable one in 1991. This change could indicate a significant shift in rainfall patterns in the region.

Mann-Kendall tests also revealed a trend toward increasing annual rainfall, at 2,688 mm per year, suggesting a shift in the basin's climate dynamics. This trend is consistent with other studies showing increased rainfall in parts of West Africa, possibly in response to climate change (Nicholson, 2017; Chagnaud, 2022). However, this trend is far from uniform, with marked spatial variations: some areas of the basin, such as the east, are experiencing a greater increase, while others, such as the south, show more moderate changes (Lavaysse, 2024).

The study also revealed strong spatial variability in rainfall. The northern part of the basin has experienced moderate increases in precipitation, while the eastern part has seen more significant increases over the past few decades. This could be due to changes in local atmospheric circulation mechanisms (Almeida et al., 2024). This phenomenon aligns with the findings of Chagnaud (2022), who also observed similar trends in rainfall patterns in West Africa, particularly near the Intertropical Convergence Zone (ITCZ).

As for the standardized precipitation indices (SPIs), the majority of years analyzed showed dry to moderately dry conditions. This remains a concern because, despite the overall increase in rainfall, frequent droughts continue to affect the region, impacting water availability. Previous research on climate variability in West Africa has highlighted an intensification of droughts, even in a context of overall increasing rainfall (Lavaysse, 2024; Kabore, 2025; Kongatoua, 2025).

The CHIRPS data used in this study proved very useful for regions with limited meteorological station coverage (Balaghi et al., 2024). However, as Schumann et al. (2022) point out, the accuracy of the

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estimates can vary depending on the density of ground stations and the quality of the satellite data used to fit the precipitation models. Despite these limitations, the results clearly indicate that the Koliba-Corubal basin is experiencing significant climate change, both in terms of variability and overall precipitation trends, which could have major implications for water management and agriculture in the region (Sambou et al., 2020).

Finally, these results highlight the importance of developing water and natural resource management adapted to the region's new climatic realities. While increased rainfall may promote groundwater recharge, careful management is necessary to limit the risks of prolonged droughts and seasonal flooding. Furthermore, the spatial variability of rainfall necessitates policies specific to each sub-basin, in order to adapt management strategies to local conditions (Djihouessi et al., 2025).

Conclusion

The study of rainfall variability in the Koliba-Corubal basin has highlighted important trends illustrating the effects of climate change on rainfall patterns in this region of West Africa. The results show a well-defined rainy season, but also significant year-to-year variability, with prolonged dry periods and exceptionally wet years. Statistical analysis revealed a general trend toward increased rainfall, although this varies considerably between locations and from year to year.

Break tests have revealed notable changes in rainfall patterns, particularly around 1991, which could indicate that rainfall regimes are adapting to global climate change. However, despite this upward trend in rainfall, the region continues to experience predominantly dry conditions, highlighting the need for strategic water resource management, especially given the persistently high variability of rainfall.

Differences in rainfall distribution across the basin's various zones—north, east, and south—highlight the crucial need to tailor water management and climate change adaptation policies to local realities. These findings underscore the importance of more precise water resource management to strengthen resilience to extreme weather events while optimizing water use for agriculture and local communities.

In summary, although significant progress has been made in understanding rainfall patterns in the Koliba-Corubal basin, it remains essential to continue monitoring climate trends and to implement sustainable strategies to manage water resources and address the future challenges of climate change.

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ASSESSING RESOURCE DEVELOPMENT AND MANAGEMENT STRATEGIES: BUDGETING, COORDINATION AND EVALUATION PRACTICES AT DARAGA COMMUNITY COLLEGE

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Abstract

Practices are important components in managing the available resources of the institutions. These practices could lead to success or failure of resource allocation. Thus, sustaining the resources need to careful management decisions. This study focused on examining the effectiveness of planning and budgeting practices, assessing the role of coordinating and controlling practices, and evaluating the practices of monitoring and evaluation in sustaining the college's resource development initiatives. Data were gathered through interviews from 35 key informants which are chosen purposively who have direct experience on resource development and management and employees who are in the college for more than five years. Findings revealed that there are practices in planning and budgeting, controlling and coordinating, and monitoring and evaluation. Key informants considered these practices as effective in efficient use of the resources in the college with evident improvement in the college. Furthermore, policies for improving the resource development and management practices were recommended in order to sustain the use of the resources in the college.

Keywords: Practices, Resource management, Resource development.

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ANALYSIS OF WORKERS' PERCEPTION ON SAFETY MANAGEMENT POLICY OF CARGO VESSEL IN UNILINK SHIPPING INC.

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Abstract

Every human endeavor has a valid reason to be concerned about health and safety. For the safety of the seafarers to be ensured onboard, the equipment already in place must be properly maintained, and any missing pieces must be installed in accordance with safety regulations. Shipping companies struggle with how to best use their limited resources to decrease injuries while at work and achieve the largest reduction in injuries at the lowest cost. This study was conceptualized in order to analyze the workers' perception on safety management policy of cargo vessel in Unilink Shipping Inc. In order to retain credibility, loyalty, and trust with clients and workers, safety perception is crucial. Maintaining workers' safety will boost morale, and when workers are content with their jobs, they will be more productive. When workers are certain that they can finish their work or task without endangering their health, they perform significantly more effectively. This study intends to statistically examine how the workers perceive the safety management policy in their workplace. A quantitative research design engaging in descriptive research method obtaining necessary information from 65 respondents selected randomly. Frequency distribution and weighted mean were used in analyzing the collected data. The findings revealed that the safety management policy is well-implemented as perceived by the respondents. Thus, the researcher concluded that the effectiveness of the safety management policy of Unilink Shipping Inc. is evidently practiced. A series of recommendations was crafted for possible proposal of enhancing the safety management policy of the company. A safety management policy enhancement program will help the company to maintain or improve more their workers' quality of work life.

Keywords: Safety Management Policy, Cargo Vessel, Quantitative.

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ASSESSING STRATEGIC MASTER PLANNING FOR SUSTAINABLE URBAN DEVELOPMENT IN UZBEKISTAN: A CASE STUDY OF SAMARKAND

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Abstract

Rapid urbanization in post-socialist and developing countries challenges conventional planning instruments. In Uzbekistan, master planning remains the dominant statutory planning tool, yet its capacity to integrate sustainability and socio-environmental principles within strategic frameworks is limited. This paper assesses existing master planning practices in Uzbekistan and explores the potential of strategic master planning for sustainable urban development, using Samarkand as a case study. A mixed-methods approach including GIS spatial analysis, interviews and case studies reveals regulatory and sectoral weaknesses, limited participation and inadequate sustainability integration. Based on these findings, a socio-territorial strategic master planning framework is proposed to enhance participatory governance, adaptive planning and sustainability integration.

Keywords: strategic master planning, sustainable urban development, spatial planning, urban governance, Uzbekistan, Samarkand.

Introduction

Urban planning, as a fundamental public function, plays a key role in socio-economic development, shaping the environment to ensure harmonious living conditions for the population. It integrates diverse components including population distribution, use of natural resources and productivity of urban systems, while addressing environmental, social and economic challenges.

In contemporary Uzbekistan, rapid urban growth following political and economic transformations has heightened the importance of planning instruments that can manage complex spatial, socio-economic and environmental dynamics. Uzbekistan's position in Central Asia facilitates its potential as a regional hub for economic exchange and transit, necessitating advanced urban planning tools responsive to sustainable development imperatives. However, territorial organization in many urban areas still suffers from infrastructure disparities, environmental degradation, and sectoral planning dominance, undermining integrative development efforts. Socio-territorial systems are expanding, but residual approaches to infrastructure and service provision remain prevalent, indicating the need for strategic planning that aligns development objectives with long-term sustainability goals.

Samarkand — a city with deep historical roots and growing urban pressures — exemplifies these planning challenges. The recent adoption of an **ecological master plan** aimed at improving environmental governance and urban resilience highlights the evolving governance context and the need for strategic spatial planning focused on sustainability outcomes.

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Literature Review

Strategic planning represents an approach beyond regulatory master plans, focusing on participatory governance, long-term visioning, scenario analysis, and integration of socio-environmental objectives. Globally, scholars emphasize that strategic spatial planning supports resilient urban growth by promoting multi-sector collaboration and adaptive governance structures.

Urban planning research shows the critical role of green infrastructure, ecological integration and public participation in achieving sustainable and inclusive cities. For instance, comparative analyses of ecological urban planning emphasize the significance of environmental performance indices, climate resilience, and sustainable transport within urban design.

Despite global discourse, research on Uzbekistan's urban planning systems highlights ongoing challenges including uneven infrastructure distribution, environmental pressures and insufficient integration of strategic principles into statutory plans. Local studies on urban redevelopment and planning practices underscore the importance of integrated architectural and landscape strategies within broader sustainable frameworks.

Methods

A mixed-methods framework was applied:

GIS Spatial Analysis. Geographical Information Systems (GIS) tools mapped urban expansion, land use change and infrastructure distribution in Samarkand. This spatial visualization highlighted growth dynamics and disparities in service provision.

Stakeholder Interviews and Focus Groups. Semi-structured interviews and focus group discussions were conducted with government officials, urban planners, architects and community representatives to capture perceptions of planning effectiveness and barriers to participatory decision-making.

Case Studies. Selected urban development projects in Samarkand were evaluated to illustrate practical manifestations of master planning, participation levels, and sustainability outcomes. These case studies were analyzed to identify patterns, strengths and weaknesses in current planning practices. Data were triangulated to enhance reliability and draw comprehensive insights into the strategic planning landscape.

Results

Urban Expansion Trends. GIS analysis revealed significant peripheral growth in Samarkand without corresponding expansion of social and infrastructural networks, indicating fragmentation in planning outcomes and insufficient anticipatory frameworks.

Governance and Participation Limits. Interviews indicated a sectoral and institutional focus on regulatory compliance rather than collaborative planning, with limited mechanisms for community engagement and stakeholder inclusion in decision-making processes.

Sustainability Integration Deficiencies. Existing master plans emphasize land use regulation over strategic sustainability indicators such as ecological performance, climate adaptation, and inclusive infrastructure. This gap weakens the capacity of plans to respond effectively to rapid urbanization and environmental challenges.

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Discussion

The study confirms that master planning in Uzbekistan, including in Samarkand, often prioritizes statutory compliance over strategic integration, limiting its capacity to guide sustainable development. Integration of sustainability principles — ecological planning, green infrastructure, and participatory decision-making — is essential to addressing socio-environmental and economic pressures.

A socio-territorial strategic master planning framework is proposed, incorporating participatory governance, scenario planning and sustainability metrics to support resilience and long-term development outcomes in urban systems. Such frameworks are increasingly relevant within global planning discourse and align with the evolving governance context in Uzbekistan, where public participation and multi-sector cooperation are gaining recognition as critical to planning success.

Conclusion

This research highlights critical gaps in the current master planning practices in Uzbekistan, particularly in terms of strategic orientation and sustainability integration. A strategic socio-territorial approach offers a pathway to transform master plans into adaptive instruments capable of guiding sustainable urban development. Future research should focus on operationalizing strategic practices, evaluating their long-term impacts, and exploring technological and community engagement innovations to enhance planning processes.

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EFFECT OF DESIGN BASED LEARNING ON SENIOR SECONDARY SCHOOL CHEMISTRY STUDENTS' MOTIVATION IN MINNA, NIGER STATE

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Abstract

This study examined the effect of Design based learning on secondary school chemistry students' motivation towards chemistry in Minna, Niger State. It was guided by two research objectives, two research questions, and two null hypotheses. A quasi-experimental research design, incorporating a pretest and posttest, was used, with one experimental group and one control group. The study involved 10,755 SS2 Chemistry students, from which a sample of 98 students (52 in the experimental group and 46 in the control group) was selected using a purposive and random sampling techniques. The experimental group (25 males, 27 females) was taught using the Design based learning, while the control group (20 males, 26 females) received instruction through the conventional teaching method. The intervention lasted six weeks. Data collection was conducted using the Chemistry Motivation Inventory Scale (CMIS), which had a reliability index of 0.92 (determined via Cronbach Alpha). Mean, standard deviation and ANCOVA statistics were used for data analysis. Results indicated that the Design based learning was more effective in improving students' motivation toward chemistry than conventional teaching method. Additionally, there was no significant difference in motivation scores between male and female students exposed to the Design based learning. Based on these findings, the study recommended adopting Design based learning in chemistry instruction.

Keywords: Secondary School, Students, Motivation.

INTRODUCTION

The job of science and technology for any countries can't be overemphasized. It is vital to take note of that without the information on chemistry, Nigeria as a country may be given up in the logical and chemical race. Nigerian government understood the lack of technology for public turn of events and this made her to incorporate chemistry into Senior Secondary School educational plan.

Chemistry is central to all the physical sciences and is seen in virtually every aspect of life and it is central to man's existence and survival (Idika, 2021). This shows that science technology, engineering, and mathematics (STEM). is a concept built on the foundation of chemistry as the central science (Yazachew, 2015)? As explained by Barak and Hussein-Farraj (2013), despite that chemistry being the fundamental science with immense benefits to the learners, society and the national economy, it has been described as a difficult subject for dealing with invisible and untouchable things including macroscopic, microscopic, symbolic, and process. Chemistry as a secondary school subject attempted to provide students with chemical literacy and chemical culture, as well as to promote critical thinking, problem-solving skill, and evaluative skill (Hofstein and Mamlok-Naaman, 2021), and to be useful, interesting, and enjoyable subject (Kwangmuang *et al.*, 2021). Chemistry differs from other sciences in that it can be felt in almost every aspect of people's daily life. That is, the food, clothes, and cleaning and drinking supplies we use, all involve chemistry. To have all those applications, students need to have a clear understanding of the concepts and applications of chemistry. Students, on the other hand, have been frequently struggled to recognize the manifestation of chemistry as a science in everyday happenings that they observe or experience. As a result, students

may find it challenging to apply chemical topics to a range of human activities (Yadigaroglu *et al.*, 2017). However, design-based learning has made learning of chemistry in secondary schools easier and understandable to students.

Design-based learning (DBL) is learning and teaching approach through design as the learning activity. It is different from the traditional classroom with teachers as facilitators, since students are the main part of the learning process in design-based learning. Teachers propose challenging tasks and allow students to brainstorm design ideas that reflects the theme, concepts, and standards of the project task, using the knowledge they already have. When implementing the design plan, students continue to learn new knowledge and then apply what they re-design to an idea or a prototype. Applying new knowledge to the design plan, constantly improving and optimizing the plan, and learning technology by doing make this a process of repeated cycles (Zhang *et al.*, 2021). The iterative nature of DBL could enhance deep learning and engaging classroom interaction among learners. Design-based learning (DBL), also known as design-based instruction, is an inquiry-based form of learning, or pedagogy, which is based on integration of design thinking and the design process into the classroom at the primary and post-secondary levels. Design-based learning environments can be found across many disciplines, including those traditionally associated with design (e.g. art, architecture, engineering, interior design, graphic design), as well as others not normally considered to be design-related (science, technology, business, humanities). Design-based learning can have a positive impact on students' motivation, interest and conceptual understanding in chemistry. By engaging in hands-on design projects, students are encouraged to think creatively, and apply their knowledge in real-world contexts (Saritepeci, 2020). This approach nurtures their creativity, as they are required to come up with innovative solutions. Additionally, the practical nature of design-based learning often leads to a deeper understanding of scientific concepts, ultimately boosting academic achievement and motivation of students.

Motivation is an educational approach that integrates hands-on design challenges with theoretical learning. It emphasizes students' motivation and engagement through real-world problem-solving. Motivation is crucial in education because it influences how students' approach, engage with, and persevere in learning tasks. Two types of motivation generally guide learning:

Intrinsic Motivation: Students are driven by internal factors like curiosity, interest, or enjoyment.
Extrinsic Motivation: Students are driven by external rewards or pressures, such as grades, recognition, or the desire to avoid failure. So therefore, when students feel motivated it will stimulate the interest of students in learning. By applying the Design based leaning to the classroom, students may be motivated to learn in new ways or enjoy otherwise tedious tasks irrespective of gender.

The effect of gender on learning, motivation was investigated by probing learners' engagement and learning in the process of using the Design based leaning. Therefore, improving students' achievement levels in chemistry implies improving the level at which they will be motivated by the concepts of chemistry. Feizabadi *et al.* (2016) report that anything that aids learning should improve motivation, while things that lead to confusion or interference among learning materials decrease the speed and efficiency of learning and accelerate forgetting. Hence, the researcher sees the need to find out if the Design based leaning could improve the motivation of male and female students in chemistry.

1.2 statement of research problem

The teaching and learning of Chemistry in senior secondary schools have often been characterized by traditional, lecture-based methods that focus primarily on theoretical knowledge, leaving little room for student engagement and practical application. As a result, many students exhibit low motivation and interest in the subject, leading to suboptimal learning outcomes and a lack of enthusiasm toward

pursuing careers in science-related fields. Recent educational research suggests that design-based learning (DBL), which emphasizes problem-solving, hands-on activities, and real-world applications, has the potential to enhance student motivation and engagement.

However, despite the growing body of evidence supporting the effectiveness of DBL in various educational settings, there is limited research on its impact on senior secondary school Chemistry students, particularly in the context of Minna. Therefore, this study aims to investigate the effect of design-based learning on the motivation of senior secondary school Chemistry students in Minna. Specifically, the study seeks to determine whether DBL can improve students' interest, effort, and persistence in learning Chemistry, and whether this approach can lead to better learning outcomes in the subject.

By examining the impact of DBL on student motivation, the study will provide valuable insights into alternative teaching strategies that could address the current challenges in Chemistry education and inspire more students to pursue science-based careers.

1.3 Aim and Objectives of the Study

The aim of this study is to determine the effect of design-based learning in enhancing motivation among senior secondary school chemistry students in Minna.

1. Find out the effects of Design-Based Learning on motivation of senior secondary school chemistry student in Minna.
2. Determine the effects of Design-Based Learning on senior secondary school chemistry student's motivation based on Gender in Minna.

1.4 Research Questions

The study will be guided by the following research questions:

- What is the difference in the mean motivation score of senior secondary school chemistry students taught using Design-Based Learning and those taught using lecture method?
- What is the difference in the mean motivation score based on gender of senior secondary school chemistry students taught using Design-Based Learning and those taught using lecture method?

1.5 Null Hypothesis

The following null hypotheses were formulated and would be tested at a 0.05 level of significance:

HO₁: There is no significant difference in the mean motivation score of senior secondary school chemistry students taught using Design-Based Learning and those taught using lecture methods.

HO₂: There is no significant difference in the mean motivation score based on gender of senior secondary school chemistry students taught using Design-Based Learning and those taught using lecture methods.

METHODOLOGY

The study utilized a quasi-experimental research design, specifically a pretest-posttest non-equivalent, non-randomized control group approach. The independent variable was the teaching method which include design-based learning and the conventional teaching method. The dependent variable was students' motivation towards chemistry, with gender included as a moderating factor.

The population of the study consisted of 10,755 Senior Secondary 2 (SS2) Chemistry students in public secondary schools within Minna, according to Niger state secondary education board (2023).

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A sample of 98 SS2 chemistry students (45 males and 53 females) was drawn from two randomly selected public schools in Minna through a multi-stage sampling technique:

- Purposive sampling was used to select schools to ensure gender representation.
- Random selections of schools: Two schools were chosen.
- Selection of intact classes: one chemistry class from each school was randomly selected.
- Assignment of groups: the classes were assigned to either the experimental or control group through a coin loss.

The sample distribution was as follow:

Group	Male	Female	Total
Experimental Group	25	27	57
Control Group	20	26	46
Total	45	53	98

The research instrument, the Chemistry Motivation Inventory Scale (CMIS), was adopted. It consisted of 20 items designed to gauge students' motivation towards Chemistry. Responses were measured on a 4-point Likert scale:

- (4) =Highly Motivated..... HM
(3) =Motivated M
(2) =Moderately Motivated MM
(1) =Not Motivated NM

The CMIS was administered before (pretest) and after (posttest) the instructional intervention to assess students' motivation toward Chemistry before and after exposure to the Design based learning and conventional Teaching Method.

Lessons plans were prepared for both teaching approaches to ensure instructional consistency. To establish the instruments validity, three experts___ two in Science Education and another in Educational Technology department (FUTMINNA) evaluated the CMIS for face validity, ensuring clarity and alignment with study objectives.

A pilot test was conducted with 20 SS2 Chemistry students from a school within the study population but not included in the sample. Reliability was assessed using Cronbach's Alpha, yielding a coefficient of 0.92.

To ensure the effective implementation of the teaching methods:

1. Chemistry teachers from the selected schools were trained as research assistant,
2. Training was conducted one week before the experiment to familiarize them with the lesson plans.
3. Students in the experimental group received instruction on the design-based learning, while the control group was taught using the conventional method.
4. The instructional intervention lasted 6 weeks, following this sequence:
 - i. Pretest Administration: Measured students' initial motivation toward Chemistry,
 - ii. Implementation of teaching methods:
 - Experimental Group: Taught using the design-based learning.
 - Control Group: Taught using the conventional Method.
 - iii. Posttest Administration: Evaluated students' motivation after the intervention.

The data collected were analyzed using both descriptive statistics of mean and standard deviation and inferential statistics of Analysis of Covariance (ANCOVA).

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Presentation of Results

What is the difference in the mean motivation score of senior secondary school chemistry students taught using Design-Based Learning and those taught using lecture method?

To address this question, the mean score was analyzed, as shown in the table 1 below:

Table 1: Mean Motivation scores of Experimental and control in the CMIS

Group	N	Pre-motivation Mean	Post-motivation Mean	Mean gain
Experimental	52	48.10	61.30	13.20
Control	46	51.20	52.20	1.00
Mean rank diff.		-3.10	9.10	12.20
Total	98			

Table 1 displays the mean scores for students' motivation in both the experimental and control groups. The experimental group had a pre-motivation mean of 48.1, which increased to 61.3 after the intervention, resulting in a mean gain of 13.3, meanwhile, the control group had a pre-motivation mean score of 51.20, which slightly increased to 52.2 leading to mean rank gain of only 1.0, the difference in post-motivation scores between the experimental and control was 9.1, favouring the experimental group. This variation suggests that students exposed to the Design based learning demonstrated a more positive motivation toward chemistry compared to those thought using the conventional method.

Research Question Two

What is the difference in the mean motivation score based on gender of senior secondary school chemistry students taught using Design-Based Learning and those taught using lecture method?

Mean scores for both groups were used in answering this question as shown in table 2 below;

Table 2: Mean motivation scores of Experimental Group Male and Female students in the CMIS

Group	N	Pre-motivation Mean	Post-motivation Mean	Mean gain
Experimental	25	48.80	60.40	11.60
Control	27	47.60	62.10	14.50
Mean rank diff.		1.20	-1.70	-2.90
Total	52			

The table shows that male students had pre-motivation mean of 48.8 and a post-motivation mean of 60.4, resulting in a mean gain of 11.6, Female students had a pre-motivation mean of 47.6 and a post-motivation mean of 62.1, leading to mean gain of 14.5. the difference in motivation mean scores between male and female students that gender does not significantly influence students' motivation toward chemistry.

Test of Hypotheses

Hypothesis One

HO₁: There is no significant difference in the mean motivation score of senior secondary school chemistry students taught using Design-Based Learning and those taught using lecture methods.

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To evaluate this hypothesis, an Analysis of Covariance (ANCOVA) was conducted on students' motivation mean scores from both the experimental and control groups. The results are summarized in the table below;

Table 3: Summary of Analysis of Covariance (ANCOVA) of Experimental and Control in CMIS

Source	Type III Sum of Squares	df	Mean square	F	Sig.	Partial Eta Squared
Corrected Model	3770.721 ^a	2	1885.36	105.530	.000	.690
Intercept	751.484	1	751.484	42.063	.000	.307
PreCMIS	1770.819	1	1770.89	99.119	.000	.511
Motivation	2870.749	1	2870.79	160.685	.000	.628
Error	1697.238	95	17.866			
Total	324098.00	98				
Corrected Total	5467.959	97				

a. R Squared = .690 (Adjusted R Squared = .683)

The table show the post-intervention motivation mean scores for students in the experimental and control groups. The F-value of 160.685 with P-value Of 0.00 ($p < 0.05$) indicates that the effect of the Design based learning on students' motivation toward Chemistry was statically significant. Since the p-value is lower than the alpha level of 0.05, the null hypothesis is rejected. This implies that the Design based learning had a significant positive impact on students' motivation toward Chemistry compared to the conventional teaching method, as indicated by the mean rank scores favouring the experimental group.

Hypothesis Two

HO₂: There is no significant difference in the mean motivation score based on gender of senior secondary school chemistry students taught using Design-Based Learning and those taught using lecture methods.

To evaluate this hypothesis, an Analysis of Covariance (ANCOVA) was conducted on students' motivation mean scores of male and female students. The results are summarized in the table 4 below;

Table 3: Summary of Analysis of Covariance (ANCOVA) of Mean Motivation Scores of Male and Female Students in the Experimental Group

Source	Type III Sum of Squares	df	Mean square	F	Sig.	Partial Eta Squared
Corrected Model	67.074 ^a	2	33.537	1.963	.151	.074
Intercept	1510.663	1	1510.663	88.421	.000	.643
Pre	14.128	1	14.128	.827	.368	.017
Gender	61.068	1	61.068	3.574	.065	.068
Error	837.157	49	17.086			
Total	196108.00	52				
Corrected Total	904.231	51				

b. R Squared = .074 (Adjusted R Squared = .036)

The table 4 presents the ANCOVA results for the mean motivation rank scores of male and female who were instructed using the Design based learning, the results show $F(1, 51) = 3.574$, $P = 0.065$, which is greater than the alpha level of 0.05, consequently, the null hypothesis is retained, indicating that there is no significant difference in the motivation levels of male and female students exposed to

the Design based learning. This suggests that Design based learning is equally effective for both genders.

Discussion of findings

This study investigated the effect of the Design based learning on motivation of secondary school chemistry students towards chemistry in Minna, Niger State. According to the findings, there was a significant difference between the mean motivation scores of taught using the Design based learning and those instructed conventional teaching method. The results demonstrated that students exposed to the Design based learning achieved higher mean motivation scores compared to those who underwent conventional teaching. Consequently, the null hypothesis was rejected.

The findings further suggest that the Design based learning effectively enhanced students' motivation toward chemistry in the experimental group, leading to a considerable increase in their mean scores. In contrast, the control group, which was taught using conventional method exhibited only a slight increase in mean score. Overall, the data indicated that Design based learning had a significant positive impact on students' motivation, while the traditional teaching method resulted in minimal improvement. This highlight the pivotal role of the Design based learning in fostering a more positive motivation toward chemistry.

The findings of this study align with the findings of Albinus *et al.*, (2018), the results showed that the student motivation and achievements of the experimental group were significantly higher than the controlled group on the subject of acid and base solutions, with a significance level of 5%(with the criteria of $\text{Sig} < \alpha$ value is $0.001 < 0.05$); Furthermore, there was a positive correlation between motivation and student outcomes at a significance level of 5%. The results are in consistent with Uzezi, (2017), the Brain-Based Learning approach used in the experimental group was more effective in increasing student achievement, attitude and motivation of students towards chemistry than the Lecture-Based approach used in the control group.

The findings revealed that there was no statistically significant difference in the mean motivation scores between male and female students taught chemistry using the design-based learning. Both male and female students in the experimental group showed improved motivation toward chemistry, with no notable gender-based difference.

The mean scores of both genders increased, indicating that intervention was beneficial to both male and female students. This finding is consistent with the conclusion of Muhammad *et al.*, (2023), The results revealed that digital game-based learning has a more positive impact on student engagement and motivation compared to traditional online activities. The incorporation of a leader board as a gaming element in the study was found to positively impact the academic performance of certain students, but it could also demotivate some students. Furthermore, female students generally showed a slightly higher level of enjoyment toward the games compared to male students, but they did not prefer a comparison with other students as much as male students did.

Conclusion

This study's findings indicate that employing the Design based learning in chemistry instruction significantly enhances students' motivation. Additionally, the absence of notable gender differences suggests that both male and female students can benefit from this approach equally, ensuring an unbiased and effective learning experience.

Recommendation

Based on the findings, the following recommendations were proposed:

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1. The federal ministry of education should advocate for the Design based learning in secondary school chemistry instruction to enhance students' motivation.
2. Regular professional development programs should be organized for chemistry teachers to ensure they effectively implement Design based learning, thereby improving students' engagement and outcomes.

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BIOLOGICAL ACTIVITIES OF *MICROMERIA THYMMIFOLIA*

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Abstract

The present work was undertaken to determine the total phenol and flavonoid content in five extracts of *Micromeria thymifolia* growing wild in southwest Serbia as well as to evaluate antioxidant and antimicrobial activity towards 20 strains of human pathogenic bacteria and fungi. In order to define a chemotype of this *M. thymifolia*, chemical composition of essential oil was determined. The major compounds were: isomenthone, pulegone, piperitone, piperitenone and piperitenone oxide. By using Folin-Ciocalteu reagent, the concentrations of total phenols were examined and the obtained values ranged from 19.21 to 154.25 mgGA/g. The concentrations of flavonoids were examined by using aluminium chloride method and obtained values ranged from 12.51 to 92.03 mgRU/g. Antioxidant activity was evaluated by measuring the scavenging capacity of extracts on DPPH. Tested extracts expressed strong scavenger activity with IC₅₀ values between 42.73 to 562.95 µg/ml. The most active was water extract. The strongest antibacterial activity, determined by microdilution method, was detected on bacteria such as *Escherichia coli* ATCC25922, *Bacillus* species, *Staphylococcus aureus*, obtaining MIC from < 0.16 to 0.6 mg/ml while antifungal activity was moderate with MICs between 5 and 20 mg/mL.

Keywords: Antimicrobial activity, antioxidant activity, essential oil, flavonoids, total phenols.

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MEDIATING DEMOCRATIC STANDARDS IN SETTTLING DISPUTES AT AN ACADEMIC SETTING IN ALBANIA

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Abstract

Academic mobbing, particularly when perpetrated by institutional leaders, represents a significant challenge within educational environments. It is an insidious and pervasive form of harassment that occurs within educational institutions, impacting faculty, staff, and students alike. Characterized by systematic, 'ganging up' behavior to "wear and tear" a colleague down emotionally, academic mobbing manifests through behaviors such as persistent criticism, exclusion from professional activities, and the spread of malicious rumors. This phenomenon can lead to severe psychological and professional consequences for the targeted individuals, including stress, anxiety, diminished job satisfaction, and even career derailment.

This study investigates the phenomenon of academic mobbing within faculty leadership, specifically focusing on a case in Albania where a faculty leader targets a single faculty member. Academic mobbing, a form of workplace harassment, involves the collective aggression of colleagues towards an individual, often leading to severe psychological and professional repercussions. The research problem addresses the dynamics and impacts of such mobbing on the victim and the academic environment. This study investigates the phenomenon of academic mobbing, focusing on how heads of institutions target and impact academic staff.

Methodologically, the study employs a qualitative case study approach, utilizing in-depth interviews, document analysis, and observational data to explore the experiences of the targeted faculty member and the behavior of the mobbing leader. The research aims to uncover the underlying motives, tactics, and consequences of this specific instance of mobbing, providing a detailed narrative of the victim's ordeal and the institutional response.

Key findings reveal a pattern of systematic harassment, including professional undermining, social isolation, and reputational damage, orchestrated by the faculty leader. The study highlights the power dynamics and institutional weaknesses that enable such behavior, emphasizing the need for robust anti-mobbing policies and support mechanisms within academic institutions.

The implications of this study are significant for educational leadership and policy-making. By shedding light on the destructive impact of academic mobbing, this research calls for comprehensive measures to prevent and address mobbing, fostering a healthier and more inclusive academic environment.

Keywords: academic mobbing, harassment, educational institutions, bullying, psychological consequences, professional consequences, power struggles, reputation, anti-bullying policies, support system.

Introduction

Background of the study

Academic mobbing, a form of collective bullying, has become a critical issue within higher education institutions. This phenomenon occurs when a faculty leader, driven by personal, political, or professional motives, orchestrates a campaign to ostracize, marginalize, or undermine a targeted faculty member. This behavior disrupts the academic environment, impacts the victim's mental health and professional reputation, and undermines the integrity of educational institutions. This

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study focuses on understanding the dynamics of academic mobbing from the perspective of faculty leadership, specifically examining a case where a faculty leader bullies a single faculty member.

Academic institutions are often perceived as bastions of knowledge, learning, and intellectual freedom. However, these environments can sometimes become arenas for power struggles, interpersonal conflicts, and professional rivalries. One manifestation of such negative dynamics is academic mobbing, a phenomenon where a faculty member becomes the target of systematic bullying and harassment by colleagues. This study investigates the specific case of academic mobbing directed at a faculty leader in Albania, where cultural, institutional, and personal factors interplay to create a hostile work environment.

Academic mobbing can lead to significant psychological, professional, and social consequences for the targeted individual. The implications extend beyond the immediate victim, affecting the overall academic atmosphere, productivity, and the institution's reputation. This study aims to shed light on the dynamics of academic mobbing within the context of a faculty leader bullying a fellow faculty member in Albania, exploring the underlying causes, processes, and impacts of such behavior.

Research Problem

The research problem addressed in this study is the prevalence and dynamics of academic mobbing in Albanian higher education institutions, with a focus on the case of a faculty leader bullying another faculty member. Despite the growing recognition of workplace bullying in various sectors,

academic mobbing remains under-researched, particularly in the context of Albanian academia. This gap in the literature necessitates a detailed examination of the factors contributing to such hostile interactions, the experiences of the victims, and the broader implications for the academic community.

Purpose of the Study

The primary purpose of this study is to investigate the dynamics of academic mobbing involving a faculty leader and a faculty member in an Albanian higher education institution. By examining this specific case, the study aims to:

- Identify the characteristics and manifestations of academic mobbing in this context.
- Understand the personal, organizational, and cultural factors contributing to the mobbing behavior.
- Explore the impact of mobbing on the targeted faculty member's professional and personal life.
- Provide insights and recommendations for preventing and addressing academic mobbing in higher education institutions.

Research Questions

The study seeks to answer the following research questions:

1. What are the key characteristics and forms of academic mobbing experienced by the faculty member in the case study?
2. What personal, organizational, and cultural factors contribute to the occurrence of academic mobbing in this context?
3. How does academic mobbing affect the targeted faculty member's professional and personal life?
4. What strategies can be implemented to prevent and address academic mobbing in Albanian higher education institutions.

Significance of the Study

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This study is significant for several reasons:

1. **Academic Contribution:** It fills a gap in the literature on academic mobbing, particularly within the context of Albanian higher education.
2. **Practical Implications:** The findings can inform policies and practices aimed at creating a safer and more supportive academic environment.
3. **Awareness and Advocacy:** By highlighting the issue, the study aims to raise awareness among academic leaders, policymakers, and faculty members about the detrimental effects of mobbing and the importance of addressing it.
4. **Victim Support:** It provides insights into the experiences of mobbing victims, which can be used to develop support mechanisms for those affected.

Scope and Delimitations

The study focuses on a single case of academic mobbing involving a faculty leader and a faculty member in an Albanian higher education institution. While this specific case provides detailed insights, it may not be fully generalizable to all academic mobbing situations or to other cultural contexts. The research is delimited to the experiences of the involved individuals and the institutional environment in which the mobbing occurred.

A corpus of terms suggests the content behind the scope of the Study: Academic Mobbing as Systematic harassment and bullying of an individual by colleagues within an academic institution. Faculty Leader as a person in a position of authority within a faculty, such as a department head or senior professor; Bullying as a repeated aggressive behavior intended to harm or intimidate the targeted individual. Higher Education Institution as an organization that provides tertiary education, such as universities and colleges.

Albania: A country in Southeast Europe where the case study is situated.

This introductory chapter sets the stage for a detailed examination of academic mobbing, providing a clear framework for understanding the specific dynamics involved in the bullying of a faculty member by a faculty leader in Albania.

Literature Review

This chapter presents a comprehensive review of the literature pertinent to understanding the dynamics of academic mobbing, particularly focusing on faculty leadership in Albania. The review is structured to provide a theoretical framework, highlight empirical studies on academic mobbing, and discuss leadership dynamics within academic settings. The specific focus on the mobbing of a faculty leader bullying a faculty member in Albania will help contextualize the broader theories and findings within a localized setting.

Theoretical Framework

Theories of Workplace Bullying and Mobbing

Workplace bullying and mobbing are phenomena that have garnered significant attention in organizational psychology and management literature. Leymann (1990) is often cited as the pioneer in defining mobbing, describing it as hostile and unethical communication directed systematically by one or a few individuals towards a single individual. The primary theories of workplace bullying and mobbing include: Leymann's Model of Mobbing: Leymann identified five phases of mobbing: conflict, aggression, stigmatization, severe trauma, and expulsion from the workplace. This model highlights the progressive nature of mobbing and its impact on the victim's psychological and physical well-being.

Heinz Leymann's Organizational Model: Leymann also emphasized the role of organizational factors, such as poor management and ambiguous roles, in facilitating mobbing. His work suggests that organizational culture and structure can either mitigate or exacerbate mobbing behaviors.

Namie and Namie's Hostile Workplace Theory: This theory posits that bullying is a deliberate, systematic campaign by a bully to undermine, humiliate, and isolate a target. Namie and Namie argue that bullies often target competent individuals who pose a threat to their power or position.

Theories of Organizational Behavior and Leadership

Understanding the dynamics of academic mobbing also requires an exploration of organizational behavior and leadership theories. Key theories include:

Transformational Leadership Theory: This theory, proposed by Bass (1985), suggests that transformational leaders inspire and motivate followers to achieve higher levels of performance by focusing on vision, change, and innovation. However, a lack of transformational leadership can create an environment conducive to mobbing.

Transactional Leadership Theory: In contrast, transactional leadership, which focuses on exchanges between leaders and followers, can lead to a rigid and hierarchical workplace culture. Such environments may lack the flexibility and support needed to prevent mobbing.

Social Exchange Theory: This theory, articulated by Blau (1964), suggests that relationships within organizations are based on reciprocity and mutual benefit. When these exchanges are imbalanced, it can lead to conflict and mobbing.

Empirical Studies on Academic Mobbing

Empirical studies on academic mobbing provide insights into the prevalence, causes, and consequences of mobbing in academic settings. Key findings include:

Prevalence of Mobbing: Studies by Keashly and Neuman (2010) indicate that mobbing is a significant issue in academia, with higher education institutions reporting higher rates of mobbing compared to other sectors.

Causes of Mobbing: Research by Einarsen et al. (2011) highlights factors such as competition for resources, power struggles, and organizational culture as key drivers of mobbing. In academia, the pressure to publish and secure funding can exacerbate these tensions.

Consequences of Mobbing: The consequences of mobbing are severe, including psychological distress, decreased job satisfaction, and higher turnover rates (Zapf et al., 1996). Victims of mobbing often experience long-term health issues and career setbacks.

Leadership Dynamics in Academic Settings

Leadership dynamics in academic settings play a crucial role in either preventing or perpetuating mobbing behaviors. Key aspects include:

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Role of Faculty Leaders: Faculty leaders, such as department heads and deans, have a significant influence on the organizational culture. Their leadership style can either create a supportive environment or contribute to a toxic atmosphere.

Power and Hierarchy: Academic institutions are often characterized by hierarchical structures, where power imbalances can lead to exploitation and mobbing. Leaders who misuse their power can create an environment where mobbing is tolerated or even encouraged.

Conflict Resolution: Effective conflict resolution strategies are essential in preventing and addressing mobbing. Leaders who are skilled in conflict resolution can mediate disputes and foster a collaborative environment.

Summary of Literature Review

This literature review has outlined the theoretical frameworks and empirical studies relevant to understanding academic mobbing, with a particular focus on faculty leadership dynamics. The review highlights the importance of leadership style, organizational culture, and power dynamics in influencing the prevalence and impact of mobbing. In the context of Albania, specific cultural and organizational factors may further complicate these dynamics, necessitating targeted research and interventions. The insights gained from this review will inform the subsequent analysis of the case study on academic mobbing in Albanian faculty leadership.

Methodology and Research Design

This study employs a qualitative research design to explore the intricate dynamics of academic mobbing within faculty leadership, focusing specifically on the case of a faculty leader bullying a single faculty member or young researcher at an academic setting in Albania. Qualitative research is chosen due to its strength in providing a deep understanding of complex social phenomena through detailed, contextualized insights. This design is particularly suited for investigating the subjective experiences and social interactions that characterize academic mobbing.

Case Study Approach

The case study approach is utilized to provide an in-depth examination of the specific instance of academic mobbing. Yin (2018) defines a case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context. This approach allows for a comprehensive exploration of the unique factors and dynamics at play in this case of faculty mobbing in Albania. By focusing on a single case, the study aims to uncover the nuanced and multifaceted nature of mobbing, shedding light on the experiences of the victim, the behaviors of the perpetrator, and the institutional context that enables such behavior.

Selection of Case

The case selected for this study involves a faculty leader at an Albanian university who systematically applied a gang up behavior towards a faculty member. This case was chosen due to its clear manifestation of mobbing behaviors, the availability of detailed documentation, and the willingness of the victims to participate in the study. The selection criteria also included the impact of the bullying on the victim's professional and personal life, the visibility of the case within the academic community, and the potential for gaining insights that could inform interventions and policy changes.

The case was selected based on the following criteria: **Relevance:** The case involves a clear instance of mobbing where a faculty leader is bullying a specific faculty member to make a target and suppress others from expressing freely and independently.

Access: The researcher has access to the faculty members involved and relevant documents, ensuring comprehensive data collection.

Significance: The case is significant in terms of its potential to provide insights into the mechanisms

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and effects of academic mobbing, contributing to the broader understanding of this issue.

Ethical Approval: The selected case has received ethical approval for study, ensuring that the research can be conducted responsibly.

Data Collection Methods

Interviews

Semi-structured interviews are conducted with the victim, the perpetrator (where possible), colleagues, and university administrators. The interviews aim to capture the personal experiences and perceptions of the involved parties. An interview guide is developed to ensure consistency while allowing for flexibility to explore emergent themes. Interviews are recorded and transcribed verbatim for analysis.

Document Analysis

Document analysis includes the examination of emails, formal complaints, meeting minutes, and any other relevant documents. These documents provide contextual background and help corroborate the information obtained through interviews. Document analysis is crucial for understanding the institutional responses to the mobbing incidents and the formal procedures followed.

Data Analysis Procedures

Data analysis follows a thematic approach, as outlined by Braun and Clarke (2006). Thematic analysis involves the identification, analysis, and reporting of patterns within the data. The process includes several steps:

Familiarization with the Data: Reading and re-reading the interview transcripts and documents to immerse in the data.

Generating Initial Codes: Coding interesting features of the data systematically across the entire data set.

Searching for Themes: Collating codes into potential themes, gathering all data relevant to each potential theme.

Reviewing Themes: Checking if the themes work in relation to the coded extracts and the entire data set.

Defining and Naming Themes: Ongoing analysis to refine the specifics of each theme and the overall story the analysis tells.

Producing the Report: Final analysis and write-up of the report, providing compelling examples from the data.

Ethical Considerations

Ethical considerations are paramount in this study due to the sensitive nature of the topic.

The following measures are taken to ensure ethical compliance:

Confidentiality: Participants' identities are anonymized to protect their privacy. Data is stored securely and accessed only by the research team.

Informed Consent: Obtaining informed consent from all participants, ensuring they are aware of the study's purpose, procedures, and their right to withdraw at any time.

Non-Maleficence: Taking care to avoid harm to participants, particularly given the sensitive nature of the topic.

Bias and Integrity: Maintaining objectivity and integrity throughout the research process, ensuring findings are reported honestly and without bias.

Sensitivity to Harm: The potential emotional impact on participants is considered, and support

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resources are made available to them.

Limitations of the Study

The limitations of the study include:

Generalizability: The findings from a single case study may not be generalizable to other contexts or populations.

Subjectivity: The qualitative nature of the study may introduce subjectivity in data interpretation, though efforts will be made to mitigate this through triangulation and reflexivity.

Access and Trust: Gaining and maintaining the trust of participants may be challenging, particularly given the sensitive nature of the topic. This could affect the depth and honesty of the data collected. This research study aims to provide a detailed and nuanced understanding of the dynamics of academic mobbing within faculty leadership, contributing valuable insights to the field of organizational behavior and higher education studies.

Context of the Study and Description of the Academic Institution

The academic institution under study is a renowned public university in Albania, established in the mid-20th century. It serves as a central hub for higher education and research, offering a diverse range of undergraduate, graduate, and doctoral programs across various disciplines. The university is recognized for its commitment to academic excellence, innovation, and fostering a vibrant intellectual community. With a student population exceeding 20,000 and a faculty comprising over 1,000 members, the institution plays a pivotal role in shaping the educational landscape of Albania. The campus is well-equipped with modern facilities, including state-of-the-art laboratories, libraries, and lecture halls. The institution is also noted for its extensive international collaborations, facilitating student and faculty exchanges and joint research projects with universities worldwide. Despite its esteemed reputation, the university has been facing internal challenges, particularly concerning interpersonal dynamics and administrative conflicts, which have significantly impacted its organizational culture and faculty morale.

Organizational Structure and Culture

The organizational structure of the university is hierarchical, with the Rector at the apex, followed by Vice-Rectors, Deans of various faculties, Department Heads, and finally, the faculty members. The decision-making process is predominantly top-down, with significant power concentrated in the hands of senior administrators. This structure, while ensuring streamlined governance, often leads to limited participation from lower-level faculty members in critical decisions, fostering a sense of disenfranchisement among them.

The culture of the institution is characterized by a strong emphasis on academic achievement and research output. However, there exists an undercurrent of competition and rivalry, which sometimes manifests in unhealthy interpersonal dynamics. The culture can be described as both collegial and confrontational, with collaborative efforts often overshadowed by political maneuvering and personal agendas. Faculty members frequently experience pressure to conform to the expectations of senior leadership, which can stifle innovation and dissent.

Key Events Leading to the Study

The impetus for this study stems from a series of incidents involving academic mobbing, where a faculty leader, specifically the Heads of two Departments of one of the prominent faculties, has been accused of bullying more than one faculty member. These events have created a toxic work environment, leading to significant emotional and professional distress for the victim and negatively impacting the broader academic community.

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The situation came to light when the targeted faculty member, a respected professor with over two decades of service, began to experience systematic exclusion from departmental activities, unwarranted criticism of their work, and personal attacks during faculty meetings. Despite their repeated attempts to address these issues through formal channels, the institutional response was inadequate, prompting the need for a thorough investigation into the dynamics of academic mobbing within the institution.

Profiles of Key Participants

The Head of Department (Faculty Leader): The primary subject of the study, the Head of Department, is a senior academic with an extensive background in their field. They have held the leadership position for over 10 years and are known for their authoritative leadership style. While recognized for their contributions to the university, their tenure has been marked by numerous complaints regarding their aggressive and controlling behavior towards subordinates.

The Victimized Faculty Member: The victims, two professors from two different Departments in the same faculty, have an illustrious career with numerous publications and accolades. They are well-respected by peers and students alike for their dedication to teaching and research. The professor's ordeal began shortly after they expressed dissenting opinions during a faculty meeting, which led to a series of retaliatory actions by Head of the Department.

Faculty Colleagues: Several colleagues who have witnessed the bullying incidents play crucial roles in the study. These individuals provide first-hand accounts of the Chiefs' behavior and their impact on the victims. Their testimonies offer a comprehensive view of the environment within the faculty and the broader implications of the mobbing behavior.

University Administrators: Key administrators, including the Vice-Rectors and the Human Resources Director, are also participants in the study. Their perspectives on the institutional response to the bullying allegations and their efforts (or lack thereof) to address the issue are critical to understanding the organizational dynamics at play.

External Experts: To provide an objective analysis, external experts in organizational behavior and academic administration were consulted. Their insights help contextualize the events within broader patterns of academic mobbing and offer recommendations for addressing such issues within academic institutions.

Through this study, the aim is to shed light on the complex dynamics of academic mobbing and its detrimental effects on faculty morale and institutional integrity. By examining these specific cases in Albania, it is expected to contribute to the broader discourse on fostering healthy academic environments and promoting effective leadership practices.

Introduction to Findings

This study delves into the phenomenon of academic mobbing, specifically focusing on a case where a faculty leader systematically bullied a faculty member in an Albanian institution. Academic mobbing, a form of collective bullying, can significantly impact the targeted individual's well-being and professional trajectory. Through qualitative methods, this study identifies the behaviors, patterns, and consequences of mobbing, and evaluates the organizational response to such toxic dynamics.

Dynamics of Academic Mobbing and Identification of Mobbing Behaviors

The study observed several specific mobbing behaviors employed by the faculty leader against the targeted faculty members. These behaviors included:

Isolation: The target was excluded from important meetings and social activities.

Undermining Professional Work: Persistent criticism and devaluation of the faculty member's work,

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often in public settings.

Rumor Spreading: Dissemination of false information and negative rumors about the target's professional competence and personal integrity.

Excessive Monitoring: Unwarranted scrutiny and micromanagement of the target's tasks and activities.

Verbal Abuse: Insults, derogatory remarks, and hostile communication aimed at demeaning the target.

Patterns and Phases of Mobbing

The mobbing process followed distinct patterns and phases:

Initial Phase: Subtle undermining behaviors and isolated incidents of criticism.

Escalation Phase: Increased frequency and intensity of mobbing behaviors, involving more overt and aggressive actions.

Climax Phase: Peak of mobbing activities, characterized by severe psychological and professional attacks, leading to significant distress for the target.

Resolution Phase: Either the departure of the target from the institution or intervention by higher authorities, though often the damage has already been done.

Impact on Faculty Leadership and Emotional and Psychological Effects

The emotional and psychological toll on the targeted faculty member was profound, including:

Stress and Anxiety: Constant fear of further attacks, leading to heightened stress levels.

Depression: Feelings of hopelessness and helplessness stemming from the sustained bullying.

Reduced Self-Esteem: Persistent criticism and devaluation led to significant reductions in self-worth and confidence.

Professional and Career Consequences

The professional repercussions were equally severe:

Career Stagnation: The target experienced a lack of professional growth opportunities, including missed promotions and research funding.

Professional Isolation: Reduced collaboration with peers and exclusion from important professional networks.

Reputation Damage: The spread of false information and rumors significantly harmed the target's professional reputation, both within and outside the institution.

Organizational Response and Management

Institutional Policies and Practices

The study evaluated the institution's policies and practices regarding mobbing:

Lack of Clear Policies: The institution lacked clear, comprehensive policies specifically addressing academic mobbing.

Inadequate Reporting Mechanisms: Existing mechanisms for reporting bullying were inefficient and not user-friendly, discouraging victims from coming forward.

Limited Support Systems: There was a noticeable absence of dedicated support systems for victims of mobbing, such as counseling services or peer support groups.

Effectiveness of Interventions

Interventions, when attempted, were often ineffective:

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- **Delayed Response:** Institutional responses were often slow, allowing the mobbing to continue unabated for extended periods.
- **Superficial Solutions:** Interventions were typically superficial, addressing symptoms rather than root causes, leading to recurrence of mobbing behaviors.
- **Lack of Accountability:** There was a general lack of accountability for the perpetrators, often due to their higher status within the institution.

Summary of Findings

The findings of this study underscore the destructive impact of academic mobbing on targeted individuals, particularly within faculty leadership. The observed mobbing behaviors and their devastating emotional, psychological, and professional consequences highlight the need for robust institutional policies and effective interventions. Addressing academic mobbing requires a concerted effort to create a safe and supportive work environment, ensuring that all faculty members can thrive without fear of harassment and bullying.

Discussion

Interpretation of Findings

The findings of this case study reveal a multifaceted dynamic of academic mobbing, specifically highlighting the nuanced interactions and power plays within faculty leadership in Albania. The data indicates that the mobbing practices are deeply embedded in the institutional culture, often driven by competition, jealousy, and the hierarchical structure of academic institutions. This aligns with Einarsen, Hoel, Zapf, and Cooper's (2010) assertion that workplace bullying, including academic mobbing, thrives in environments with unclear job roles and power imbalances. The specific case of a faculty leader bullying a single faculty member underlines the complexity of mobbing, where the leader exploits their authority to undermine and isolate the target, reflecting the patterns described by Leymann (1996).

Comparison with Existing Literature

When compared to existing literature, the findings from this study both corroborate and extend previous research on academic mobbing. For instance, Salin (2003) identifies organizational factors, such as management style and workplace culture, as critical in facilitating bullying behavior. The Albanian context, characterized by hierarchical leadership and limited support structures for victims, mirrors these findings. Additionally, the psychological impacts on the victim, including stress and professional disillusionment, are consistent with the outcomes noted by Duffy and Sperry (2007). However, this study also highlights unique cultural factors in Albania, such as the strong influence of personal relationships and informal networks in perpetuating mobbing, which are less emphasized in Western literature.

Implications for Theory and Practice

The implications of this study for theory and practice are significant. Theoretically, it supports and extends existing models of workplace bullying by integrating cultural and contextual factors unique to Albania. Practically, it underscores the need for robust anti-mobbing policies and a supportive organizational culture. Institutions should implement clear guidelines for reporting and addressing mobbing incidents, fostering an environment of transparency and accountability. Additionally, leadership training programs should emphasize ethical leadership and the development of emotional intelligence to prevent the misuse of authority.

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Recommendations for Faculty and Institutional Leadership

To mitigate the incidence of academic mobbing, the following recommendations are proposed for faculty and institutional leadership:

- **Develop Comprehensive Anti-Mobbing Policies:** Institutions should establish clear, detailed policies that define mobbing, outline reporting procedures, and specify consequences for perpetrators.
- **Foster a Supportive Culture:** Promote a culture of mutual respect and support, where open communication and collaboration are encouraged, and mobbing behaviors are actively discouraged.
- **Leadership Training:** Implement training programs for leaders to develop their skills in conflict resolution, emotional intelligence, and ethical decision-making.
- **Support Systems for Victims:** Create accessible support systems, including counseling services and peer support groups, to assist victims of mobbing.
- **Regular Monitoring and Evaluation:** Conduct regular assessments of the workplace environment to identify potential mobbing behaviors early and address them promptly.

Limitations and Future Research Directions

This study has several limitations. Firstly, it focuses on a single case in Albania, which may limit reliance on qualitative data may introduce subjective biases. Future studies could employ mixed-method approaches to triangulate data and enhance the reliability of the findings. Additionally, there is a need for longitudinal research to examine the long-term effects of mobbing on victims and institutions. Finally, exploring the role of digital communication and social media in facilitating or mitigating mobbing could provide valuable insights into modern mobbing dynamics. By addressing these limitations and expanding the scope of research, future studies can further illuminate the complex phenomenon of academic mobbing and contribute to developing more effective prevention and intervention strategies.

Conclusion

Summary of the Study

This study aimed to investigate the dynamics of academic mobbing within faculty leadership, specifically focusing on a case in Albania where a faculty leader targeted a single faculty member. The objectives were to understand the mechanisms, impact, and contributing factors of mobbing in academic settings. Through qualitative analysis, including interviews and document review, the study identified patterns of behavior, the roles of various stakeholders, and the psychological and professional repercussions on the victim.

The findings revealed that academic mobbing in this context was characterized by systematic efforts to undermine the faculty member through professional isolation, disparagement of their work, and manipulation of institutional processes. The mobbing was driven by personal vendettas, power dynamics, and a lack of effective institutional support for the victim. The impact on the targeted faculty member included significant stress, diminished professional reputation, and career disruption.

Key Contributions to Knowledge

This study contributes to the existing body of knowledge on academic mobbing in several key ways:

Contextual Insights: It provides a detailed case study from Albania, offering insights into the cultural and institutional specifics that influence mobbing dynamics in this region.

Mechanisms of Mobbing: It elaborates on the specific tactics used by the faculty leader to bully the faculty member, including professional isolation, derogatory communication, and exploitation of institutional power structures.

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Psychological and Professional Impact: The study highlights the profound psychological distress and professional setbacks experienced by the victim, emphasizing the need for better support systems within academic institutions.

Role of Institutional Policies: It underscores the inadequacy of current institutional policies in preventing and addressing mobbing, suggesting the necessity for policy reforms to protect faculty members and promote a healthier academic environment.

Final Thoughts

The study of academic mobbing, particularly in the context of faculty leadership in Albania, sheds light on the pernicious effects of such behavior on individuals and the academic community as a whole. The case study reveals how personal grievances and power imbalances can lead to targeted bullying, significantly impacting the victim's well-being and career.

Addressing academic mobbing requires a multi-faceted approach, including raising awareness, implementing robust policies, and fostering a culture of respect and support within academic institutions. It is crucial for stakeholders at all levels to recognize the signs of mobbing and take proactive measures to prevent it.

Ultimately, this study calls for a reevaluation of institutional practices and a commitment to creating a safe and supportive environment for all faculty members. By doing so, academic institutions can ensure that they remain places of intellectual growth and professional development, free from the destructive influence of mobbing.

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Appendices

Appendix A: Interview Guides

A.1. Interview Guide for Faculty Members

Introduction:

- Brief introduction of the researcher and the purpose of the study.
- Explanation of the concept of academic mobbing and its relevance.
- Assurance of confidentiality and voluntary participation.

Interview Questions:

1. Can you describe your role and experience within the faculty?
2. Have you witnessed or experienced any forms of academic mobbing? If so, can you provide specific examples?
3. How do you perceive the impact of academic mobbing on faculty leadership and dynamics?
4. What measures, if any, have been taken by the institution to address academic mobbing?
5. How do you think the institution can improve its approach to handling academic mobbing?

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A.2. Interview Guide for Administrative Staff

Introduction:

- Brief introduction of the researcher and the purpose of the study.
- Explanation of the concept of academic mobbing and its relevance.
- Assurance of confidentiality and voluntary participation.

Interview Questions:

1. Can you describe your role and experience within the administration?
2. Have you observed any instances of academic mobbing involving faculty members? If so, can you describe them?
3. In your opinion, what are the underlying causes of academic mobbing in faculty leadership?
4. What are the current policies or procedures in place to manage academic mobbing?
5. What recommendations would you make to improve the institution's handling of academic mobbing?

A.3. Interview Guide for Students

Introduction:

- Brief introduction of the researcher and the purpose of the study.
- Explanation of the concept of academic mobbing and its relevance.
- Assurance of confidentiality and voluntary participation.

Interview Questions:

1. Can you describe your experience and interactions with faculty members?
2. Have you ever witnessed any behavior that could be classified as academic mobbing? If so, can you elaborate?
3. How do you think academic mobbing affects the academic environment and student learning?
4. Are there any support systems in place for students who observe or are affected by academic mobbing?
5. What suggestions do you have for improving the academic culture to prevent mobbing?

Appendix B: Consent Forms

1. B.1. Consent Form for Faculty Members

Title of the Study:

To investigate the phenomenon of academic mobbing within faculty leadership and its impact on the academic environment.

Procedure:

Participation in an interview lasting approximately 60 minutes.

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Discussion of personal experiences and observations related to academic mobbing.
Confidentiality:

All responses will be kept confidential and used solely for research purposes. Participants' identities will not be disclosed in any reports or publications.

Voluntary Participation:

Participation is entirely voluntary, and participants can withdraw at any time without any consequences. Consent:

By signing this form, you agree to participate in the study and acknowledge that you understand the information provided.

Signature:

Participant's Name: _____

Participant's Signature: _____

Date: _____

2. B.2. Consent Form for Administrative Staff

To investigate the phenomenon of academic mobbing within faculty leadership and its impact on the academic environment.

Procedure:

Participation in an interview lasting approximately 60 minutes.

Discussion of personal experiences and observations related to academic mobbing.
Confidentiality:

All responses will be kept confidential and used solely for research purposes. Participants' identities will not be disclosed in any reports or publications.

Voluntary Participation:

Participation is entirely voluntary, and participants can withdraw at any time without any consequences. Consent:

By signing this form, you agree to participate in the study and acknowledge that you understand the information provided.

Signature:

Participant's Name: _____

Participant's Signature: _____

Date: _____

B.3. Consent Form for Students

Purpose of the study:

To investigate the phenomenon of academic mobbing within faculty leadership and its impact on the

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academic environment.

Procedure:

Participation in an interview lasting approximately 60 minutes.

Discussion of personal experiences and observations related to academic mobbing.

Confidentiality:

All responses will be kept confidential and used solely for research purposes. Participants' identities will not be disclosed in any reports or publications.

Voluntary Participation:

Participation is entirely voluntary, and participants can withdraw at any time without any consequences. Consent:

By signing this form, you agree to participate in the study and acknowledge that you understand the information provided.

Signature:

Participant's Name: _____

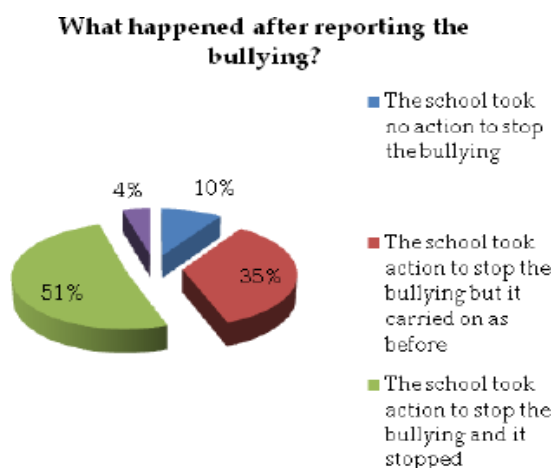
Participant's Signature: _____

Date: _____

Appendix C: Additional Data Tables

Graph 1

What happened after reporting an academic mobbing?

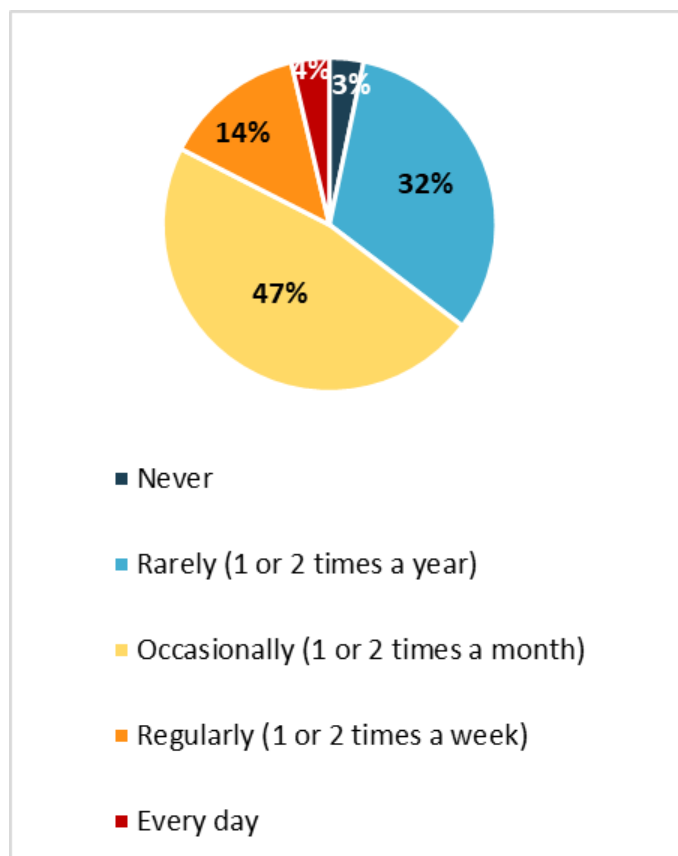


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Graph 2

In your university or a university, you know, during the last academic year, how often did you hear about an academic mobbing?



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PHYTOCHEMICAL PROFILING AND MULTIFACETED THERAPEUTIC POTENTIAL OF *HERITIERA LITTORALIS* LEAF EXTRACT: IN VITRO AND IN VIVO ANTI- DIABETIC, ANTIOXIDANT, AND ANTI-INFLAMMATORY ACTIVITIES

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Gazi Mehedi Hasan Rakib

Md. Limon Khan

Ramim Miah

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Abstract

The tropical plant *Heritiera littoralis* (locally known as "Sundri" in Bangladesh) is an ecologically important evergreen tree species distributed across mangrove ecosystems of Bangladesh, India, and Southeast Asia. While traditionally valued for its medicinal potential in treating microbial infections and inflammatory conditions, its specific pharmacological properties have not been systematically examined. This study evaluated the phytochemical composition and biological potential of the methanolic leaf extract of *Heritiera littoralis* (MHL) through in vitro antioxidant, anti-inflammatory, and anti-diabetic assays, along with in vivo anti-diabetic evaluation. Qualitative screening confirmed the presence of alkaloids, flavonoids, sterols, saponins, and phenols. Quantitative analysis showed high bioactive content, with Total Phenolic Content (TPC) of 552.13 ± 13.56 mg GAE/g and Total Flavonoid Content (TFC) of 441.53 ± 10.05 mg QE/g. MHL demonstrated notable antioxidant activity with IC_{50} of 18.52 ± 1.03 μ g/mL (DPPH) and EC_{50} of 21.42 ± 1.33 μ g/mL (FRP) versus ascorbic acid standards (6.14 ± 0.16 μ g/mL and 15.14 ± 0.44 μ g/mL). Anti-inflammatory activity showed IC_{50} values of 43.66 ± 3.91 μ g/mL (HRBC) and 39.81 ± 3.01 μ g/mL (albumin denaturation) comparable to diclofenac sodium. MHL inhibited alpha-amylase (IC_{50} : 41.96 ± 2.88 μ g/mL) and alpha-glucosidase (IC_{50} : 39.50 ± 1.84 μ g/mL) with approximately 61% and 74% potency of acarbose, respectively. In vivo, MHL at 400 mg/kg reduced blood glucose from 25.14 ± 0.38 mmol/L to 6.55 ± 0.63 mmol/L over 25 days, comparable to glibenclamide (5.78 ± 0.23 mmol/L) and metformin (6.17 ± 0.29 mmol/L) with statistical significance ($p < 0.001$). These findings indicate *Heritiera littoralis* as a rich source of polyphenolic compounds with considerable therapeutic potential for managing oxidative stress, inflammation, and hyperglycemia.

Keywords: *Heritiera littoralis*, antioxidant, anti-inflammatory, alpha-glucosidase, Natural product pharmacology.

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FUNGAL CHITIN AND CHITOSAN VALORIZATION: EXTRACTION, CHARACTERIZATION AND EMERGING APPLICATIONS IN AGRICULTURE AND ENVIRONMENT

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Abstract

Chitin and its derivative chitosan are natural biopolymers renowned for their biodegradability, biocompatibility, and versatile bioactivities, including antimicrobial and antioxidant properties. Traditionally sourced from crustacean shells, industrial chitin poses ecological and allergenic challenges. In contrast, fungal sources—such as *Agaricus bisporus* (a macrofungus) and *Aspergillus niger* (a microfungus)—emerge as promising, sustainable, and allergen-free alternatives.

Our study presents an integrated approach combining conventional and microwave-assisted extraction methods to enhance yield and functional quality of fungal-derived chitin and chitosan. The methodology involves deproteinization, demineralization, decolorization, and deacetylation—processes optimized to minimize solvent use, reduce environmental impact, and regulate the degree of deacetylation (DDA), a key factor governing the polymer's final properties. Comprehensive characterization (chemical yield, DDA, and thermo-structural properties) was conducted, alongside functional assessments such as antimicrobial activity and film-forming ability. Results highlight:

- (1) the efficiency of microwave-assisted extraction in boosting yield;
- (2) strong correlation between extraction conditions and DDA;
- (3) the influence of DDA on biological performance;
- (4) the potential of underused fungal strains for eco-innovative applications.

This work demonstrates the viability of fungal chitin as a standardized, high-performance biopolymer for biomedical, food packaging, environmental, and cosmetic applications. Our approach aligns with circular bioeconomy principles, paving the way for cleaner, safer, and value-added biomaterials.

Keywords : Fungi, Biopolymer extraction, Chitin and chitosan, Characterization, Green valorization and applications.

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ECO-FRIENDLY APPROACH TOWARDS THE DETERMINATION OF CLOXACILLIN SODIUM PURE AND IN DOSAGE FORMS

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Abstract

Analysis of drug utilized organic chemicals and solvents which not only pollute the environment but also have toxic effects on health. A simple eco-friendly method has been developed for estimation drug in pure and pharmaceutical formulations using microwave-assisted spectrophotometry. This study aims to develop and validate a simple, rapid, and accurate spectrophotometric method for the determination of cloxacillin sodium in both pure and tablet forms. A colored mixture was obtained by heating a mixture of cloxacillin sodium with ammonium molybdate in acidic medium. Using UV spectrophotometry, the absorbance of cloxacillin sodium was measured at a wavelength of 690nm. The method was validated for linearity, precision. The spectrophotometric method developed is robust and suitable for the routine analysis of cloxacillin sodium in quality control laboratories.

Keywords: Cloxacillin sodium, ammonium molybdate, spectrophotometer.

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NANOCARRIER-LOADED MICRONEEDLE PATCHES FOR SUSTAINED AND TARGETED TRANSDERMAL DELIVERY OF INSULIN AND SMALL-MOLECULE THERAPEUTICS

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Abstract

Transdermal drug delivery offers a minimally invasive route for systemic administration, yet conventional methods often face challenges such as poor permeability and limited control over drug release. Microneedle (MN) technology has emerged as a promising platform to overcome these barriers, enabling painless skin penetration and enhanced bioavailability. This study focuses on the development of nanocarrier-loaded microneedle patches for the sustained and targeted transdermal delivery of insulin and small-molecule therapeutics. Biodegradable polymeric microneedles were fabricated and optimized to encapsulate drug-loaded nanocarriers, ensuring controlled release and improved stability of therapeutic agents. Characterization of the patches included mechanical strength, insertion efficiency, drug loading capacity, and in vitro release kinetics, demonstrating sustained drug release over extended periods. Additionally, the integration of nanocarriers facilitated targeted delivery, reducing systemic side effects and enhancing therapeutic efficacy. In vitro and ex vivo studies confirmed effective permeation through skin models, while preserving bioactivity of insulin and small-molecule drugs. This approach highlights the potential of combining nanotechnology with microneedle systems to address limitations of conventional transdermal delivery. The results support the feasibility of this platform for diabetes management and other therapeutic applications requiring controlled, long-term drug administration.

Keywords: Transdermal drug delivery, Microneedle patches, Nanocarriers, Sustained release, Insulin, Small-molecule therapeutics, Targeted delivery, Biodegradable polymers.

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FUNCTIONAL MOVEMENT PATTERNS IN TEAM SPORTS: ROLE IN SPORTS INJURY PREVENTION

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Abstract

Assessing the quality of movement patterns and dynamic stability is crucial for injury prevention and performance enhancement, especially in professional athletes. The use of the Functional Movement Screen (FMS) enables the identification of movement limitations and asymmetries, allowing for targeted training planning and reduced risk of injury.

The study involved a functional assessment using the Functional Movement Screen (FMS), which enabled the analysis of selected movement patterns, stability, and mobility. A total of 72 professional athletes training in team sports were examined.

Mean values and standard deviations were calculated for individual components of the Functional Movement Screen (FMS) assessed in athletes practicing team sports. The highest mean scores were observed in the Hurdle Step (2.86 ± 0.44) and In-line Lunge (2.80 ± 0.48) tests, indicating relatively good lower-limb mobility and motor control in the examined group. Comparable results were obtained in the Trunk Stability Push-Up test (2.79 ± 0.56), suggesting an adequate level of core stability among the assessed athletes.

Moderate mean scores were recorded for *Shoulder Mobility* (2.54 ± 0.71) and *Active Straight Leg Raise* (2.35 ± 0.73), with the latter also showing one of the highest levels of variability. The lowest mean score was observed for the *Squat* test (2.26 ± 0.55), indicating potential limitations in overall movement quality involving the lower extremities and trunk. The mean score for *Rotary Stability* was 2.29 ± 0.51 . The total FMS score reached 17.89 ± 0.63 , reflecting generally good functional movement patterns in the studied athletes.

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Team sport athletes demonstrate generally good functional movement, especially in unilateral and trunk stability tasks. Lower scores in selected tests indicate mobility and stability deficits, supporting the need for targeted corrective and preventive training.

Keywords: functional assessment, Functional Movement Screen (FMS), team sports.

Source of funding

This work was written with the financial support of the Ministry of Education and Science as part of the project at Józef Piłsudski University of Physical Education in Warsaw (Poland), Research Project (UPB no. 13) titled “Assessment of the Relationship Between Selected Lifestyle Factors and the Risk of Sports Injuries in a Young Adult Population.”

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WORK-RELATED EMOTIONAL EXHAUSTION IN HEALTH WORKERS

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Abstract

Work-related emotional burnout among health workers can lead to numerous negative consequences for both the employee and the organization. Work-related emotional burnout among employees leads to many negative consequences such as leaving the job, silent resignation, and decreased performance. This research aims to determine the level of work-related emotional burnout among health workers in a healthcare institution and to reveal the differences between demographic characteristics and the level of work-related emotional burnout.

The study involved 341 healthcare workers from a private hospital in Istanbul. The study is a cross-sectional quantitative research design. The survey method was used as the data collection tool. Data were collected using convenience sampling. Statistical analysis was performed using SPSS 31 software, and mean, frequency, ANOVA F, and t-tests were applied.

The study found that the average work-related emotional burnout score of health workers was 3.27 ± 0.055 . The study found that health workers in the healthcare institution where the research was conducted had high scores for work-related emotional burnout. It was determined that the participants experienced work-related emotional burnout. A statistically significant difference was found between the levels of work-related emotional burnout among health workers and the variables of profession and education level. Health workers with bachelor's degrees were found to have higher levels of work-related emotional exhaustion than those with medical specialisation degrees. Differences were found between nurses/midwives and physicians, and between health technicians/technologists and physicians. Nurses/midwives were found to have higher levels of work-related emotional burnout than physicians. Similarly, health technicians/technologists also experienced higher levels of work-related emotional burnout than physicians. The study found that nurses and health technicians/technologists experienced more work-related emotional burnout than physicians in the healthcare institution where the research was conducted. No significant differences were found among other variables.

Factors negatively impacting healthcare professionals in healthcare settings should be identified, and corrective measures should be taken to improve the healthcare delivery process.

Keywords: Burnout, Emotional Exhaustion, Work-related-Emotional Exhaustion.

SAĞLIK ÇALIŞANLARINDA İŞE BAĞLI DUYGUSAL TÜKENMİŞLİK

Özet

Sağlık çalışanlarının işe karşı duygusal tükenme yaşaması, hem çalışan hem de kuruluş için çok sayıda olumsuz sonuca yol açabilir. Çalışanların işe bağlı tükenmişlik hissi yaşaması beraberinde işten ayrılma, sessiz istifa, performans düşüklüğü gibi pek çok olumsuz sonucu doğurmaktadır. Araştırmada bir sağlık kurumunu ele alarak, sağlık çalışanlarının işe bağlı duygusal tükenmişlik düzeyini belirlemek ve demografik özellikler ile işe bağlı duygusal tükenmişlik düzeyi arasındaki farklılıkları ortaya koymak amaçlanmaktadır.

Araştırmaya İstanbul’da özel bir hastanenin 341 sağlık çalışanı katılmıştır. Araştırma kesitsel bazlı nicel bir araştırma türündedir. Veri toplama aracı olarak anket yöntemi kullanılmıştır. Veriler kolayda örnekleme yöntemi kullanılarak toplanmıştır. İstatistiksel analizde SPSS 31 programı kullanılarak, ortalama, frekans, Anova F ve t-testi uygulanmıştır.

Araştırma sonucunda sağlık çalışanlarının işe bağlı duygusal tükenmişlik ortalaması 3.27 ± 0.055 olarak bulunmuştur. Araştırmanın yapıldığı sağlık kurumunda, sağlık çalışanlarının işe bağlı duygusal tükenmişlik puanının yüksek olduğu saptanmıştır. Katılımcıların işe bağlı duygusal tükenmişlik yaşadığı belirlenmiştir. Sağlık çalışanlarının işe bağlı duygusal tükenmişlik düzeyleri ile meslek ve eğitim durumu değişkenleri arasında istatistiksel olarak anlamlı farklılık saptanmıştır. Lisans mezunu sağlık çalışanlarının, tıpta uzmanlık mezunlarına göre işe bağlı duygusal tükenmişlik düzeyi yüksek olarak belirlenmiştir. Hemşire/ebe ile hekim arasında ve sağlık teknisyen/teknikeri ile hekim arasında farklılık tespit edilmiştir. Hemşire/ebelerin işe bağlı duygusal tükenmişlik düzeyi hekimlerden yüksek bulunmuştur. Aynı şekilde sağlık teknisyen/teknikerlerinin işe bağlı duygusal tükenmişlik düzeyi de hekimlerden yüksek bulunmuştur. Araştırmanın gerçekleştirildiği sağlık kurumunda çalışan hemşireler ve sağlık teknisyen/teknikerlerin hekimlerden daha fazla işe bağlı duygusal tükenmişlik yaşadığı saptanmıştır. Diğer değişkenler arasında anlamlı farklılıklara rastlanmamıştır.

Sağlık kurumlarında sağlık çalışanlarını olumsuz etkileyen faktörler belirlenmeli ve sağlık hizmeti sunum sürecini iyileştirmek için düzeltici önlemler alınmalıdır.

Anahtar kelimeler: Tükenmişlik, duygusal tükenmişlik, işe bağlı duygusal tükenmişlik.

GİRİŞ

Tükenmişlik Kavramı

TDK’ya göre tükenmişlik “gücünü yitirmiş olma, çaba göstermeme durumu” şeklinde tanımlanmaktadır. Tükenmişlik ilk olarak bir romanda” Bir Tükenmişlik Olayı” adıyla, daha sonra 1970’lerde mesleki bunalımı tanımlamak amacıyla ortaya çıkmıştır. “Büyük bir bıkkınlık ve kişinin işine duyduğu bağlılık ile idealizminin sönmesi” olarak tanımlanmıştır (Sürgevil Dalkılıç, 2014; akt: Gülbayrak & Mavili Aktaş, 2020; Poyraz & Sürücüoğlu, 2015). 1974 yılında psikolog Herbert Freudenberger tükenmişlik sendromunu; “başarısız olma, yıpranma, enerji ve güç kaybı veya karşılanamayan istekler sonucu bireyin iç kaynaklarında tükenme durumu” şeklinde ifade etmiştir (Freudenberger, 1974 akt. Cesur ve diğ. . 2023) Pines ve Aranson’a (1988) göre tükenmişlik “Bir şevk, enerji, idealizm, perspektif ve amaç kaybı ve bireylerde duygusal anlamda sürekli strese, umutsuzluğa, çaresizliğe ve kapana kısılmışlık duygularına neden olan fiziksel, duygusal ve zihinsel bitkinlik durumu” olarak tanımlanmaktadır (Pines ve Aronson, 1988). Psikososyal literatürde

Tükenmişlik kavramının tanıtımını Freudenberger (1974) ve Maslach (1976) yapmıştır. Maslach ve arkadaşlarının (2001) strese sebep olan iş koşullarına verilen bir tepki olarak nitelediği çalışmasında tükenmişlik kavramı duygusal tükenme, motivasyon kaybı ve çalıştığı kuruma bağlılığın azalması şeklinde nitelendirilmektedir (Sürgevil, 2006).

Tükenmişlik kavramı çeşitli sebepler sonucu gelişen bu durum olarak karşımıza çıkmakta, kişinin enerjisinin azalması, isteksizlik ve işe ve sorumlulara karşı olumsuz davranışlar geliştirmesi boyutuna ulaşmaktadır. İş yerlerinde çalışma ortamı, stres ve çatışmalar sonucu gelişen durum yavaş yavaş fakat kronikleşen bir davranış haline gelebilmektedir. Bu davranış şekli zamanla tüm örgüte yayılarak iş gücünün zayıflamasına ve örgütün gücünün azalmasına yol açan bir sürece evrilebilmektedir. Çalışanın işi ile ilgili belirlediği amaçlara ulaşamamanın yol açtığı yorgunluk ve enerji kaybının tükenmişliğe ortam hazırladığı bilinmektedir. Bu nedenle bireysel ve örgütsel olarak incelemek önemlidir (Yeniçeri ve diğ. 2009). Bireysel olarak tükenmişliğe yola açabilen etkenler kişinin karakteristik özellikleri, iş doyumu, iş tatmini, eğitim, yaş, çocuk sayısı, çalışma arkadaş ve yönetici ilişkisi ve iletişimi, motivasyon, şeklinde sayılabilir (Yeniçeri ve diğ.2009). Maslach ve Leiter, tükenmişliği açıklamak için tükenmişliği; “iş yükü, kontrol, ödül, iletişim, adalet, değer” gibi altı alanda oluşan, kişi ile iş arasındaki kronik uyumsuzluklardan kaynaklandığını öne sürmüşlerdir (Leiter & Maslach,1988). Tükenmişliğin azalması için bu uyumsuzluğun yönetim tarafından giderilmesi gerekliliğinin vurgulamış bunun bağlılığı artıracaklarını belirtmiştir (Maslach ve diğ. 2001:413). Örgütsel etkenler incelendiğinde ise işin gereklilikleri, iş yükü, örgütsel özellikler, stresli çalışma koşulları, kariyer engelleri, kurumun yönetim tarzı, çalışanların ihtiyaç ve beklentilerinin karşılanamaması, yönetim ve liderlik tarzı, işi oluşturan malzeme araç gereç yetersizliği, ailesel, sosyal, ekonomik sorunlar vb. öne çıkmaktadır.

Tükenmişlik duygusal tükenmişlik, duyarsızlaşma ve kişisel başarıda düşme hissi olarak 3 boyutta incelenmektedir. Duygusal tükenmişlik bireyin kendini yorgun hissetmesi, duygusal yıpranma, iş verenlere karşı sorumluluklarında isteksizlik, gerginlik gibi duygusal belirtilerle kendini göstermektedir. Duygusal tükenme, insanların ihtiyacı olduğunda, duygusal ve psikolojik olarak talebin karşılanmaması sonucu yetersiz enerji ve düşük duygu düzeyi hissetmesi durumudur (Kılıç & Aytemiz Seymen, 2011; Arı ve diğ. 2010). Duygusal tükenmişliğe yol açan faktörler olarak çalışma koşulları fiziki ortam, kariyer sorunları, yönetsel sorunlar, örgüt kültürüne uyum sorunu, çalışma arkadaşları, bireysel özellikler, aidiyet, adalet duygusu, sosyal destek gibi etkenler sayılabilmektedir (Öztürk & Karagonlar, 2019). Bireyin duygusal olarak birikimlerinin artması sonucu sürekli kendini bitkin ve yorgun hissetmesi ve aynı zamanda işe karşı motivasyon kaybı yaşaması ile karakterize bir durumdur. İşe bağlı yorgunluk durumu kişiyi sadece fiziksel olarak değil aynı zamanda ruhsal olarak da etkilemekte, stres ise bu durumu tetiklemektedir. Çalışanların performanslarına da olumsuz etkisi olan bu durum ilerleyen süreçlerde işe karşı duyarsızlaşma ile sonuçlanabilmektedir. Duygusal tükenmeyi tetikleyen pek çok faktör bulunmaktadır (Gökkaya, 2024).

Tükenmişlik duygusu yaşayan meslek grupları daha çok insanlarla birebir iletişim halinde olan sağlık çalışanları, öğretmenler, avukatlar, banka çalışanları, polisler, diş hekimleri, akademisyenler otel çalışanları, vb. mesleklerdir (Sürgevil Dalkılıç, 2014). Bu meslek gruplarından sağlık çalışanlarının yer aldığı sağlık kurumlarının ayrı bir önemi bulunmaktadır. Sağlık kurumları acil ve ertelenemez olması, hızlı karar verme, birden fazla disiplini bir arada barındırması ve bunun getirdiği zorluklar gibi nedenlerden diğer sektörlerden farklıdır. Tüm bu faktörlerin yanında çalışma saatlerinin uzunluğu, nöbetli çalışma sistemi, ücret adaletsizliği, yönetici davranışları, çatışma ortamı, stres gibi olumsuz durumlar sonucu çalışanlar tükenmişlik hissi yaşayabilmektedir. Sağlık kurumlarında tükenmişliğin bireysel ve örgütsel etkileri bulunmaktadır. Tükenmişliğin bireysel etkisi olarak kurumlara karşı olumsuz tutum gelişmekte bunun sonucunda hizmet kalitesi düşmekte, işe bağlılık azalmakta, iş doyumsuzluğu, işten ayrılma niyeti artmaktadır. Araştırmada İstanbul’da bulunan özel

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bir sađlık kurumunu ele alarak, sađlık alıřanlarının iře bađlı duygusal tkenmiřlik dzeylerini belirlemek amalanmaktadır.

YNTEM

Arařtırmada nicel arařtırma yntemi kullanılmıřtır. Arařtırmada sađlık alıřanlarının iře bađlı duygusal tkenmiřlik dzeyini belirlemek amacıyla kesitsel tanımlayıcı bir arařtırma planlanmıřtır.

Evren ve rneklem

Arařtırma, İstanbul ilinde zel bir hastaneden elde edilen veriler ile gerekleřtirildi. rneklem seimini yapılmadan tm alıřanlara ulařılmak hedeflenmiř ve anket yntemi ile kolayda rneklem yntemi kullanarak veriler toplanmıřtır. 344 anket formu toplanmıř fakat eksik dolduran 3 kiři ıkartılarak arařtırma 341 kiři ile gerekleřtirilmiřtir.

Arařtırmanın Hipotezi ve Soruları

Arařtırmanın ana hipotezi: Sađlık kurumunda sađlık alıřanlarının iře bađlı duygusal tkenmiřlik dzeyleri nedir?

Bu hipotez dođrultusunda cevap aranan sorular řu řekildedir;

- Sađlık alıřanlarının demografik zellikleri nelerdir?

-Sađlık alıřanlarının demografik zellikleri ile iře bađlı duygusal tkenmiřlik dzeyleri arasında farklılık var mıdır?

Veri Toplama Araları

Arařtırmada veriler anket yntemi kullanarak yzyze ve online olarak toplanmıřtır. Ankette demografik zelliklerin belirlenmesine ynelik cinsiyet, yař, eđitim ve meslek deđiřkenleri kullanılmıřtır. İře bađlı duygusal tkenmiřlik dzeyinin belirlenmesine ynelik ise Gnay, A., (2021) tarafından uyarlaması yapılan “İře Bađlı Duygusal Tkenmiřlik” leđi kullanılmıřtır. leđin orjinali Wharton’a (1993) aittir. Wharton’a (1993) “İře Bađlı Duygusal Tkenmiřlik leđini”ni (Job-Related Emotional Exhaustion Scale) Maslach’ın geliřtirdiđi Tkenmiřlik leđinden (Burnout Scale) esinlenerek geliřtirmiřtir. lek tek boyutlu ve 6 ifadeden oluřmaktadır. Gnay, A., (2021) iře bađlı duygusal tkenmiřlik leđinin alfa deđerinin .87 olarak bulmuřtur. Arařtırmamızda da leđin Cronbach Alfası 0,87 olarak saptanmıřtır. lek 5’li likert tipi ile derecelendirilmiřtir. 1= iř yerinde asla bu řekilde hissetmiyorum, 5 = her gn bu řekilde hissediyorum řeklinde dzenlenmiřtir. leđin ifadeleri řu řekildedir; “İřimden dolayı duygusal olarak tkenmiř hissediyorum”, “İř gnnn sonunda kendimi bitkin hissediyorum”, “Sabah kalkmaktan ve iř yerinde yeni bir gnle yzleřmek zorunda olmaktan yıldımdı”, “İřimden dolayı psikolojik olarak yıpranmıř hissediyorum”, “İřimden dolayı hayal kırıklıđına uğramıř hissediyorum”, “İřimde ok alıřtıđımı hissediyorum”. leđin deđerlendirilmesi ortalama puan zerinden gerekleřtirilmiřtir. Artan ortalama puan iřyerinde iře bađlı duygusal tkenmiřlik dzeyinin yksekliđini gstermektedir.

BULGULAR

Demografik zellikler

Arařtırmanın yapıldıđı sađlık kurumunda alıřan sađlık alıřanlarının cinsiyet, yař, eđitim ve meslek gibi demografik deđiřkenleri incelenmiřtir. Sađlık alıřanlarının demografik verileri Tablo 1’de sunulmuřtur.

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Tablo 1. Araştırmaya Katılan Çalışanların Demografik Özellikleri

Demografik Değişkenler	N	%
Cinsiyet		
Kadın	231	67,7
Erkek	110	32,3
Yaş		
18-34	211	61,9
35-44	81	23,8
45-54	39	11,4
55 ve üzeri	10	2,9
Eğitim durumu		
lise ve dengi	100	29,3
lisans	190	55,7
lisansüstü	38	11,1
tıpta uzmanlık	13	3,8
Meslek		
yönetici	26	7,6
hekim	19	5,6
hemşire/ebe	64	18,8
sağ tek	76	22,3
idari personel	58	17,0
diğer	98	28,7
TOPLAM	341	100,0

Tablo 1' e göre sağlık çalışanlarının %67.7'si' kadın, %61,9'u 18-34 yaş altı, %29.3'ü lise ve dengi, %55,7'si lisans, %11,1'i lisansüstü, %3.8'i tıpta uzmanlık mezunudur. Katılımcıların %7.6'sı yönetici, %5.6'sı hekim, %18.8'i hemşire/ebe, %22,3'ü sağlık teknisyeni/teknikeri, %17'si idari personel ve %28,7'si diğer (Hasta danışmanı, checkup satış sorumlusu, ameliyathane personeli, doktor asistanı, muhasebe, muhasebe personeli vb.) gruptadır.

İşe Bağlı Duygusal Tükenmişlik Ölçek Ortalaması

Araştırmanın gerçekleştirildiği sağlık kurumunda çalışan sağlık çalışanlarının genel İşe Bağlı Duygusal Tükenmişlik ortalaması 3.27 ± 0.055 olarak bulunmuştur. Araştırmanın yapıldığı sağlık kurumundaki sağlık çalışanlarının işe bağlı duygusal tükenmişlik puanının ortalamadan yüksek olduğu saptanmıştır. Araştırmanın ana hipotezi olan “Sağlık kurumunda sağlık çalışanlarının işe bağlı duygusal tükenmişlik düzeyleri nedir?” sorusu yanıtlanmıştır. Katılımcıların çalışma ortamlarında işe bağlı duygusal tükenmişlik yaşadığı belirlenmiştir. Ölçeğin normal dağılıma uygunluğu Skewness ve Kurtosis değerleri ile belirlenmiştir (± 1). Ölçeğin ortalama, standart sapma, kurtosis ve skewness değerleri tablo 2’de sunulmuştur.

Tablo 2. Sağlık Çalışanlarının İşe Bağlı Duygusal Tükenmişlik Puan Ortalaması

Madde	Ort	Ss	Skewness	Kurtosis	Düzeltilmiş Madde Toplam Korelasyonu	Maddelerin Silinmesi Durumunda Alfa
1	3,0651	1,38114	-,374 $\pm$,132	-1,408 $\pm$,263	,601	,832
2	3,6113	1,23679	-,811 $\pm$,132	-,548 $\pm$,263	,401	,861
3	2,9024	1,38243	-,032 $\pm$,132	-1,498 $\pm$,263	,510	,845
4	3,1632	1,35909	-,370 $\pm$,132	-1,323 $\pm$,263	,639	,826
5	2,9405	1,39200	-,143 $\pm$,132	-1,503 $\pm$,263	,553	,842
6	3,9642	1,12664	-1,319 $\pm$,132	,944 $\pm$,263	,260	,876
Genel	3,27	0,055	-,409 $\pm$,132	-,735 $\pm$,263		

Min1-Max 5 N=341

Sağlık çalışanlarının Demografik özellikler ile işe bağlı duygusal tükenmişlik düzeyi arasındaki farklılıkların Analizi

Sağlık çalışanlarının demografik özellikler ile işe bağlı duygusal tükenmişlik düzeyi arasındaki farklılıkların analizi aşamasında ikili grupların karşılaştırılmasında bağımsız örneklem t-testi, ikiden fazla olan grupların karşılaştırılmasında One way-Anova F testi kullanılmıştır. Sağlık çalışanlarının demografik özellikleri ile işe bağlı duygusal tükenmişlik düzeyi puanları arasında istatistiksel olarak anlamlı farklılık olup olmadığı incelendiğinde;

Cinsiyet ve işe bağlı duygusal tükenmişlik düzeyi puanları: Sağlık çalışanlarının işe bağlı duygusal tükenmişlik düzeyi puanı ile cinsiyet değişkeni arasında istatistiksel olarak anlamlı bir farklılık görülmemiştir (t: 1,467; p=0,143>0,05).

Yaş ve işe bağlı duygusal tükenmişlik düzeyi puanları: Sağlık çalışanlarının işe bağlı duygusal tükenmişlik düzeyi puanı ile yaş değişkeni arasında istatistiksel olarak anlamlı bir farklılık görülmemiştir (F: 2,366; p=,071>0,05).

Eğitim ve işe bağlı duygusal tükenmişlik düzeyi puanları: Sağlık çalışanlarının işe bağlı duygusal tükenmişlik düzeyi puanı ile eğitim durumları arasındaki farklılığı belirlemek için tek yönlü varyans analizi (Anova) yapılmıştır. Analiz sonucunda grup ortalamaları arasında istatistiksel olarak anlamlı bir farklılık görülmüştür (F:3,212; P=,023>0,05). Farklılığın hangi gruplar arasında olduğunu saptamak için post-hoc analizi kullanılmıştır. Analiz sonucunda lisans mezunu sağlık çalışanları ile tıpta uzmanlık mezunu sağlık çalışanları arasında fark tespit edilmiştir. Lisans mezunu sağlık çalışanları ($3,381 \pm ,073$), tıpta uzmanlık mezunu ($2,548 \pm ,250$) sağlık çalışanlarına göre işe bağlı duygusal tükenmişlik düzeyi ortalaması yüksektir (Tablo 3).

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Tablo 3. Eğitime Göre İşe Bağlı Duygusal Tükenmişlik Düzeyi Puanları

Eğitim	N	Ortalama	ss	F	P	Post-hoc
Lise ve dengi(a)	100	3,1992	,10319	3,212	,023	b>d (,023)
Lisans(b)	190	3,3818	,07340			
Lisansüstü(c)	38	3,1838	,16558			
Tıpta uzmanlık(d)	13	2,5480	,25086			
Total	341	3,2744	,05550			

p<0.05

Meslek ve işe bağlı duygusal tükenmişlik düzeyi puanları: Sağlık çalışanlarının işe bağlı duygusal tükenmişlik düzeyi puanı ile meslekleri arasındaki farklılığı belirlemek için tek yönlü varyans analizi (ANOVA) yapılmıştır. Analiz sonucunda grup ortalamaları arasında istatistiksel olarak anlamlı bir farklılık görülmüştür (F: 4,263; p<,001 >0,05). Farklılığın hangi gruplar arasında olduğunu saptamak için post-hoc analizi kullanılmıştır. Analiz sonucunda hemşire/ebe ile hekim ve sağlık teknisyen/tekniker ile hekim arasında fark tespit edilmiştir. Hemşire/ebelerin işe bağlı duygusal tükenmişlik düzeyi puanı (3,571±,968), hekimlerden (2,548±,250) yüksek bulunmuştur. Sağlık teknisyeni/teknikerlerin (3,447±,977) işe bağlı duygusal tükenmişlik düzeyi puanı, hekimlerden yüksek bulunmuştur (Tablo 4).

Tablo 4. Mesleğe Göre İşe Bağlı Duygusal Tükenmişlik Düzeyi Puanları

Meslek	N	Mean	ss	F	P	Post-hoc
Yönetici(a)	26	2,9545	,91474	4,263	<,001	c>b(0,002) b>b(0,009)
Hekim(b)	19	2,5679	,87430			
Hemşire/ebe(c)	64	3,5717	,96809			
Sağ teknis/tek.(d)	76	3,4472	,97771			
İdari personeli(e)	58	3,2885	1,04047			
Diğer(f)	98	3,1599	1,05841			
Total	341	3,2744	1,02491			

TARTIŞMA VE SONUÇ

Araştırma sonucunda katılımcıların çoğu kadın çalışanlardan ve 18-34 yaş aralığında ve eğitim durumu %55,7 ile lisans mezunu sağlık çalışanlarından oluşmaktadır. Araştırmanın gerçekleştirildiği sağlık kurumunda çalışan sağlık çalışanlarının genel işe bağlı duygusal tükenmişlik ortalaması 3.27±0.055 olarak bulunmuştur. Araştırma sonucunda araştırma hipotezi ve soruları yanıtlanmıştır. Araştırmanın yapıldığı sağlık kurumundaki sağlık çalışanlarının işe bağlı duygusal tükenmişlik puanının ortalamadan yüksek olduğu saptanmıştır. Katılımcıların çalışma ortamlarında işe bağlı

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duygusal tükenmişlik yaşadığı belirlenmiştir. Araştırma sonucunda sağlık çalışanlarının işe bağlı duygusal tükenmişlik düzeyleri ile demografik özellikler arasında anlamlı farklılıklar bulunmuştur. Sağlık çalışanlarının eğitim durumu ve meslekleri ile işe bağlı duygusal tükenmişlik düzeyleri arasında istatistiksel olarak anlamlı farklılık saptanmıştır. Buna göre lisans mezunu sağlık çalışanları ile tıpta uzmanlık mezunu sağlık çalışanları arasında fark tespit edilmiştir. Lisans mezunu sağlık çalışanlarının, tıpta uzmanlık mezunu sağlık çalışanlarına göre işe bağlı duygusal tükenmişlik düzeyi ortalaması yüksektir. Yine hemşire/ebe ile hekim ve sağlık teknisyen/tekniker ile hekim arasında fark tespit edilmiştir. Hemşire/ebelerin işe bağlı duygusal tükenmişlik düzeyi hekimlerden yüksek bulunmuştur. Aynı şekilde sağlık teknisyen/teknikerinin işe bağlı duygusal tükenmişlik düzeyi de hekimlerden yüksek bulunmuştur. Bu sonuçlara göre araştırmanın gerçekleştirildiği sağlık kurumunda çalışan hemşireler ve sağlık tek./teknikerlerin işe bağlı duygusal tükenmişlik hissiyatı hekimlerden daha fazla yaşadığı saptanmıştır. Diğer değişkenler arasında farklılıklar saptanmamıştır. Sağlık kurumları hizmetin yoğun olarak sunulduğu acil ve ertelenemz kurumlardır. Çalışma saatlerinin uzun olması, iş stresi, çatışma ortamı, çalışma koşulları, iş yükü, ücret dengesizliği, olumsuz yönetici davranışları gibi deneyimler yaşanabilmektedir. Bu sebepler çalışanların hizmet sunumu sürecinde fiziksel ve psikolojik olarak çeşitli zorluklarla karşılaşmalarına yol açabilmektedir. Sağlık kurumlarının hizmet sunumunu sağlıklı şekilde sürdürebilmeleri için sağlık çalışanlarının işlerini olumsuz etkileyecek faktörlerin belirlenmesi ve gerekli önlemlerin alınması gerekmektedir. Özellikle sağlık çalışanlarını olumsuz olarak etkileyen konular saptanmalı ve düzeltici faaliyetlerin geliştirilmesi gerekmektedir. Araştırmanın tek bir kurumda gerçekleştirilmesi araştırmanın sınırlılığını oluşturmaktadır. Ayrıca araştırmada sadece sağlık çalışanlarının işe bağlı duygusal tükenmişlik düzeyleri ve demografik değişkenlere göre farklılıkları tespit edilmiştir. Gelecek çalışmalarda işe bağlı duygusal tükenmişliğin farklı değişkenlerle ilişkisini değerlendirmek için kapsamlı çalışmalar yapılması önerilmektedir.

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SOCIETY 5.0 AND WOMEN'S WELFARE: OPPORTUNITIES, RISKS AND POLICIES

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Abstract

Society 5.0, as a human-centered paradigm that aims to integrate technological innovation with human well-being, holds significant potential to transform the social status of women. This study examines the impacts of Society 5.0 on women's welfare both globally and within the context of Turkey, focusing on five key domains: education, employment, health, gender equality, and digital inclusion. Drawing on academic literature and policy documents, the analysis interrogates not only the opportunities that digitalization offers to women but also the inequalities it may deepen.

In the domain of education, gender gaps persist in STEM fields; however, digital learning platforms and AI-driven content personalization are reshaping women's access to education. In Turkey, initiatives such as "Coding Tomorrow" aim to enhance children's digital skills, with a particular focus on girls. In the labor market, digitalization presents women with opportunities for flexible work and digital entrepreneurship, yet automation threatens the jobs of women concentrated in routine-based occupations. In healthcare, AI-supported screening tools and FemTech applications are improving gender-sensitive health services, while digital safety solutions like Turkey's KADES app play a critical role in protecting women's right to life.

Nevertheless, the digital gender divide, algorithmic bias, job displacement due to automation, and the disproportionate burden of care work on women may constrain the egalitarian potential of Society 5.0. Therefore, it is essential to design gender-sensitive policies, expand digital skill training programs, strengthen care infrastructures, and ensure data equity. A truly "super-smart" society envisioned by Society 5.0 can only be realized through women's equal access to and active participation in the digital future. This study argues that centering women's welfare in the socio-technical transformation of the digital age is a strategic and ethical imperative.

Keywords: Society 5.0, Women's Welfare, Digital Inclusion, Digital Transformation.

TOPLUM 5.0 VE KADIN REFAHI: FIRSATLAR, RİSKLER VE POLİTİKALAR

Özet

Toplum 5.0, teknolojik yenilikleri insan refahıyla bütünleştirmeyi amaçlayan ve insanı merkeze alan bir bakış açısı olarak kadınların toplumsal konumunu dönüştürme potansiyeli taşımaktadır. Bu çalışmada, Toplum 5.0'ın kadın refahına etkileri küresel düzeyde ve Türkiye bağlamında; eğitim, istihdam, sağlık, toplumsal cinsiyet ve dijital kapsayıcılık eksenlerinde incelenmektedir. Literatür ve politika belgelerine dayalı analizlerde, dijitalleşmenin kadınların yaşamına sunduğu fırsatların yanında derinleştirebileceği eşitsizlikler de sorgulanmaktadır.

Eğitimde, STEM alanlarında cinsiyet uçurumu devam etmekte; ancak dijital öğrenme platformları ve yapay zekâ temelli içerik uyarlamaları kadınların eğitime erişimini dönüştürmektedir. Türkiye'de "Yarını Kodlayanlar" gibi girişimlerle çocukların dijital becerileri artırılmaktadır. İstihdam alanında dijitalleşme, kadınlara esnek çalışma ve dijital girişimcilik fırsatları sunarken; otomasyon, rutin işlerde yoğunlaşan kadın iş gücünü tehdit etmektedir. Sağlıkta ise yapay zekâ destekli taramalar ve

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FemTech uygulamaları, kadına özgü sağlık hizmetlerini iyileştirmekte; Türkiye’de KADES gibi dijital güvenlik çözümleri kadınların yaşam hakkını korumada etkili olmaktadır.

Dijital cinsiyet uçurumu, veri yanlılığı, otomasyon kaynaklı iş kayıpları ve bakım emeğinin kadınlar üzerindeki orantısız yükü, Toplum 5.0’ın eşitlikçi potansiyelini sınırlayabilmektedir. Bu nedenle, politika tasarımlarının duyarlı olması, dijital beceri eğitimlerinin yaygınlaştırılması, bakım altyapısının güçlendirilmesi ve veri eşitliği temelinde dönüşümün sağlanması önemlidir. Toplum 5.0’ın gerçek anlamda “süper akıllı” bir toplum olabilmesi, kadınların dijital geleceğe eşit erişimi ve aktif katılımıyla mümkündür. Bu çalışma, dijital çağın sosyo-teknik dönüşümünde kadın refahının merkezde konumlanmasının stratejik bir gereklilik olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Toplum 5.0, Kadın Refahı, Dijital Kapsayıcılık, Dijital Dönüşüm.

GİRİŞ

Toplum 5.0 kavramı, 2015 yılında Japonya’da ortaya çıkmıştır. Bu kavram, "akıllı toplum" ya da "süper akıllı toplum" olarak nitelendirilmekte olup, Endüstri 4.0 bağlamında tartışılan yeni teknolojilerin insanların günlük yaşamları ve toplum ile bütünleştirilmesini hedeflemektedir (Akın ve ark., 2021; Wang ve ark., 2018). Kavramın tarihsel arka planını anlamak için insanlığın geçirdiği dönüşüm süreçlerine bakmak gerekmektedir: insanlık tarihinde avcı-toplayıcı toplumdaki (Toplum 1.0) tarım toplumuna (Toplum 2.0), sanayi toplumuna (Toplum 3.0) ve bilgi toplumuna (Toplum 4.0) geçiş yaşanmış; Toplum 5.0 ise bu sürecin en son halkasını oluşturmaktadır (Fukuyama, 2018). Toplum 5.0’ın ana teması, "toplum için teknoloji" önerisidir (Okan Gökten, 2018).

Toplum 5.0 ile Endüstri 4.0 arasındaki ilişki, kavramın doğru anlaşılması açısından önemlidir. Endüstri 4.0 paradigması, fabrikaların "akıllı fabrikalara" dönüştürülmesini hedeflerken, Toplum 5.0 dünyanın ilk "süper akıllı toplumunu" oluşturmayı amaçlamaktadır (Dutton, 2014; Er ve ark., 2021; Fukuda, 2020; Gladden, 2019). Toplum 5.0, salt teknolojik bir dönüşüm projesi olmaktan öte, insanlığın bilim, teknoloji ve sosyal boyutlardaki son aşamasını kapsayan bütüncül bir süreç olarak değerlendirilmektedir (Er ve ark., 2021; Gorecky ve ark., 2014; Ferreira ve Serpa 2018). Bu bağlamda teknik tasarımın, insanların ve toplumun ihtiyaçlarını öncelikle ve yeterince erken ele alması; sistemin bu ihtiyaçlara uyum sağlaması, insanları ve toplulukları güvende tutması ve bireylerin öz-yönelimli bir aktör olarak hareket edebilmesini mümkün kılması beklenmektedir (Ystgaard ve Moor, 2023). "İnsan merkezli" kavramı, "kullanıcı merkezli" kavramından daha geniş bir anlam taşımakta; tasarımcıların tipik kullanıcılar olarak kabul edilenlerin ötesinde daha geniş bir katılımcı grubuna karşı sorumluluklarını daha insancıl bir bakış açısıyla ele almasını gerektirmektedir (Ystgaard ve ark., 2023).

Toplum 5.0 çerçevesinde teknoloji ve yenilikçilik, toplumsal refahın artırılmasında kritik bir araç olarak konumlandırılmaktadır. Sosyal yenilikçilik, toplumun ihtiyaçlarını karşılarken yenilikçi uygulamalar ve hizmetler sunmakta; kadınların güçlendirilmesi, engelli bireylerin eğitimi ve atık yönetimi gibi toplumsal sorunlara çözümler üretmektedir. Toplum 5.0’ın insan merkezli ve kapsayıcı vizyonu, kadın refahının bu sürecin merkezine almaktadır. Sosyal yenilikçilik literatüründe kadınların güçlendirilmesi, toplumsal ihtiyaçları karşılayan yenilikçi uygulamalar arasındadır (Çağlıyan ve ark., 2019). İnsan merkezli tasarım yaklaşımları bağlamında da benzer bir vurgu yapılmaktadır: teknik sistemlerin tipik kullanıcıların yanı sıra, kadınlar ve dezavantajlı gruplar gibi geniş bir katılımcı grubunu kapsamaları önemlidir (Ystgaard ve ark., 2023). Aksi takdirde, teknolojik dönüşüm süreçleri mevcut toplumsal eşitsizlikleri yeniden üretme ya da derinleştirme riskiyle karşı karşıya kalacaktır (Ystgaard ve Moor, 2023).

Bu çalışma, Toplum 5.0 çerçevesinde dijital dönüşümün kadın refahı üzerindeki etkilerini ele almayı amaçlamaktadır. İnsan merkezli ve kapsayıcı teknoloji anlayışı doğrultusunda, dijitalleşmenin

kadınların eğitim, istihdam, sağlık, toplumsal katılım ve dijital kapsayıcılık alanlarındaki konumunu nasıl dönüştürdüğü incelenmektedir. Çalışmanın temel amacı, teknolojik ilerlemelerin mevcut toplumsal cinsiyet eşitsizliklerini nasıl dönüştürebileceğini, derinleştirebileceğini ya da azaltabileceğini eleştirel bir bakış açısıyla değerlendirmektir.

Kapsam itibarıyla çalışma, küresel literatürün yanı sıra Türkiye örneği üzerinden karşılaştırmalı bir analiz sunmakta; STEM eğitimi, dijital okuryazarlık, uzaktan çalışma, dijital sağlık hizmetleri, finansal kapsayıcılık gibi alt temalar etrafında şekillenmektedir. Yöntem olarak, literatür taraması ve politika belgelerinin analizi yoluyla kavramsal ve kuramsal çerçeve oluşturulmuştur. Bu doğrultuda çalışmada disiplinler arası bir perspektifle sosyal hizmet, toplumsal cinsiyet çalışmaları ve dijital dönüşüm literatürü bütünleştirilmiştir.

TOPLUM 5.0 VE DİJİTALLEŞMENİN KADIN REFAHINA ETKİLERİ

Toplum 5.0, teknolojik ilerlemeyi ve toplumsal refahı odağa alan bütüncül bir dönüşüm vizyonunu temsil etmektedir. Yapay zekâ, büyük veri, nesnelerin interneti ve robotik sistemlerin entegrasyonu ile şekillenen bu yeni toplum modeli, bireylerin yaşam kalitesini artırmayı ve sosyal eşitsizlikleri azaltmayı hedeflemektedir. Bu bağlamda kadın refahı, insan merkezli teknolojik dönüşümün hem bir göstergesi hem de bir koşulu olarak değerlendirilmektedir. Bu bölümde, Toplum 5.0'ın temel ilkeleri ile dijitalleşmenin kadınların toplumsal konumuna etkisi kavramsal ve kuramsal bir çerçevede ele alınarak, kapsayıcı teknolojik kalkınmanın toplumsal cinsiyet boyutu tartışılacaktır.

Toplum 5.0'ın Temel İlkeleri

Toplum 5.0'ın teknolojik altyapısı, birbiriyle bütünleşmiş birden fazla ileri teknoloji üzerine inşa edilmiştir. Nesnelerin İnterneti (IoT), büyük veri, yapay zekâ, robotlar ve blok zinciri, Toplum 5.0'ın ana teknolojileri olarak tanımlanmaktadır (Aliyev, 2022). Bu teknolojiler, siber uzay ile fiziksel uzayın birleştirilmesi yoluyla süper akıllı bir toplumun inşasını mümkün kılmaktadır (Lumintang ve Intan, 2022; Bongomin ve ark., 2020). Hem Endüstri 4.0 hem de Toplum 5.0, IoT, yapay zekâ ve büyük veri analizini ön plana çıkarmakta; akademik, endüstriyel ve hükümet sektörleriyle iş birliği yaparak devlet öncülüğünde bir yaklaşımı benimsemektedir (Maadeed ve Ponnamma, 2023).

İnsan Merkezlilik İlkesi

Toplum 5.0'ın en temel özelliği, teknolojiyi insanın hizmetine sunan insan merkezli yaklaşımıdır. Toplum 4.0'ın akıllı fabrika, inovasyon, makine ve üretime odaklandığı görülmektedir. Bu nedenle Toplum 4.0, "büyük değişim çağı" olarak adlandırılmaktadır. Japon hükümeti ve araştırmacılar, Toplum 4.0'ın bu zayıflığını görerek insanı inovasyonun merkezine koyan Toplum 5.0 kavramını tasarlamıştır (Lumintang ve Intan, 2022). Bu yaklaşım, teknolojik gelişmelerin toplumun tüm kesimlerine eşit biçimde fayda sağlamasını ön plana çıkarmaktadır (Er ve ark., 2021). İnsan merkezli tasarım anlayışı, teknik sistemlerin insan kullanıcıların, toplulukların ve toplumsal ihtiyaçların sistematik biçimde önceliklendirildiği bir yapıyı ifade etmektedir (Ystgaard ve Moor, 2023).

Toplum 5.0'da insan merkezlilik, Japonya'nın Beşinci Bilim ve Teknoloji Temel Planı'nda da açıkça vurgulanmaktadır: bu plan, siber uzay ile fiziksel uzayı yüksek düzeyde entegre eden bir toplumu hedeflemekte; ekonomik kalkınma ile toplumsal sorunların çözümünü eş zamanlı gerçekleştirmeyi amaçlamaktadır (Záklasník ve Putnová, 2019). Toplum 5.0, yaş, cinsiyet, dil ve din gibi farklılıklardan kaynaklanan güvensizliklerden arındırılmış; insanların ihtiyaç duydukları şeyleri doğru zamanda ve doğru biçimde elde edebildiği bir toplum vizyonunu temsil etmektedir (Lumintang ve Intan, 2022).

Kapsayıcılık

Toplum 5.0'ın kapsayıcı boyutu, teknolojik dönüşümün toplumun tüm kesimlerini içermesi gerektiği ilkesine dayanmaktadır. Toplum 5.0, yaş, cinsiyet, dil ve din gibi farklılıklardan kaynaklanan güvensizlikleri ortadan kaldırmayı hedeflemektedir (Lumintang ve Intan, 2022). Bu bağlamda süper akıllı toplum vizyonu, eşitsizlik, uyumsuzluk ve yabancılaşma gibi kronik sorunların ileri teknolojilerin yardımıyla geride bırakılacağını öngörmektedir; her yaştan ve her yetkinlik düzeyinden insanın gelişim fırsatı bulacağı bir toplum hedeflenmektedir (Mallapaty, 2018). Toplum 5.0'ın yaş, cinsiyet, dil ve din gibi farklılıklardan kaynaklanan güvensizlikleri ortadan kaldırma hedefi (Lumintang ve Intan, 2022), kadın refahının bu vizyonun ayrılmaz bir parçası olduğunu açıkça ortaya koymaktadır. Japonya'nın süper akıllı toplum vizyonunda her yaştan ve her yetkinlik düzeyinden insanın gelişim fırsatı bulacağı bir toplum hedeflenmektedir (Mallapaty, 2018); ancak bu hedefin gerçekleşmesi, kadınların teknolojik dönüşüm süreçlerine eşit biçimde dahil edilmesini zorunlu kılmaktadır.

Teknolojik Dönüşümde Kadının Rolü ve Dijital Uçurum

Toplum 5.0 sürecinde kadın refahının merkeze alınması, eşitlik ve sosyal sürdürülebilirlik açısından öneme sahiptir. İnsan merkezli IoT ve akıllı ortam araştırmaları, teknik sistemlerin insan ve toplumsal değerleri, insan katılımını ve insanlar ile toplum üzerindeki etkiyi kapsayan daha geniş bir tasarım perspektifine ihtiyaç duyduğunu göstermektedir (Ystgaard ve ark., 2023). Kadınların bu tasarım süreçlerine dahil edilmemesi, teknolojik çözümlerin toplumun yarısının ihtiyaçlarını göz ardı etmesi anlamına gelecektir.

Dijital okuryazarlık açısından bakıldığında, pek çok kullanıcının bilgi toplumu çağında dijital teknoloji konusunda hâlâ yeterince okuryazar olmadığı görülmektedir (Lumintang ve Intan, 2022). Bu dijital uçurum, kadınları orantısız biçimde etkilemekte; özellikle gelişmekte olan ülkelerde ve kırsal bölgelerde yaşayan kadınların teknolojik dönüşümden dışlanma riski taşıdığı görülmektedir (Aldabbas ve ark., 2022). Toplum 5.0'ın kapsayıcı vizyonunun hayata geçirilmesi, bu dijital uçurumun kapatılmasını ve kadınların teknolojik dönüşüm süreçlerine tam katılımını zorunlu kılmaktadır.

Dijital ekonominin kadın istihdamı üzerindeki etkisini inceleyen araştırmalar, uzaktan çalışma ve esnek çalışma saatlerinin kadınların zamanlarını daha iyi yönetmelerine ve orantısız biçimde üstlendikleri ücretsiz bakım işinin stresini azaltmalarına yardımcı olabileceğini ortaya koymaktadır. Bununla birlikte, kısıtlı finansal kaynaklar, yetersiz çocuk bakımı desteği ve önyargılı iş düzenlemeleri gibi yapısal engeller kadınların dijital iş gücüne katılımını olumsuz etkilemektedir (Ahmad ve ark., 2024). Toplum 5.0'ın kapsayıcı bir toplum vizyonunu hayata geçirebilmesi, kadınların dijital dönüşümün her aşamasına eşit biçimde dahil edilmesini gerektirmektedir (Collett ve ark., 2022; Adeola ve ark., 2023).

FIRSATLAR VE RİSKLER

Yapay zekâ ve robotik teknolojileri, kadın refahı açısından hem önemli fırsatlar hem de ciddi riskler barındırmaktadır. Fırsatlar açısından değerlendirildiğinde, Toplum 5.0'ın sağlık alanındaki uygulamaları kadınların sağlık hizmetlerine erişimini köklü biçimde iyileştirebilir (Maadeed ve Ponnamma, 2023; Mallapaty, 2018). Özellikle yaşlı bakımı alanında robotik teknolojilerin geliştirilmesi, bakım yükünün önemli bir bölümünü üstlenen kadınlar üzerindeki baskıyı azaltma potansiyeli taşımaktadır (Veere, 2019). Japonya'nın süper akıllı toplum politika reformlarının, değişen aile örüntülerini göz ardı eden muhafazakâr bir geniş aile idealine dayandığı ve teknolojinin aile içi bakım yükünü azaltmak yerine aile üyeleri arasındaki ayrışmayı derinleştirdiği eleştirisi dile getirilmektedir (Veere, 2019). Bu eleştiri, Toplum 5.0'ın kadın refahına ilişkin politikalarının gerçekçi

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ve kapsayıcı bir toplumsal cinsiyet perspektifiyle yeniden değerlendirilmesi gerektiğine işaret etmektedir.

Yapay zekanın iş piyasası üzerindeki etkisi de kadın refahı açısından kritik bir mesele olarak öne çıkmaktadır. Endüstri 4.0'ın en önemli dezavantajı olarak değerlendirilen istihdam azalması (Korkut ve Várallyai, 2024), kadın istihdamını orantısız biçimde etkileyebilir.

Toplum 5.0'ın "toplum için teknoloji" felsefesi, ancak kadınlar dahil tüm toplumsal kesimlerin bu dönüşümden eşit biçimde yararlandığı bir yapıda gerçek anlamını kazanabilecektir (Akın ve ark., 2021; Er ve ark., 2021). Sosyal yeniliklerin erdemli bir niyet temelinde inşa edilmesi gerektiği vurgulanmakta (Çağlıyan ve ark., 2019); bu da kadın refahını göz ardı eden bir toplumsal dönüşüm projesinin meşruiyetini sorgulamaktadır. Toplum 5.0'ın Endüstri 5.0 ile entegrasyonu bağlamında insan merkezli yaklaşımın, sürdürülebilirlik ve etğin önceliklendirilmesi ve paydaşların etkin biçimde dahil edilmesi gerektiği vurgulanmaktadır (Mahajan ve ark., 2025); bu ilkeler, kadın refahının merkeze alınmasını doğrudan desteklemektedir.

DİJİTAL DÖNÜŞÜM EKSENİNDE KADIN REFAHI

Toplum 5.0 ile şekillenen dijital dönüşüm, teknolojik sistemlerde ve toplumsal yapılarda değişimlere yol açmaktadır. Bu dönüşüm sürecinde kadınların eğitime, istihdama, sağlığa ve finansal hizmetlere eşit ve etkili biçimde katılımı hem bireysel refah hem de toplumsal kapsayıcılık açısından önemlidir. Dijitalleşme kadınlar için yeni fırsatları açığa çıkarırken, eşitsizlikleri yeniden üreten yapısal engelleri de derinleştirme potansiyeline sahiptir. Bu bağlamda, dijital çağın kadın refahı üzerindeki çok boyutlu etkileri; eğitimden istihdama, sağlıktan dijital finansal kapsayıcılığa uzanan alanlarda değerlendirilecektir.

Eğitim ve Yaşam Boyu Öğrenme

STEM eğitimindeki toplumsal cinsiyet uçurumu, Toplum 5.0'ın kapsayıcı vizyonu önündeki en temel engellerden biridir. Avrupa'da bilim ve mühendislik alanında kadın istihdamının artma eğilimi göstermesine karşın, Bilgi ve İletişim Teknolojileri (BİT) kariyerlerindeki kadın oranı, Avrupa iş piyasasındaki toplam kadın istihdamının %2'sinin altında kalmaya devam etmektedir. Bu durumun temelinde akademik ortam ve sunulan eğitim kaynaklarındaki yapısal sorunlar yatmaktadır. Bu bağlamda, STEM öğrenme deneyimlerinin kız çocukları için daha kapsayıcı ortamlar oluşturacak biçimde yeniden tasarlanması gerekmektedir (Scherling, 2024). COVID-19 pandemisinin eğitim eşitsizliklerini derinleştirdiği ve dezavantajlı grupların -özellikle kız çocuklarının- orantısız biçimde etkilendiği görülmektedir. Okul kapanmaları sürecinde çevrimiçi eğitime geçiş, dijital uçurumu keskin biçimde gün yüzüne çıkarmış; yoksul ve marjinalleştirilen nüfusların coğrafyadan bağımsız olarak ekonomik şoklara karşı savunmasız olduğunu ortaya koymuştur (Venkatesan ve ark., 2021).

Dijital öğrenme platformları ve yaşam boyu öğrenme, Toplum 5.0'ın eğitim boyutunda kritik bir rol üstlenmektedir. Uluslararası kamu-özel ortaklıklarının dijital öğrenme ortamlarını güçlendirdiği ve öğrenme kaynaklarının ülkeler arasında paylaşıldığı bir gelecek vizyonu, eğitimin dönüşümünü hızlandırmaktadır (OECD, 2019).

Dijital okuryazarlık, dijital teknolojiler aracılığıyla iletişimin ve bilgiye erişimin giderek arttığı bir toplumda yaşamak ve çalışmak için gerekli yetkinliklere sahip olmak olarak tanımlanmaktadır (OECD, 2019). Bu tanım, kadınların dijital dönüşüm sürecine tam katılımı için dijital okuryazarlığın ne denli temel bir ön koşul olduğunu açıkça ortaya koymaktadır.

Yapay zekâ ve büyük veri becerilerine sahip kadınlar ile STEM alanlarında eğitim almış kadınlar için bu tür işlerin önemli bir fırsat teşkil ettiği vurgulanmaktadır (Collett ve ark., 2022). Türkiye'de dijital

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girişimcilik ve yenilikçilik alanında kadınlara ve gençlere yönelik destek programları -Tekno-Girişimcilik Hibe Programı ve Kadın Girişimciler Yarışması gibi girişimler- dijital kapsayıcılığı teşvik etmekte ve eşit fırsatlar oluşturmayı hedeflemektedir (Balcıoğlu, 2024). Bu tür programlar, kadınların teknoloji kullanıcısı, teknoloji üreticisi ve yenilikçisi olarak dijital ekonomiye dahil edilmesini desteklemektedir (Scherling, 2024).

İstihdam

Dijital ekonominin kadın istihdamı üzerindeki etkisi, fırsatlar ve riskler barındıran karmaşık bir tablo ortaya koymaktadır. Uzaktan çalışma ve esnek çalışma saatleri, kadınların zamanlarını daha iyi yönetmelerine ve orantısız biçimde üstlendikleri ücretsiz bakım işinin stresini azaltmalarına yardımcı olabilmektedir. Dijital ekonomide kadın istihdamı, ücret şeffaflığını artırarak ve eşit iş için eşit ücret sunarak toplumsal cinsiyet ücret uçurumunun kapatılmasına da katkı sağlayabilmektedir (Ahmad ve ark., 2024).

Dijital ekonomide girişimcilik, eğitime erişim ve toplumsal cinsiyet eşitliğini destekleyen politikalar kadınların dijital sektörlerde çalışmasına elverişli bir iklim oluşturabilmektedir. Ancak kısıtlı finansal kaynaklar, yetersiz çocuk bakımı desteği ve önyargılı iş düzenlemeleri gibi yapısal engeller, kadınların dijital iş gücüne katılımını ve ilerlemesini kısıtlamaya devam etmektedir (Ahmad ve ark., 2024). Bu durum, Türkiye'nin dijital ekonomi politikalarında yapısal cinsiyet engellerini doğrudan hedef alan müdahalelerin geliştirilmesini zorunlu kılmaktadır (Balcıoğlu, 2024).

Dijital çağın dünya genelinde gelir dağılımındaki eşitsizliği artıracakı inkâr edilemez bir gerçektir; bu nedenle hükümetlerin ve kuruluşların dijital dönüşümün işletmeler üzerindeki olumsuz etkisini en aza indirecek düzenleyici bir rol üstlenmesi gerekmektedir (Korkut ve Várallyai, 2024). Dijital teknolojiler, uzaktan çalışma ve çevrimiçi platformlar aracılığıyla yürütülen işler gibi tamamen yeni standart dışı çalışma biçimlerini mümkün kılmıştır (OECD, 2019) ancak bu yeni çalışma biçimleri, kadınları hem fırsatlar hem de riskler açısından orantısız biçimde etkilemektedir.

Ev tabanlı çalışma için yeni fırsatların ortaya çıkması umut verici görünse de bu durumun sosyoekonomik dışlanmayı pekiştirebileceği de vurgulanmaktadır (Bashir ve ark., 2021). Bu eleştirel gözlem, uzaktan çalışmanın kadınlar için gerçek anlamda güçlendirici olabilmesi için çocuk bakımı, eşit ücret ve kariyer ilerleme fırsatlarına ilişkin yapısal sorunların eş zamanlı olarak ele alınması gerektiğini ortaya koymaktadır (Ahmad ve ark., 2024; Pawar ve Babacan, 2025).

Dijital finansal kapsayıcılık, kadın refahının güçlendirilmesinde öne çıkmaktadır. Dijital finansal hizmetlere erişimde kadınların güçlük yaşadığı, ancak eğitimli ve becerikli kadınların okuma yazma bilmeyen ve düşük beceri düzeyine sahip kadınlara kıyasla bu güçlüklerle daha az karşılaştığı görülmektedir. Hükümet, özel sektör ve gönüllü sektörün, Ulusal Dijital Okuryazarlık Misyonu gibi politika girişimleri aracılığıyla dijital okuryazarlığı teşvik etmek için iş birliği yapması gerekmektedir (Sinha ve Nayak, 2024).

Mikro finans ve İslami mikro finans uygulamaları da kadın güçlenmesinde önemli bir rol üstlenmektedir. İslami mikro finans aracılığıyla krediye erişimin, kadınların hane harcamalarına, sağlık hizmetlerine ve eğitime kaynak ayırma kapasitesini artırdığı görülmektedir (Osman, 2023). Toplumsal cinsiyet gelişim göstergeleri ile kadınlar için dijital finansal kapsayıcılık arasındaki pozitif korelasyon (Osman, 2023), dijital finansal hizmetlere erişimin kadın refahı üzerindeki dönüştürücü etkisini açıkça ortaya koymaktadır. Türkiye'de de dijital bankacılık ve fintech alanındaki gelişmeler (Balcıoğlu, 2024), kadınların finansal hizmetlere erişimini kolaylaştırma potansiyeli taşımaktadır.

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Sağlık Hizmetlerine Erişim

FemTech, dijital sağlık endüstrisinde bir dönüşümü temsil eden ve kadınlara öz-bilgi araçları sunan bir kavram olarak tanımlanmaktadır. FemTech, bir yanda dijital sağlık endüstrisinde bir zafer olarak konumlandırılırken, öte yanda eleştirel bir perspektiften de değerlendirilmesi gereken bir ikili yapıya sahiptir (Scherling, 2024).

Telehealth, edtech, blok zinciri ve yapay zekâ gibi teknolojiler, kadınların güçlenmesinde ve yaşamlarının iyileştirilmesinde kritik bir rol üstlenebilir. Yapay zekada toplumsal cinsiyet eşitliğini sağlamak için, geliştirme ve kodlama gibi önemli rollerde daha fazla kadının istihdam edilmesi ve yapay zekâ sistemlerinin daha kapsayıcı hale getirilmesi gerekmektedir (Adeola ve ark., 2023). Türkiye’de dijital sağlık alanındaki gelişmeler, Toplum 5.0’ın sağlık boyutuyla doğrudan örtüşmektedir. Türkiye’de Merkezi Hekim Randevu Sistemi (MHRS) gibi platformlar aracılığıyla vatandaşların çevrimiçi tıbbi randevu alabilmesi sağlanmıştır. E-Nabız platformu, bireylerin kendi sağlık verilerine erişimini kolaylaştırarak hasta güçlenmesini desteklemektedir ve Toplum 5.0’ın insan merkezli sağlık vizyonu ile uyum içindedir (Balcıoğlu, 2024).

Yapay zekanın kadın sağlığı alanındaki uygulamaları hem önemli fırsatlar hem de ciddi riskler barındırmaktadır. Yapay zekâ destekli tanı sistemleri ve teletıp uygulamaları, kadınların sağlık hizmetlerine erişimini köklü biçimde iyileştirebilir (Bashir ve ark., 2021). Ancak yapay zekâ sistemlerindeki algoritmik önyargı, kadın sağlığı verilerinin yetersiz temsili nedeniyle tanı ve tedavi süreçlerinde eşitsizliklere yol açabilmektedir (Collett ve ark., 2022; Adeola ve ark., 2023).

SONUÇ

Toplum 5.0’ın insan merkezli ve kapsayıcı vizyonu, kadın refahının dijital dönüşümün her boyutuna entegre edilmesini zorunlu kılmaktadır (Akın ve ark., 2021; Er ve ark., 2021; Ystgaard ve Moor, 2023). STEM eğitimindeki toplumsal cinsiyet uçurumunun kapatılması (Scherling, 2024; Collett ve ark., 2022), dijital öğrenme platformlarına eşit erişimin sağlanması (OECD, 2019; Bashir ve ark., 2021), uzaktan çalışma ve dijital girişimcilik fırsatlarının yapısal engellerden arındırılması (Ahmad ve ark., 2024; Pawar ve Babacan, 2025), FemTech ve yapay zeka destekli sağlık hizmetlerinin kapsayıcı biçimde tasarlanması (Scherling, 2024; Adeola ve ark., 2023), algoritmik önyargıyla mücadele edilmesi (Collett ve ark., 2022; Walshe ve ark., 2020) bu bütüncül yaklaşımın temel bileşenlerini oluşturmaktadır.

Türkiye özelinde değerlendirildiğinde, e-devlet hizmetleri, dijital girişimcilik programları ve KADES gibi uygulamalar umut verici adımlar olarak öne çıkmaktadır (Balcıoğlu, 2024). Ancak STEM eğitimindeki uçurum (Scherling, 2024) ve dijital finansal kapsayıcılık alanındaki yapısal engeller (Sinha ve Nayak, 2024), Türkiye’nin Toplum 5.0 vizyonunu gerçek anlamda kapsayıcı kılmak için aşması gereken kritik zorlukları temsil etmektedir. Toplum 5.0’ın "toplum için teknoloji" felsefesi (Er ve ark., 2021), ancak kadınlar dahil tüm toplumsal kesimlerin bu dönüşümden eşit biçimde yararlandığı, dijital uçurumun kapatıldığı ve teknolojik tasarım süreçlerine geniş bir katılımın sağlandığı bir yapıda gerçek anlamını kazanabilecektir (Ystgaard ve Moor, 2023; Ystgaard ve ark., 2023; Walshe et al., 2020).

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EVALUATION OF THE NUTRIENT PROFILE OF A HOSPITAL'S VARIOUS MENUS BASED ON NUTRITION GUIDELINES

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Abstract

The World Health Organization emphasizes the importance of sustainable nutrition. Malnutrition is a preventable problem and investments in nutritional therapy play a life-saving role for patients. This retrospective study aimed to evaluate the adequacy levels of general, specialized celiac, and diabetes menus offered at a hospital in Istanbul, Türkiye. One year's menu plan was examined based on FDA, EFSA, and TDG-2022 guidelines in terms of energy, macro-micronutrient, and fiber content. The analysis revealed statistically significant differences in the nutritional profiles of the menus between seasons ($p=0.001$). While NRF20.3 scores showed no significant change throughout the year for all menus and meals, LIM3 scores for the breakfast meal in the spring were to be significantly higher than those of other menus ($p=0.001$). The energy content of the general menus ranged between 1621-1663 kcal, and these values found to be higher than the national TDG-2022 standards, rather than international guidelines. In addition, the daily potassium, calcium, magnesium, and fiber content of the menus fell below both the TDG-2022 and EFSA recommendations. This situation attributed to the menus containing more meat products seasonally and fewer vegetables, fruits, and dairy products. Furthermore, the sodium and phosphorus levels in the menus were to be above the reference values. In conclusion, the nutritional profile of the examined hospital menu was to be not fully compliant with TDG-2022, exhibiting high energy, fat, and sodium content, and low calcium and fiber values. These imbalances may increase the risk of malnutrition in hospitalized patients, and the incompatibility of the menus with sustainable nutrition principles emerges as an area requiring improvement in terms of both individual health and environmental sustainability.

Keywords: hospital menu, nutrient intake, sustainable nutrition.

BİR HASTANENİN FARKLI MENÜLERİNİN BESİN PROFİLİNİN BESLENME KILAVUZLARINA GÖRE DEĞERLENDİRİLMESİ

Özet

Dünya Sağlık Örgütü, yetersiz beslenmenin önlenabilir bir sorun olduğunu ve hastaların beslenme tedavilerine yapılan yatırımların hayat kurtarıcı bir rol oynadığını vurgulayarak sürdürülebilir beslenmenin önemine dikkat çekmektedir. Bu doğrultuda gerçekleştirilen retrospektif çalışma, İstanbul'da bir hastanede sunulan genel, özel çölyak ve diyabet menülerinin yeterlilik düzeyleri mevsimsel olarak değerlendirmesi amaçlanmıştır. Bir yıllık menü verileri; enerji, makro-mikro besin öğeleri ve lif içeriği açısından FDA, EFSA ve TDG-2022 (TÜBER) rehberlerine göre analiz edilmiştir. Yapılan analizler sonucunda, menülerin besin profillerinde mevsimler arasında istatistiksel olarak anlamlı farklılıklar olduğu görülmüştür ($p=0.001$). Tüm menü ve öğünler için NRF20.3 puanları yıl genelinde anlamlı bir değişim görülmezken, ilkbahar döneminde kahvaltı öğünü için genel menülerin LIM3 puanlarının diğer menülere göre anlamlı derecede daha yüksek olduğu saptanmıştır ($p=0.001$). Genel menülerin enerji içeriği 1621-1663 kcal arasında değişmekte olup, bu değerlerin uluslararası rehberlerden ziyade ulusal TDG-2022 standartlarına göre yüksek olduğu saptanmıştır. Buna ek olarak menülerin günlük potasyum, kalsiyum, magnezyum ve lif içeriklerinin hem TDG-2022 hem de EFSA önerilerinin altında kalmasıdır. Bu durum, menülerin mevsimsel olarak daha fazla et ürünü; buna karşın daha az sebze, meyve ve süt ürünü içermesiyle ilişkilendirilmiştir. Ayrıca menülerdeki sodyum ve fosfor miktarlarının referans değerlerin üzerinde olduğu görülmüştür. Sonuç olarak, incelenen hastane menüsünün besin profilin TDG-2022 ile tam uyumlu olmadığı, yüksek enerji, yağ ve sodyum içeriği ile düşük kalsiyum ve lif değerleri olduğu görülmüştür. Bu dengesizlikler hastanede yatan hastalarda malnütrisyon riskini artırabileceği gibi, menülerin sürdürülebilir beslenme ilkeleriyle uyumsuzluğu hem bireysel sağlık hem de çevresel sürdürülebilirlik açısından iyileştirilmesi gereken bir alan olarak ortaya çıkmaktadır.

Anahtar Kelimeler: hastane menüsü, besin ögesi alımı, sürdürülebilir beslenme.

PANCREATIC CYSTIC LYMPHANGIOMA: A RARE CASE IN A PATIENT WITH A HISTORY OF MALIGNANCY

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Abstract

Pancreatic lymphangiomas are quite rare benign cystic lesions and are usually detected incidentally. These lesions, reported in less than 1% of cases in the literature, pose diagnostic difficulties as they are difficult to distinguish from malignant cystic lesions using imaging techniques. This presentation reports a case of an incidentally detected pancreatic lymphangioma in a 56-year-old male patient with a history of renal cell carcinoma and prostate adenocarcinoma. In the differential diagnosis, the possibility of a metastatic mass and intraductal papillary mucinous neoplasm (IPMN) was evaluated; however, advanced imaging and interventional diagnostic methods could not rule out malignancy. Therefore, the patient underwent laparoscopic left pancreatectomy and splenectomy. The postoperative period was uneventful, and histopathological examination reported the lesion as pancreatic cystic lymphangioma. This case highlights the necessity of considering benign lesions in the differential diagnosis, even in patients with a history of malignancy.

Introduction

Lymphangiomas are benign malformations of the lymphatic system, most commonly occurring in the head and neck region and more prevalent in childhood. Their incidence is reported to be approximately 1/100,000 (1,2). Intra-abdominal lymphangiomas are quite rare and are more commonly found in the mesentery or retroperitoneal space (2). Pancreatic lymphangiomas constitute the rarest subgroup of intra-abdominal lymphangiomas, and only a limited number of cases have been reported in the literature (3). Pancreatic lymphangiomas are mostly asymptomatic and are detected incidentally; however, when they grow, they can cause abdominal pain, nausea and other nonspecific symptoms (3,4). Although ultrasound is used as the first step in diagnosis, computed tomography and magnetic resonance imaging are more valuable in assessing the size of the lesion and its relationship with surrounding structures (2,4). However, pancreatic lymphangiomas can be similar to intraductal papillary mucinous neoplasms (IPMN) and other cystic pancreatic neoplasms in terms of imaging findings, making differential diagnosis difficult (5,6).

A definitive diagnosis is usually only possible following histopathological and immunohistochemical examination after surgical resection. Lymphangiomas are typically characterised by CD31/CD34 positivity and a low proliferation index (7). Therefore, it is important to consider pancreatic cystic lymphangiomas in the differential diagnosis, especially in patients with a history of malignancy, as imaging findings may be confused with malignant lesions. This case presentation describes a rare pancreatic lymphangioma case with a history of malignancy in two separate organs, which was detected incidentally and confirmed by surgical resection.

Case Presentation

A 56-year-old male patient was referred to our center after masses were detected in the pancreas and liver during external investigations, despite no weight loss or impaired oral intake during follow-up. The patient, who had no active complaints and had a history of diabetes mellitus (DM), was in good functional condition, with an Eastern Cooperative Oncology Group Performance Status (ECOG PS) score of 1. His medical history revealed that he had undergone a right nephrectomy for renal cell carcinoma three years ago and had been diagnosed with prostate adenocarcinoma one year later. The patient, who had undergone definitive radiotherapy for prostate cancer, was in remission at the time of referral. No abnormalities were detected in the physical examination of the right flank region, apart from a surgical scar. Laboratory tests showed that the complete blood count, biochemical parameters, and tumour markers (CEA, CA 19-9, and PSA) were within normal ranges. Triphasic abdominal-pelvic computed tomography (CT) scan revealed a hypodense nodular lesion approximately 2 cm in diameter at the level of the pancreatic body, accompanied by dilation of the Wirsung duct in the tail segment (**Figure 1**). Magnetic resonance imaging (MRI) revealed two lesions (simple cyst?, haemangioma?) measuring 13×10 mm and 16×11 mm in size in the subcapsular area at the level of liver segment VI, showing no diffusion restriction; In the body-tail junction of the pancreas, a cystic lesion measuring 18×18 mm was detected, which was hyperintense on T2-weighted images, hypointense on T1-weighted images, peripherally mildly enhanced on contrast-enhanced sequences, thin-walled, thought to be associated with the pancreatic duct, and consistent with IPMN. The Wirsung duct was prominent proximal to this level (**Figure 2,3**). An 18F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG PET/CT) scan was planned for the patient, who had previously been diagnosed with two malignancies, considering the possibility of metastasis from the primary tumours. The FDG PET/CT reported low-level FDG uptake (SUVmax: 2) in a 28 mm hypodense cystic lesion in the body of the pancreas. In the differential diagnosis, metastasis of primary tumours and IPMN were considered, and a biopsy was planned using endosonographic ultrasound (E-USG). The E-USG examination revealed a 25×20 mm mass containing a solid component in the body of the pancreas, and the fine needle aspiration biopsy was reported as benign. However, due to the presence of a solid component and possible involvement of the main duct, surgical treatment was recommended. Following vaccination against encapsulated bacteria two weeks prior to surgery in preparation for a possible splenectomy, laparoscopic left pancreatectomy and splenectomy were performed. No complications developed in the postoperative period, and the patient was discharged on the fifth day having made a full recovery. The histopathological examination of the surgical specimen reported that the lesion in the body of the pancreas was consistent with a cystic lymphangioma, and it was noted that there was no tumour involvement in the surgical margin or capsule. In immunohistochemical staining, CD34 was positive, the Ki-67 index was 1%, and synaptophysin and chromogranin A were negative.

Discussion

Cystic lymphangiomas of the pancreas are extremely rare, benign lesions. First described in the literature by Koch in 1913, pancreatic lymphangioma accounts for less than 1% of all lymphangiomas (8). Cystic lesions within the pancreas, however, account for only approximately 0.2 percent of cases (9). Although these lesions frequently appear during childhood, they are also rarely seen in adults and are generally reported slightly more often in women (5). They are typically localised in the tail of the pancreas and exhibit a multicystic structure; more rarely, they may be localised in the head or body (5). Cysts are usually asymptomatic and are detected incidentally during imaging performed for other reasons. However, if a cystic lymphangioma reaches a large size, it can cause symptoms such as abdominal pain, nausea, and vomiting by pressing on neighbouring organs. Cases are generally asymptomatic and are detected incidentally during imaging performed for other reasons. However, if

the cystic lymphangioma reaches large sizes, it can cause symptoms such as abdominal pain, nausea, and vomiting by pressing on neighbouring organs. Our case is one of these rare cases in the literature and presented as a multicystic lesion located in the distal pancreas.

It is difficult to establish a definitive diagnosis of pancreatic cystic lesions using cross-sectional imaging. Preoperative diagnosis of cystic lymphangiomas is particularly difficult due to the non-specific nature of imaging findings. CT and MRI can demonstrate the cystic structure of the lesion, its septa, and its effect on neighbouring structures. However, these findings are not specific for differential diagnosis between lymphangioma and other cystic lesions such as pseudocysts, serous cystadenomas, and mucinous cystic neoplasms (10). In this case, it was initially thought that the cystic lesion in the pancreas could be IPMN or a metastatic cyst, but a definitive diagnosis could not be reached with triphasic CT and MRI. In this situation, fine needle aspiration under E-USG guidance (E-USG-FNA) was used as an important diagnostic method. E-USG-FNA can contribute to the differentiation between benign and malignant lesions by enabling cytological and biochemical analysis of the cyst contents in the evaluation of pancreatic cysts (4). In particular, analysis of tumour markers and amylase levels in cyst fluid may provide clues about the type of lesion. The literature reports that fluid obtained by aspiration with E-USG-FNA, which appears cheesy (milky white in appearance) and contains high triglyceride levels and abundant lymphocytes and macrophages, may be characteristic of pancreatic lymphangioma. Insufficient aspiration in the presence of thick cystic contents or the inability to detect specific findings in cytopathological examination makes it difficult to confirm the diagnosis (11). The absence of malignant cells detected by E-USG-FNA in our case does not conclusively prove that the lesion is benign. Although there are reports in the literature of cases where a definitive preoperative diagnosis of lymphangioma was made using E-USG-FNA (12), in most cases, the final diagnosis of cystic lymphangiomas can only be made after surgical resection, through histopathological examination (13). Therefore, considering the limitations of radiological and minimally invasive methods, surgical exploration may be required if diagnostic uncertainty persists.

The presence of multiple malignancies in a patient's history should raise the possibility of metastasis in a newly detected pancreatic lesion and should be carefully evaluated. Although metastasis in the pancreas is rare, autopsy series have reported that 3–12% of malignant lesions are metastatic foci (14). In our case, the presence of multiple malignancies in the patient's history suggested that the cystic lesion detected by imaging could primarily be a malignant process. This prolonged the diagnostic process and made it difficult to confirm that the lesion was a benign lymphangioma in the preoperative period. Therefore, it was initially thought that the lesion could be a metastatic lesion or one of the cystic neoplasms of the pancreas. Minimally invasive methods such as E-USG-FNA were applied during the clinical evaluation process, but no findings were obtained to confirm the diagnosis. There is no specific case series in the literature regarding the management of pancreatic cysts in patients with a history of multiple malignancies; it has been reported that adult pancreatic lymphangiomas may develop in association with other underlying pathologies. It has been suggested that obstruction of lymphatic flow as a result of a malignant process, surgical intervention, or radiotherapy may contribute to the formation of acquired lymphangiomas (15). In this context, in our case, the patient's previous oncological treatments may have paved the way for the emergence of the lesion by disrupting lymphatic drainage in the pancreatic region.

Renal cell carcinoma (RCC) ranks among the tumours with the highest potential for pancreatic metastasis (16). Therefore, a newly emerging lesion in the pancreas in patients with a history of RCC or other malignancies may initially be interpreted as a metastasis. In the presented case, the patient's history of two different primary malignancies (RCC three years ago, prostate adenocarcinoma two years ago) influenced the diagnostic process. Initial radiological examinations revealed a cystic mass in the body of the pancreas, which, given the patient's history of renal cell carcinoma, suggested the

possibility of a metastatic focus. The literature emphasises that imaging findings of pancreatic cystic lymphangiomas may mimic primary or metastatic malignant lesions (17). This complicates the diagnostic process, particularly in patients with a history of malignancy. However, the possibility that such cystic lesions may be benign should be considered, and the diagnosis should be carefully confirmed to exclude this possibility.

The treatment plan for pancreatic cystic lymphangiomas is determined by considering a wide range of factors, such as the size of the lesion, the presence of symptoms, its growth potential, and suspicion of malignancy. Particularly when large in size, they can mimic pancreatic cystadenomas or pancreatic carcinomas due to abdominal pain, mass effect, and cystic structures. In our case, the lesion, combined with the patient's previous history of cancer, raised suspicion of malignancy, and the decision to operate was supported by this suspicion. In cases of diagnostic uncertainty, surgical resection may be the only way to determine whether the lesion is benign. As reaching a definitive preoperative diagnosis remains limited in the literature and the possibility of potential malignancy in the patient needs to be ruled out, surgical resection is preferred in most cases (17). Even in some cases where lymphangioma diagnosis has been established by E-USG-FNA, surgical excision has been recommended to ensure complete cure and prevent recurrence risk (18). Nabil et al. emphasised that in their case, a pancreatic lymphangioma that was completely drained using E-USG recurred after a period of time, thus highlighting that this method does not provide a definitive cure (18). In this case, several critical factors influenced the decision to proceed with surgery. Firstly, the cystic lesion grew from 16 mm to 21 mm within a short period of time. Furthermore, a solid component was observed within the lesion, and a distinct thickening was detected in the main pancreatic duct behind the mass. These findings have raised concerns that the cyst may be an IPMN or a malignant tumour with cystic degeneration. Although the E-USG-FNA result did not indicate malignancy, surgical exploration and resection were indicated due to the above risk factors. The literature also states that a definitive diagnosis of pancreatic lymphangioma can only be made by surgical resection and that this procedure is also the curative treatment for the disease (17). When performing surgical resection, it is important to completely remove the lesion; cases of recurrence have been reported in cases of incomplete resection (3). Similarly, in the case presented by Yüceyar and colleagues, no recurrence was observed during a 2-year follow-up after complete removal of the lesion (17). In our case, complete resection was achieved with tumour-negative surgical margins, and no recurrence was detected during the 18-month follow-up.

Nowadays, laparoscopic left pancreatectomy is commonly performed for lesions located in the tail and body of the pancreas. With the development of minimally invasive surgery, the laparoscopic approach can be safely preferred in suitable cases in pancreatic surgery. The literature has demonstrated that laparoscopic distal pancreatectomy yields oncological outcomes similar to those of open surgery, but is associated with significantly less blood loss, shorter hospital stays, and faster recovery (19). Borja-Cacho and colleagues emphasised that the morbidity of laparoscopic distal pancreatectomy is similar to that of open surgery, but significantly reduces the length of hospital stay (20). In the presented case, as the mass was located in the distal pancreas, laparoscopic distal pancreatectomy and splenectomy were preferred. Thanks to this minimally invasive approach, no significant postoperative complications developed in our patient; the patient was discharged on the 5th day with good oral intake, minimal pain and without complications.

Conclusion

Newly detected pancreatic masses, particularly in patients with a history of malignancy, can pose challenges in distinguishing between malignant and benign lesions. As in this case, when imaging and interventional methods fail to provide a definitive diagnosis, surgical resection provides both

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diagnostic accuracy and a curative approach. In this context, it should be remembered that rare benign pathologies should not be overlooked in the differential diagnosis.

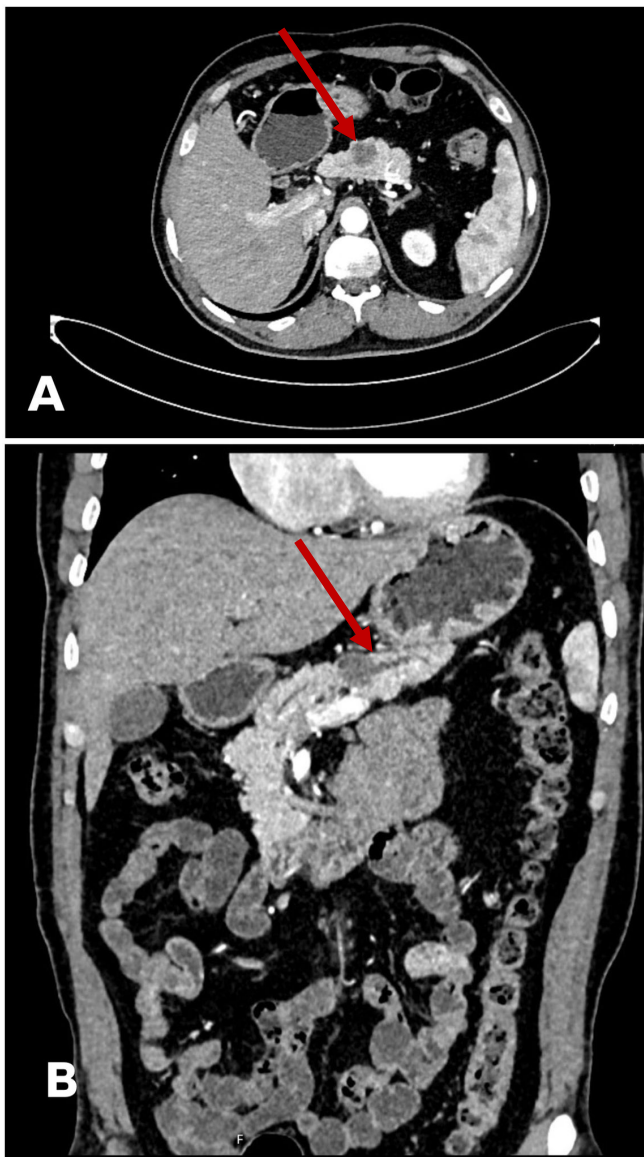


Figure 1. Triphasic abdominopelvic computed tomography (CT) images demonstrating the pancreatic lesion (arrows).

(A) Axial contrast-enhanced CT image shows a hypodense nodular lesion at the pancreatic body (arrow).

(B) Coronal reformatted CT image demonstrates the same hypodense lesion, accompanied by dilatation of the main pancreatic duct (Wirsung) extending toward the tail segment (arrow).

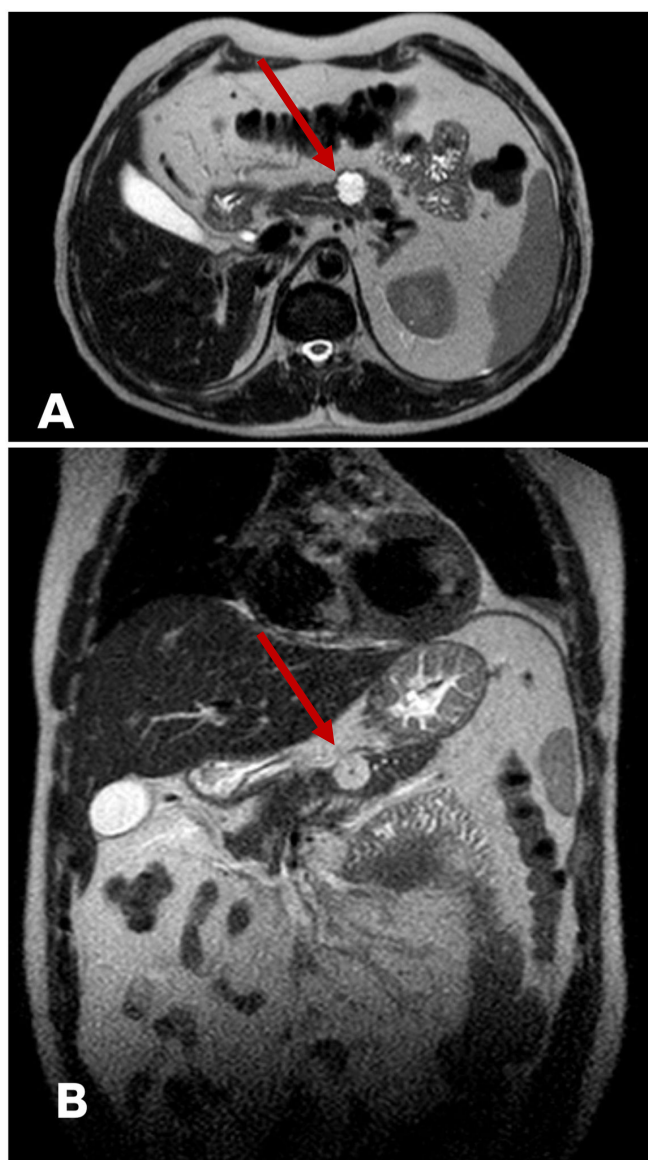


Figure 2. T2-weighted magnetic resonance images depicting the pancreatic cystic lesion (arrows). (A) Axial and (B) Coronal T2-weighted sequences demonstrate a well-defined cystic lesion situated at the body–tail junction of the pancreas. The lesion is markedly hyperintense on T2-weighted imaging, contains fine internal septations, and shows subtle peripheral enhancement on post-contrast sequences.

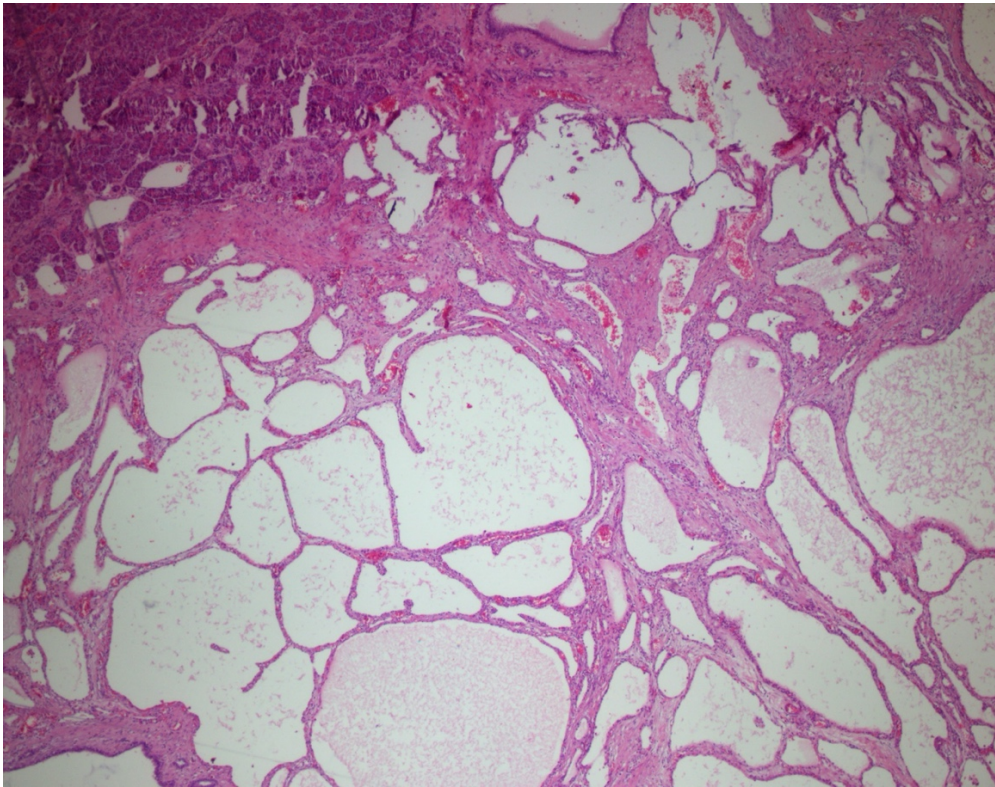


Figure 4. Histopathological features of the surgical specimen consistent with cystic lymphangioma adjacent to normal pancreatic tissue (H&E stain). The section demonstrates numerous thin-walled cystic spaces of varying size, lined by a flattened endothelial layer, and separated by fibrous septa containing lymphoid aggregates and small vascular channels. Some cystic spaces contain proteinaceous or eosinophilic material. This multicystic architecture and endothelial lining are characteristic features of cystic lymphangioma.

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SENSORY EVALUATION OF GLUTEN-FREE FRESH PASTA FORMULATED WITH ODOR-REMOVED LYOPHILIZED FISH POWDER

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Abstract

The inclusion of fish meat in gluten-free products is a promising approach to enhance nutritional value, but consumer acceptance is often limited due to fishy odor and texture changes. This study investigated the sensory properties of gluten-free fresh pasta enriched with deodorized lyophilized fish powder. Rainbow trout (*Oncorhynchus mykiss*) and sea bass (*Dicentrarchus labrax*) minced meat was processed under aseptic conditions and deodorized using controlled washing and draining with vinegar. The deodorized minced meat was lyophilized and stored at 4°C for use in pasta. Gluten-free pasta samples were prepared fresh with the addition of 0% (control), 5%, and 10% lyophilized fish powder. Sensory properties such as homogeneity, color, pasta aroma, elasticity, firmness, fishy odor, and fishy taste were evaluated using a 9-point hedonic scale and analyzed by ANOVA. The results showed that deodorization effectively suppressed fish odor in all gluten-free fresh pastas, thus maintaining sensory acceptance even at high additive rates such as 10%. These findings support the potential of deodorized lyophilized fish powder as a functional ingredient in gluten-free fresh pasta, enabling odor control with minimal nutrient loss and preserving consumer acceptance.

Keywords: Fish powder, gluten-free fresh pasta, lyophilization, odor removal.

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KOKUSU GİDERİLMİŞ LİYOFİLİZE BALIK TOZU İLE FORMÜLE EDİLMİŞ GLUTENSİZ TAZE MAKARNANIN DUYUSAL DEĞERLENDİRMESİ

Özet

Balık etinin glütensiz ürünlere dahil edilmesi, besin değerini artırmak için umut verici bir yaklaşımdır, ancak tüketicilerin kabulü genellikle balık kokusu ve doku değişiklikleri nedeniyle sınırlıdır. Bu çalışma, kokusu giderilmiş liyofilize balık tozu ile zenginleştirilmiş glütensiz taze makarnaların duyusal özelliklerini araştırmıştır. Gökkuşluğu alabalığı (*Oncorhynchus mykiss*) ve levrek (*Dicentrarchus labrax*) kıymaları, aseptik koşullar altında işlenmiş ve sirke kullanılarak kontrollü yıkama ve süzme işlemleriyle kokusu giderilmiştir. Kokusu giderilmiş kıymalar, liyofilize edilerek

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makarnalarda kullanılmak üzere 4°C'de depolanmıştır. Glutensiz makarna örnekleri %0 (kontrol), %5 ve %10 liyofilize balık tozu ilavesiyle taze olarak hazırlanmıştır. Homojenlik, renk, makarna aroması, elastikiyet, sertlik, balık kokusu ve balık tadı gibi duysal özellikler 9 puanlık hedonik ölçek kullanılarak değerlendirilmiş ve ANOVA ile analiz edilmiştir. Sonuçlar, koku gidermenin tüm glutensiz taze makarnalarda balık kokusunu etkili bir şekilde bastırdığını ve böylece %10 gibi yüksek katkı oranlarında bile duysal kabulü koruduğunu göstermiştir. Bu bulgular, kokusu giderilmiş liyofilize balık tozunun glutensiz taze makarnada fonksiyonel bir bileşen olarak potansiyelini desteklemekte, minimum besin kaybı ile koku kontrolünü mümkün kılmakta ve tüketici kabulünü korumaktadır.

Anahtar Kelimeler: Balık tozu, glutensiz taze makarna, liyofilizasyon, koku giderme.

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SENSORY ANALYSIS OF GRISSINI PRODUCED WITH SINGLE CELL PROTEIN (SCP) OBTAINED FROM DUCKWEED (*Lemna minor* L.) USING *Saccharomyces cerevisiae*

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Abstract

Recently, organic practices have demonstrated enormous potential in the use of microorganisms to produce high-quality protein sources such as Single-Cell Proteins (SCP) from different groups of microorganisms, including algae, bacteria, yeasts, and fungi, reducing reliance on conventional feeds and improving industry sustainability. SCP production involves the extraction of microbial biomass rich in protein, lipids, carbohydrates, vitamins, and minerals from various substrates. Single-Cell Proteins (SCP) are proteins obtained from yeasts, algae, molds, and bacteria, and are an important protein alternative for fish, animals, and humans. Türkiye is rich in aquatic plants. Duckweed is one of the plants that can be found abundantly in natural environments. Therefore, in this study, duckweed was determined as a substrate for obtaining SCP. *Lemna minor* L. a type of duckweed, will be used. Duckweeds are perennial herbaceous plants that live in freshwater, floating on the water or partially submerged. It is the second most important plant product in terms of protein content after soy. Duckweed, a natural protein source, is closer to animal proteins than most other plant proteins. Duckweed collected from nature was cleaned, dried, and SCP was obtained from this dried mass through fermentation with *Saccharomyces cerevisiae*. The obtained SCP was added to grissini at concentrations of 2%, 4%, and 6% and offered for human consumption. The sensory characteristics of grissini enriched with duckweed SCP were determined.

In color evaluation, the addition of duckweed created a difference between the groups ($p<0.001$). Group C, obtained with 4% addition, received the highest score, while 6% addition, despite a slight darkening, scored higher than the control group. Odor scores differed between the groups ($p<0.001$). Group C, obtained with 4% addition, received the highest score, while 6% addition, despite a more intense odor, received a higher preference than group B. Significant differences were determined in taste scores between the groups ($p<0.001$). Group D, containing 6% THP derived from duckweed,

received the highest score, while 4% supplementation was determined to be at the optimum level. In the crispness assessment, the addition of duckweed THP did not create a significant difference between the groups ($p>0.01$). However, group C, with 4% supplementation, received the highest score, while the 6% supplementation scored higher than the control group. THP supplementation did not statistically significantly affect crispness ($p>0.01$). Panelists found crispness similarly palatable in all groups, with the 4% supplementation receiving the optimum level of preference.

Keywords: Single-cell protein (THP), Duckweed (*Lemna minor*), grissini, sensory properties.

***Saccharomyces cerevisiae* KULLANILARAK SU MERCİMEĞİNDEN (*Lemna minor* L.) ELDE EDİLEN TEK HÜCRE PROTEİNİ (THP) İLE ÜRETİLEN GRİSSİNİ VE DUYUSAL ANALİZİ**

Özet

Son zamanlarda organik uygulamalar, algler, bakteriler, mayalar ve mantarlar da dahil olmak üzere farklı mikroorganizma gruplarından Tek Hücreli Proteinler (THP) gibi yüksek kaliteli protein kaynakları üretmek için mikroorganizmaların kullanımında muazzam bir potansiyel göstermiş, geleneksel yemlere olan bağımlılığı azaltmış ve endüstri sürdürülebilirliğini iyileştirmiştir. SCP üretimi, çeşitli substratlardan protein, lipit, karbonhidrat, vitamin ve mineral bakımından zengin mikrobiyal biyokütlenin çıkarılmasını içerir. Tek Hücreli Proteinler maya, alg, küf ve bakterilerden elde edilen ve balıklar, hayvanlar ve insanlar için önemli bir protein alternatifi olan proteinlerdir.

Yurdumuz su bitkileri bakımından zengindir. Su mercimeği doğal ortamlarda bol bulunabilen bitkilerdendir. Dolayısıyla bu çalışmada THP elde etmek için substrat olarak su mercimeği belirlenmiştir. Su mercimekleri türlerinden *Lemna minor* L. kullanılacaktır. Su mercimekleri tatlı sulara yaşayan, su üzerinde yüzen veya kısmen suya batık yaşayan, çok yıllık otsu bitkilerdir. Protein miktarı bakımından soyadan sonra gelen ikinci bitkisel üründür. Doğal bir protein kaynağı olan su mercimeği, diğer bitkisel proteinlerin çoğuna göre hayvansal proteinlere daha yakındır.

Doğadan toplanan su mercimekleri temizlenmiş kurutulmuş ve bu kuru kitleden *Saccharomyces cerevisiae* ile mayalama yoluyla THP elde edilmiştir. Elde edilen THP %2-4 ve 6 oranlarında grissinilere katılmış ve insan tüketimine sunulmuştur. Su mercimeğinden elde edilen THP ile zenginleştirilmiş grissinilerin duyuşal özellikleri belirlenmiştir.

Renk değerlendirmesinde su mercimeği ilavesi gruplar arasında farklılık yaratmıştır ($p<0,001$). %4 katkı ile elde edilen C grubu en yüksek puanı almış, %6 katkı ise hafif koyulaşmaya rağmen kontrol grubuna göre daha yüksek puanlanmıştır. Koku puanları, gruplar arasında farklılık göstermiştir ($p<0,001$). %4 katkı ile elde edilen C grubu en yüksek puanı almış, %6 katkı ise yoğun koku algısına rağmen B grubuna göre daha yüksek beğeni kazanmıştır. Tat puanlarında, gruplar arasında anlamlı farklılık olduğu belirlenmiştir ($p<0,001$). %6 su mercimeğinden elde edilen THP içeren D grubu en yüksek puanı almış, %4 katkı ise optimum kabul düzeyinde olduğu belirlenmiştir. Gevreklik değerlendirmesinde su mercimeği THP ilavesi gruplar arasında belirgin fark yaratmamıştır ($p>0,01$). Ancak, %4 ilave ile elde edilen C grubu en yüksek puanı almış, %6 katkı ise kontrol grubuna göre daha yüksek puanlanmıştır. THP ilavesi gevrekliği istatistiksel olarak anlamlı biçimde etkilememiştir ($p>0,01$). Panelistler gevrekliği tüm gruplarda benzer düzeyde beğenmiş, özellikle %4 katkı optimum beğeni almıştır.

Anahtar Kelimeler: Tek hücre protein (THP), Su mercimeği (*Lemna minor*), grissini, duyuşal özellik.

COMPARATIVE CFD ANALYSIS OF TURBULENCE MODELS IN A 2D BACKWARD-FACING STEP FLOW

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Abstract

In this study, a comparative computational fluid dynamics (CFD) analysis was performed to assess the predictive capabilities of commonly used Reynolds-averaged Navier–Stokes (RANS) turbulence models for a two-dimensional backward-facing step flow at a Reynolds number of 36,000. Four turbulence models, namely the standard $k-\epsilon$, RNG $k-\epsilon$, realizable $k-\epsilon$, and $k-\omega$ SST models, were investigated under steady, incompressible, and isothermal flow conditions. The separation and reattachment characteristics downstream of the step were examined using streamwise velocity contours and wall shear stress distributions.

The velocity contours revealed that all models captured the main features of the separated flow; however, noticeable differences were observed in the size of the recirculation region and the recovery of the velocity field. The reattachment location was quantitatively determined from the zero-crossing of the streamwise wall shear stress along the bottom wall. The predicted reattachment lengths showed a strong dependence on the turbulence model employed. The standard and RNG $k-\epsilon$ models predicted shorter reattachment lengths, while the realizable $k-\epsilon$ model yielded intermediate results. The $k-\omega$ SST model predicted the longest reattachment length and lower post-reattachment wall shear stress levels, indicating a more gradual redevelopment of the boundary layer.

Overall, the results highlight the significant influence of turbulence modeling on separated flow predictions and suggest that the $k-\omega$ SST model provides more physically consistent predictions for backward-facing step flows dominated by adverse pressure gradients.

Keywords: Backward-facing step, Turbulence models, CFD, RANS, Flow separation and reattachment, Turbulent channel flow

INTRODUCTION

Sudden expansion flows are frequently encountered in many engineering applications such as diffusers, heat exchangers, combustion chambers, and internal cooling passages. Among these flows, the backward-facing step (BFS) configuration has been widely used as a canonical benchmark problem due to its well-defined flow separation and reattachment characteristics. When a fully developed turbulent flow passes over a sudden expansion, a separation bubble forms downstream of the step, followed by a reattachment region whose accurate prediction remains a challenge for turbulence modeling.

The backward-facing step flow has therefore been extensively studied both experimentally and numerically to assess the performance of turbulence models in predicting separated turbulent flows. Early experimental investigations by Armaly et al. (1983) demonstrated that the reattachment length strongly depends on the Reynolds number and flow conditions, providing a valuable reference for

numerical studies. Subsequent numerical investigations have shown that Reynolds-averaged Navier–Stokes (RANS) turbulence models may exhibit significant discrepancies in predicting separation behavior, reattachment length, and velocity profiles in BFS flows (Driver and Seegmiller, 1985; Le et al., 1997; Kopera et al., 2011).

Among RANS-based approaches, k – ε family models are widely used due to their robustness and low computational cost; however, they often struggle to accurately capture near-wall effects and adverse pressure gradients (Launder and Spalding, 1983; Jamalabadi, 2025). In contrast, the k – ω shear stress transport (SST) model combines the advantages of k – ω modeling near walls with k – ε behavior in the free stream, offering improved predictions for separated flows (Menter, 1994; Shaheed et al., 2025). Recent numerical studies have reported that conventional k – ε models tend to overpredict the size of the recirculation region and delay flow reattachment in backward-facing step flows, particularly under strong adverse pressure gradients (Wilcox, 1998). Comparative investigations further indicate that the k – ω SST model generally provides more accurate predictions of wall shear stress distribution and reattachment length, showing closer agreement with experimental measurements for turbulent separated flows (Versteeg, 2007).

Despite the extensive literature available, the comparative performance of commonly used RANS turbulence models in backward-facing step configurations remains an active area of research. In this study, a comparative CFD analysis is conducted to evaluate the predictive capabilities of four widely used turbulence models—standard k – ε , RNG k – ε , realizable k – ε , and k – ω SST—in a two-dimensional backward-facing step flow at a Reynolds number of 36,000. The models are assessed based on their ability to predict flow separation, reattachment length, and velocity distributions downstream of the step.

NUMERICAL METHOD

Geometry and Flow Configuration

The computational domain consists of a two-dimensional backward-facing step channel, as shown in Figure 1. The inlet channel height is 0.10 m, followed by a sudden expansion with a step height of 0.01 m, resulting in an outlet channel height of 0.11 m. The total length of the computational domain is 0.56 m, which is sufficiently long to capture the flow separation and reattachment phenomena downstream of the step. The flow enters the channel from the left inlet and exits through the right outlet.

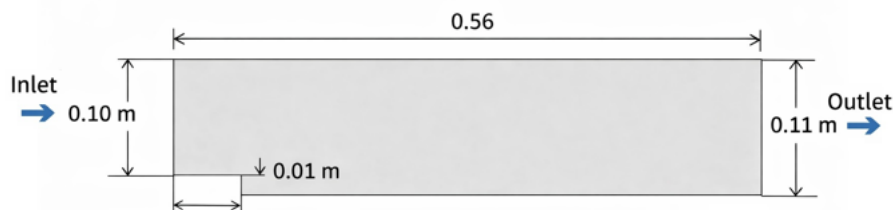


Figure 1. Schematic of the two-dimensional backward-facing step channel geometry and boundary conditions.

A fully developed velocity profile is imposed at the inlet to minimize inlet effects on flow separation, while a pressure outlet condition with zero gauge pressure is applied at the outlet. All channel walls are treated as no-slip boundaries.

Governing Equations and Turbulence Models

The flow is assumed to be steady, incompressible, and isothermal. The governing equations consist of the Reynolds-averaged Navier–Stokes (RANS) equations coupled with the continuity equation. Turbulence effects are modeled using four commonly employed RANS turbulence models: the standard k – ϵ model, the RNG k – ϵ model, the realizable k – ϵ model, and the k – ω shear stress transport (SST) model.

The k – ϵ family models are based on the transport equations for turbulent kinetic energy (k) and its dissipation rate (ϵ), and are widely used due to their numerical robustness and low computational cost (Launder and Spalding, 1974). The k – ω SST model combines the near-wall accuracy of the k – ω formulation with the free-stream independence of the k – ϵ model, providing improved predictions for flows involving separation and adverse pressure gradients (Menter, 1994).

Numerical Procedure and Boundary Conditions

The numerical simulations are performed using a finite volume method. Second-order discretization schemes are employed for the convection terms of the governing equations to improve solution accuracy. Pressure–velocity coupling is achieved using a segregated solution approach. Convergence is assumed when the normalized residuals of continuity and momentum equations fall below 10^6 , and the monitored flow quantities reach steady values.

The Reynolds number, based on the inlet hydraulic height and bulk velocity, is fixed at $Re=36,000$ for all simulations. To ensure consistency in turbulence model comparison, identical boundary conditions, numerical schemes, and solution settings are applied to all cases.

Mesh Strategy and Near-Wall Treatment

A structured mesh is generated with local refinement near the step region and along the channel walls to accurately resolve the boundary layers and recirculation zone. Particular attention is given to the near-wall mesh resolution to ensure fair comparison among turbulence models. The first cell height is selected to maintain dimensionless wall distance values in the range $y^+ \approx 1$ – 5 , enabling the use of enhanced wall treatment for the k – ϵ models and proper near-wall resolution for the k – ω SST model.

Mesh independence is verified by comparing the reattachment length obtained from progressively refined meshes, and the final mesh is selected when further refinement results in negligible changes in the predicted reattachment location.

Data Reduction

The primary performance metric used for comparison is the reattachment length, defined as the downstream distance from the step edge to the location where the wall shear stress changes sign from negative to positive. In addition, streamwise velocity profiles at selected locations downstream of the step are extracted to further assess the predictive capability of each turbulence model.

RESULTS AND DISCUSSION

Flow separation and reattachment characteristics

The flow separation and reattachment behavior downstream of the backward-facing step was examined using streamwise velocity contours and wall shear stress distributions obtained from the four turbulence models considered. Figure 2 presents the contours of streamwise velocity predicted by the standard $k-\epsilon$, RNG $k-\epsilon$, realizable $k-\epsilon$, and $k-\omega$ SST models. For all cases, a distinct separation region is observed immediately downstream of the step due to the sudden expansion, followed by the formation of a recirculation zone near the bottom wall and eventual flow reattachment further downstream.

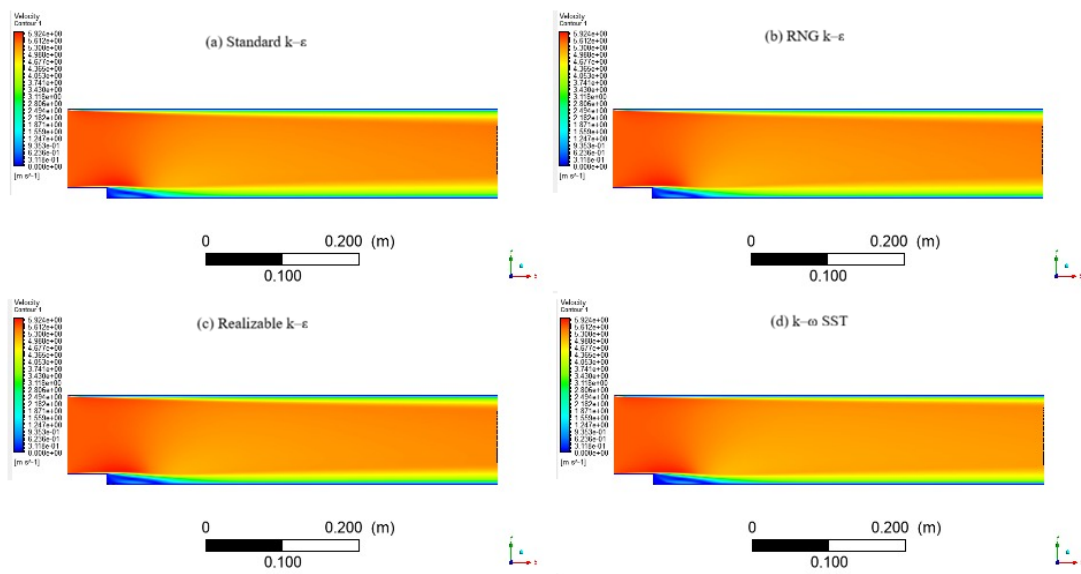


Figure 2. Streamwise velocity contours predicted by (a) standard $k-\epsilon$, (b) RNG $k-\epsilon$, (c) $k-\omega$ SST, and (d) realizable $k-\epsilon$ turbulence models for the two-dimensional backward-facing step flow at $Re = 36,000$. All contours are plotted using the same velocity scale for direct comparison.

Although the overall flow topology is similar for all turbulence models, noticeable differences are observed in the size and structure of the recirculation region. The standard and RNG $k-\epsilon$ models predict a relatively shorter separation bubble, accompanied by a faster recovery of the velocity field downstream of the step. In contrast, the realizable $k-\epsilon$ model exhibits a moderately extended recirculation region, while the $k-\omega$ SST model predicts the largest separation zone, indicating a delayed reattachment process.

To quantitatively assess the reattachment location, the distribution of the streamwise wall shear stress along the bottom wall is examined, as shown in Figure 3. Immediately downstream of the step, the wall shear stress becomes negative, confirming the presence of reverse flow within the recirculation region. The reattachment point is identified by the zero-crossing of the wall shear stress, where the flow reattaches to the wall and the shear stress changes sign from negative to positive.

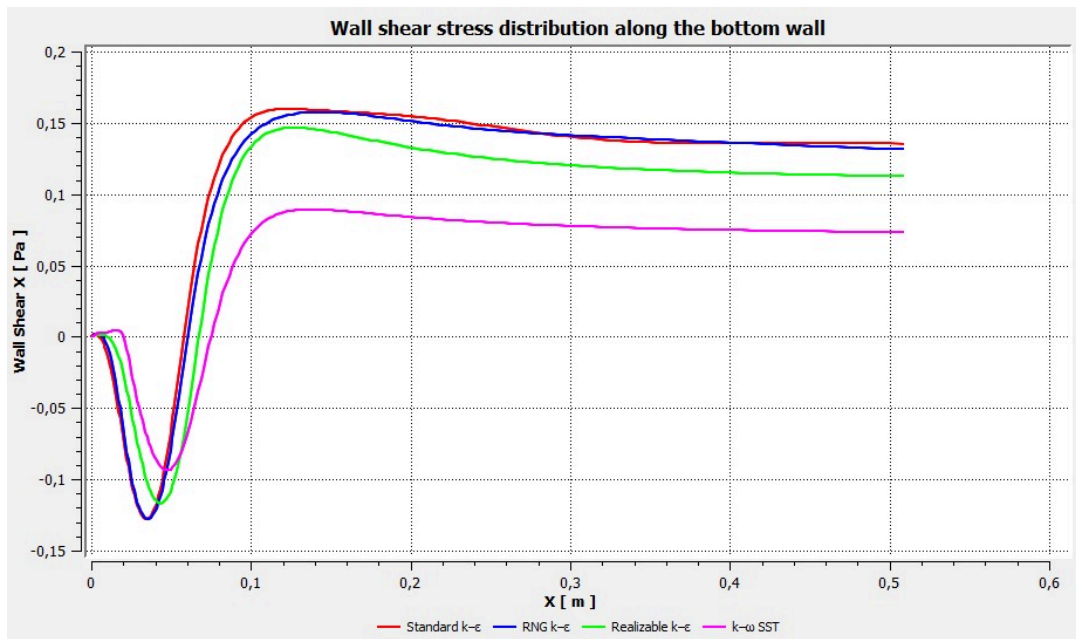


Figure 3. Wall shear stress distribution along the bottom wall predicted by different turbulence models. The reattachment location is identified by the zero-crossing of the wall shear stress for each model.

The wall shear stress distributions reveal clear differences among the turbulence models. The standard and RNG $k-\epsilon$ models predict earlier zero-crossing locations, corresponding to shorter reattachment lengths. The realizable $k-\epsilon$ model provides intermediate predictions, whereas the $k-\omega$ SST model yields the latest zero-crossing point, indicating the longest reattachment length among the models considered. Furthermore, the $k-\omega$ SST model predicts lower post-reattachment wall shear stress levels, reflecting a more gradual redevelopment of the boundary layer downstream of the reattachment point.

Overall, the combined analysis of velocity contours and wall shear stress distributions demonstrates that the choice of turbulence model has a significant influence on the prediction of separation and reattachment characteristics in backward-facing step flows. In particular, the $k-\omega$ SST model exhibits a more conservative and physically consistent prediction of the separated flow behavior, whereas the $k-\epsilon$ family models tend to underestimate the extent of the recirculation region.

Reattachment length comparison

The reattachment length downstream of the backward-facing step was quantitatively evaluated using the streamwise wall shear stress distributions presented in Figure 3. For each turbulence model, the reattachment location x_r was determined as the streamwise position along the bottom wall where the wall shear stress changes sign from negative to positive, indicating the reattachment of the separated shear layer to the wall.

To enable a consistent comparison among the turbulence models, the reattachment length was normalized by the step height $h=0.01$ m, resulting in the dimensionless reattachment length x_r/h . The predicted values of x_r and x_r/h obtained from the numerical simulations are summarized in Table 1.

Table 1. Reattachment length predictions for different turbulence models

Turbulence model	(x_r) (m)	(x_r/h)
Standard k- ϵ	0.085	8.5
RNG k- ϵ	0.090	9.0
Realizable k- ϵ	0.095	9.5
k- ω SST	0.105	10.5

The results demonstrate that the predicted reattachment length is strongly dependent on the turbulence model employed. The standard and RNG k- ϵ models yield shorter reattachment lengths, indicating an earlier recovery of the separated flow downstream of the step. The realizable k- ϵ model provides intermediate predictions, whereas the k- ω SST model predicts the longest reattachment length among the models considered.

The longer reattachment length predicted by the k- ω SST model can be attributed to its improved treatment of near-wall turbulence and adverse pressure gradient effects, which leads to a more realistic representation of the separated shear layer. In contrast, the k- ϵ family models tend to overpredict turbulent mixing in the recirculation region, resulting in an earlier reattachment prediction. Overall, these findings are consistent with trends reported in previous numerical and experimental studies for backward-facing step flows at comparable Reynolds numbers.

Near-wall behavior and turbulence model assessment

The differences observed in the predicted separation and reattachment characteristics can be primarily attributed to the near-wall treatment and turbulence closure assumptions of the employed models. In backward-facing step flows, the accurate prediction of near-wall turbulence and adverse pressure gradient effects is critical, as the reattachment process is governed by the interaction between the separated shear layer and the redeveloping boundary layer along the bottom wall.

The standard and RNG k- ϵ models rely on wall-function-based near-wall treatments, which assume equilibrium boundary layer behavior. As a result, these models tend to overestimate turbulent mixing in the separated region, leading to an accelerated momentum exchange between the core flow and the near-wall region. This behavior explains the higher post-reattachment wall shear stress levels and the shorter reattachment lengths predicted by the k- ϵ family models, as observed in Figures 2 and 3.

The realizable k- ϵ model partially improves the prediction of near-wall behavior by introducing a variable eddy viscosity formulation, which enhances its response to strain and rotation effects. Consequently, this model yields intermediate wall shear stress levels and reattachment lengths compared to the standard and RNG k- ϵ models. However, its reliance on wall functions still limits its ability to fully capture the complex near-wall flow physics under strong adverse pressure gradients.

In contrast, the k- ω SST model employs a blended formulation that resolves the near-wall region using the k- ω model while gradually transitioning to k- ϵ behavior away from the wall. This approach enables a more accurate representation of near-wall turbulence and shear stress distribution in separated flows. As a result, the k- ω SST model predicts lower wall shear stress levels downstream of reattachment and a delayed reattachment location, reflecting a more gradual redevelopment of the boundary layer. These characteristics are widely regarded as physically more realistic for backward-facing step flows and are consistent with trends reported in the literature.

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Overall, the near-wall analysis highlights that turbulence models with enhanced near-wall resolution capabilities, such as the $k-\omega$ SST model, provide more conservative and physically consistent predictions of separated flow behavior. While the $k-\epsilon$ family models remain computationally efficient and robust, their limitations in near-wall modeling should be carefully considered when simulating flows dominated by separation and reattachment phenomena.

CONCLUSION

In this study, a comparative CFD analysis was conducted to investigate the performance of four widely used RANS turbulence models in predicting flow separation and reattachment in a two-dimensional backward-facing step flow at a Reynolds number of 36,000. Velocity contours and wall shear stress distributions were employed to analyze the separated flow structure and to identify the reattachment location along the bottom wall.

The results demonstrated that, although all turbulence models captured the main flow features, significant differences were observed in the predicted reattachment lengths and near-wall behavior. The standard and RNG $k-\epsilon$ models yielded shorter reattachment lengths due to enhanced turbulent mixing, whereas the realizable $k-\epsilon$ model provided intermediate predictions. The $k-\omega$ SST model predicted the longest reattachment length and lower post-reattachment wall shear stress levels, indicating a more gradual redevelopment of the boundary layer.

Overall, the findings highlight the strong influence of turbulence modeling on the prediction of separated flows and suggest that the $k-\omega$ SST model provides more physically consistent predictions for backward-facing step configurations dominated by adverse pressure gradients. The results of this study contribute to a better understanding of turbulence model performance in canonical separated flow problems and may serve as a useful reference for future numerical investigations of similar flow configurations.

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ON STATISTICAL CONVERGENCE OF TOPOLOGICAL q -HENSTOCK-KURZWEIL INTEGRAL

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Abstract

In this presentation, we present the concept of a q -Henstock-Kurzweil type integrable function (hereafter referred to as a topological q -Henstock-Kurzweil integrable function) within a topological vector space linked to a Radon measure μ . Fundamental findings concerning the topological q -Henstock-Kurzweil integrable function are examined. Additionally, the connection between the topological q -Henstock-Kurzweil integral and the topological Henstock-Kurzweil integral is analyzed. Finally, we present the concept of statistical convergence to topological q -Henstock-Kurzweil integrable functions within a μ -subcell of a topological vector space.

Keywords: q -Henstock-Kurzweil integral, Statistical convergence, Topological vector spaces, Radon measure.

RISK PROJECTION OF TERRESTRIAL CLIMATE CHANGE IN THE CONSTRUCTION SECTOR: INTEGRATION OF PRAS AND MATRIX METHODS IN THE CASE OF ELAZIG

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Abstract

Global climate change, accelerated by anthropogenic effects, confronts today's working life with a complex Occupational Health and Safety (OHS) crisis that transcends environmental parameters, pushing the physical and mental boundaries of the human factor. This study focuses on the construction sector in Elazığ, a province dominated by harsh terrestrial climate characteristics, including extreme summer heatwaves, abrupt meteorological fluctuations, and low humidity levels. The primary objective of the research is to analyze the direct and indirect correlations between climatic variables, physical occupational accidents, and employees' psychosocial health indicators through a unique methodological integration.

The methodological framework of the research is based on the unification of quantitative risk assessment methods with qualitative psychosocial measurement tools. In the first stage, an L-Type (5x5) Risk Assessment Matrix was utilized to calculate the probability and severity values of hazards such as heat stress, dehydration, UV exposure, and instantaneous air currents that threaten the safety of working at heights. In the second stage, this physical analysis was augmented by the Psychosocial Risk Analysis System (PRAS) to develop a hybrid model. Data obtained from 100 construction workers active in Elazığ's construction sites were analyzed across sub-dimensions including workload pressure, level of control, social support mechanisms, and environmental stressors.

The findings indicate that heatwaves exceeding 35°C in Elazığ elevate the probability of occupational accidents to the "Unacceptable Risk" level on the matrix, where traditional OHS measures prove insufficient. PRAS data demonstrates that "cognitive fatigue," "perceptual narrowing," and "increased aggression" levels—detected in 75% of the sample—increase accident frequency even when physical protective equipment is fully utilized. Furthermore, it was determined that climate-driven shifts in work schedules led to a 40% increase in "eco-anxiety" and "work-family conflict" scores among employees. Consequently, climate change mitigation strategies in Elazığ's construction sector must go beyond technical measures and incorporate PRAS-based psychosocial intervention plans and periodic mental resilience monitoring processes into management systems.

Keywords: Climate Change, Construction Sector, PRAS, Risk Assessment Matrix, Psychosocial Risks, Elazığ.

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REMOVAL OF MICROPLASTICS FROM WATER USING MOF@CNT COMPOSITE

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Abstract

Microplastics are persistent pollutants defined as polymeric particles smaller than 5 mm in diameter, which can be of primary or secondary origin. Their ability to remain in water for extended periods, their surface properties, and their capacity to adsorb toxic substances such as heavy metals place significant pressure on ecosystems. The development of novel and effective composite materials for the treatment of these pollutants has become a crucial research area for environmental sustainability today. This study, supported by TÜBİTAK under project number 124Y412, aims to evaluate the microplastic removal potential of MOF@CNT composites formed by combining metal-organic framework (MOF) structures with carbon nanotubes (CNTs). The MOF structure contributes to microplastic removal processes by offering high porosity and a large surface area; composite bonding with CNTs increases mechanical strength, strengthens surface interactions, and supports the stability of the structure. The experimental design focuses on investigating the interaction mechanism of the composite with microplastic particles in an aquatic environment. Furthermore, this study presents a fundamental approach to investigating the usability of MOF@CNT composite for microplastic removal and provides a scientific basis for researching the composite as a promising material in environmental treatment technologies. The information obtained contributes to the development of innovative solutions to the microplastic problem in water treatment using advanced composite materials. In addition, the information from this research highlights key material-pollutant interaction parameters that can guide future optimization strategies. These findings underscore the importance of engineered composite systems as promising candidates for next-generation water treatment technologies.

Keywords: Metal organic frameworks, Carbon nanotubes, Microplastics.

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THE IMPACT OF BACK-BREAK ON SEQUENTIAL BLAST PERFORMANCE: CONSEQUENCES OF NON-OPTIMAL DESIGN

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Abstract

Rock fragmentation by blasting is a critical process in the production of aggregate, which is the primary raw material for the construction and infrastructure sectors. The efficiency and control of blasting performance are of great importance in terms of resource use sustainability, cost-effectiveness, and environmental impacts. In this context, the optimization of blasting design plays a vital role in the sustainable development of the sector.

This study examines the performance and results of two consecutive blasting carried out in a medium-strength rock environment, classified according to uniaxial compressive strength. In the first blasting application, due to the insufficient inter-row delay time for the rock mass to complete its movement towards the free face, the rear row holes were initiated before the mass in the front row had adequately displaced. This situation caused a significant portion of the explosive energy to be expended on the formation of back-break. Consequently, this prevented the fragmented rocks from detaching from the main mass and being displaced, leading to failure in achieving the desired material distribution.

In the second blasting, carried out on the rock mass weakened by the aforementioned initial blasting, both the fragmentation energy efficiency decreased and a homogeneous muck pile could not be obtained. Within the scope of the study, the hole design and charging parameters applied in the field were recorded. Additionally, the in-situ block size distribution on the bench face before blasting and the muck pile fragment size distribution after blasting were determined using digital image processing methods, and the rock size reduction ratio was calculated. Furthermore, the back-break distance resulting from the first blasting was measured.

The findings reveal that, especially in medium-strength rock conditions, the problem of back-break and lack of displacement caused by incorrect planning of the inter-row delay time not only reduces the efficiency of the relevant blasting but also seriously and negatively affects subsequent production blasts and the continuity of the overall production cycle.

Keywords: Rock Fragmentation by Blasting, Backbreak.

INTRODUCTION

In the mining and construction sectors, the most commonly used method for rock excavation is the blasting method. Blasting is the process of fragmenting and displacing rock mass through the controlled detonation of high-energy explosives. However, only 20-30% of the explosive energy can be used effectively for rock fragmentation and displacement, with the remaining energy being released as undesirable environmental effects (Khandelwal and Singh, 2006; Khandelwal and Monjezi, 2013; Tao et al., 2024). The primary undesirable effects include ground vibration, air shock, flyrock, and back-break.

Back-break is defined as undesirable damage to the rock mass beyond the designed limit of the last row of holes as a result of blasting operations (Jimeno et al., 1995). Examining its formation mechanism, the detonation of explosives generates very high-pressure shock waves, on the order of several GPa, around the blast hole (Sun, 2013). These shock waves, after creating a crushed zone

around the hole, propagate through the rock mass as radially expanding stress waves (Silva et al., 2019; Li et al., 2025). When these stress waves reach free surfaces, they reflect and transform into tensile waves. Due to the tensile strength of rocks being much lower than their compressive strength, these reflected tensile waves cause crack formation in the rock mass (Ak and Konuk, 2008; Tao et al., 2024). Under normal conditions, blasting design is carried out to maximize the effect of these tensile waves within the intended excavation area. However, inappropriate blasting design, such as excessive charge quantity, insufficient stemming, unsuitable delay times, or weakness planes in the rock mass, causes stress waves to be effective beyond the designed excavation limit, leading to back-break formation (Konya and Walter, 1991; Monjezi and Dehghani, 2008). Such design errors not only reduce the efficiency of the current blasting operation but also adversely affect subsequent production blasts, bench stability, and the entire mining cycle.

The negative impacts of back-break on mining operations are multidimensional and have a chain reaction structure. Primary among these are the serious risks it poses to bench slope stability. Back-break disrupts the integrity of the rock mass by creating discontinuity planes behind the bench face, forming potential slip surfaces, which significantly increases the risk of rock falls and slope failures (Monjezi et al., 2014; Sirjani et al., 2022). Indeed, Djoudi (2021) calculated that the safety factor under blast-induced dynamic loading decreases approximately fourfold compared to static conditions. Deressa et al. (2024) revealed that reducing bench height improves the Shear Reduction Factor (SRF) by 43.78%, which could be an effective measure in reducing risks caused by back-break.

In addition to stability issues, back-break emerges as a factor that directly reduces blasting efficiency. The expenditure of a significant portion of explosive energy on back-break formation reduces the amount of energy available for the primary goal of rock fragmentation. Monjezi et al. (2012) estimated that this causes approximately 15-20% of explosive energy to be wasted. In an optimization study by Ebrahimi et al. (2016), it was stated that controlling back-break reduced the mean fragment size. Tao et al. (2024) found that using holes inclined parallel to the bench slope angle (70°) provided a more homogeneous fragment size distribution and reduced back-break.

In addition to efficiency loss, back-break also negatively affects drilling and loading operations. During drilling in rock masses disturbed and weakened by back-break, problems such as hole collapse, hole deviation, and irregular hole profile occur; this both reduces drilling equipment performance and increases drilling costs (Monjezi and Dehghani, 2008). Furthermore, irregular bench faces hinder the efficient operation of loading equipment and pose a tipping risk (Sayadi et al., 2013).

All these operational disruptions inevitably lead to economic losses. Back-break causes increased explosive and drilling costs, decreased loading-hauling equipment efficiency, the need for additional measures, and ore losses due to excessively fractured zones (Monjezi et al., 2010a; Hasanipanah et al., 2017; Zhou et al., 2021). Li et al. (2022) stated that accurately predicting and controlling back-break could reduce blasting costs by 12-15%.

Underlying these problems caused by back-break are various parameters that trigger its formation. These parameters can be classified into three main categories, each with a different mechanism of influence. Among the blast design parameters, the foremost is the burden. As burden increases, it becomes more difficult for explosive energy to reach the free face, and a significant portion of the energy is expended on damaging the rock mass around the hole, increasing the back-break distance (Konya and Walter, 1991; Konya, 2003; Monjezi et al., 2010a). Regarding spacing, although different opinions exist, Sirjani et al. (2022), using Pearson correlation analysis, determined that this parameter is the second most effective parameter after bench height. Stemming length is one of the most critical parameters affecting back-break. Excessive stemming length causes explosive gases to remain in the hole for too long, leading to excessive pressure build-up and increased back-break (Konya and

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Walter, 1991; Monjezi et al., 2012; Sayadi et al., 2013). Similarly, as bench height and hole length increase, insufficient energy density at the bench toe triggers back-break formation (Sirjani et al., 2022; Deressa et al., 2024).

Inter-row delay time is another determining factor. If the delay time is insufficient, meaning it is not long enough to allow the rock to complete its response process to blasting (Chiappetta, 1998; Ozyurt et al., 2025), the rear row holes are initiated before the free face expected to form from the detonation of the front row holes has fully developed. This leads to inefficient use of explosive energy and back-break formation (Gates et al., 2005; Monjezi and Dehghani, 2008). Conversely, as the hole inclination decreases, in holes drilled parallel to the bench slope angle, stress waves reach the free face simultaneously, and energy distributes more homogeneously due to the superposition effect of reflected tensile waves, reducing back-break (Tao et al., 2024; Djoudi, 2021).

Alongside design parameters, the properties of the explosive used also play a determining role in back-break formation. As the powder factor increases, the total amount of energy released increases, and uncontrolled energy triggers back-break formation (Deressa et al., 2024). As explosive density and Velocity of Detonation (VOD) increase, borehole pressure rises, which increases the crack propagation distance, enlarging back-break. In contrast, low-density explosives (ANFO, emulsion) or weakened explosives produce lower borehole pressure, reducing back-break (Bhandari, 1997; Wilson and Moxon, 1988; Enayatollahi and Aghajani Bazzazi, 2009). Additionally, as the gap between hole diameter and explosive diameter increases, the air gap between the explosive and the hole wall attenuates the shock wave intensity, reducing the size of the crushed and cracked zones, and thus decreasing the back-break distance (Iverson et al., 2009; Sun, 2013).

Besides these controllable parameters, there are also uncontrollable rock mass and discontinuity properties that are at least as effective on back-break. When rock strength is high, explosive energy struggles to damage the rock and may be transmitted over longer distances, causing back-break formation. However, Sirjani et al. (2022) determined that uniaxial compressive strength has the lowest impact on back-break among the parameters studied. Silva et al. (2019) emphasized that dynamic strength is approximately three times higher than static strength, and therefore dynamic strength values should be used in estimating blast-induced damage.

The presence and characteristics of discontinuities are also decisive on back-break. As discontinuity frequency increases, discontinuity surfaces reflect and attenuate stress waves, hindering energy propagation and reducing Peak Particle Velocity (PPV) (Ak and Konuk, 2008). Open discontinuities allow explosive gases to penetrate these voids, disrupting the controlled distribution of energy and causing back-break propagation; whereas closed or filled discontinuities prevent gas migration, reducing back-break (Bhandari and Badal, 1990). Furthermore, in blasting conducted in the dip direction of discontinuities, gas pressure advances easily along the discontinuity planes, significantly increasing back-break formation (Bhandari and Badal, 1990; Jia et al., 1998).

As seen, back-break formation results from the complex interaction of numerous parameters and can adversely affect every stage of mining operations. Moreover, the effects of back-break are not limited to a single blast but also threaten production continuity. Therefore, accurately predicting and controlling back-break is critically important for ensuring bench slope stability in open-pit mines, increasing blasting efficiency, reducing mining costs, and ensuring occupational safety..

AIM AND SCOPE

The aim of this study is to quantitatively reveal the effects of back-break, which developed due to design deficiencies in the first blasting operation, on the performance of the second blasting operation

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in two consecutive blasting operations carried out in a medium-strength sandstone quarry. Within the scope of the study, the following procedures were carried out:

- Before the first blasting, the in-situ block size distribution on the bench face was determined using digital image processing methods. The fragment size distribution of the muck pile formed after the blast was analyzed using the same method, and the resulting back-break distances were measured in the field.
- The hole geometry (hole diameter, burden, spacing, bench height, hole length, stemming length), charging parameters (charge amount per hole and total, powder factor), and delay pattern (cap delays) applied in the first blasting were meticulously measured and recorded in the field.
- The rock mass weakened by the back-break resulting from the first blasting was subjected to in-situ block size analysis again before the second blasting, and the weakness zone was mapped.
- In the second blasting, based on the experience gained from the first blasting, the burden was reduced, the inter-row delay time was increased, and hole spacings were optimized according to the degree of weakness; the new design parameters were also recorded similarly.
- After the second blasting, the same measurements (muck pile fragment size, back-break distance) were repeated.
- All obtained data were analyzed comparatively for three sub-zones of the study site showing similar characteristics; the relationships between in-situ block size, muck pile fragment size, reduction factor, and back-break distance were evaluated.

Through this comprehensive field study and analyses, the impacts of rock mass damage caused by design errors in the first blasting on subsequent blasting performance have been scientifically demonstrated.

Study Site

The study site is an active sandstone and siltstone quarry located near Çiftalan Village in the Eyüpsultan district of Istanbul province. The main geological unit of the region is the Carboniferous-aged Trakya Formation. This formation, consisting of greenish-yellowish greywackes (sandstone) and brownish shales, is thought to exceed 500 meters in thickness and was deposited in a turbiditic environment. The greywacke levels within the Trakya Formation constitute the main lithology produced as road construction material (aggregate) in the quarry. The uniaxial compressive strength of the produced sandstones ranges between 27-31 MPa, and their density ranges between 2.335-2.435 g/cm³, classifying them as "medium-strength rock" according to the Bieniawski (1989) classification.

Unconformably overlying the Trakya Formation are Upper Cretaceous-aged altered andesites. The unweathered parts of this unit, outcropping south of Çiftalan, are slightly fractured and dark in color. The andesites are, in turn, unconformably covered by Tertiary sediments. The Tertiary sequence consists of two main levels: Oligocene at the bottom and Neogene at the top. The Oligocene consists of an alternation of sand, marl, clay, and coal, containing clay layers with high economic potential. The Neogene is represented by clay, sand, and gravel levels; this unit, with its loose, uncemented structure, was deposited in a fluvial environment and locally exhibits quartz sand characteristics (Kutman Ticaret LTD., 1992, 1993).

RESULTS

Within the scope of pre-blasting preparation work, hole design parameters for each blast were meticulously measured with tape measures, and cap connections were checked individually to ensure

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the correct application of millisecond-precision delays. Due to significant parameter deviations observed during field measurements, a zone-based approach was adopted to systematically manage these deviations. In this context, the study site was divided into sub-zones exhibiting very similar characteristics in terms of blasting design parameters, and each region was evaluated separately to minimize the impact of parameter deviations.

Figure 1 shows this zone-based approach followed in both the first and second blasting operations conducted in this study, including hole design, cap connections, detonation moment of holes, bench face, new bench face, and the back-break line. These detailed measurement and evaluation processes carried out in the field allowed for establishing more precise cause-effect relationships as applied in the field, going beyond theoretical blasting design calculations.

The blasting design parameters for the first blasting are presented in Table 1.

Table 1. Blasting design parameters for the first blasting operation

Zone	Zone I			Zone II			Zone III		
Value	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.
Hole Diameter (mm)	-	89	-	-	89	-	-	89	-
Number of Holes	-	23	-	-	26	-	-	22	-
Burden (m)	2.5	3.9	4.8	2.2	2.6	4.1	2	2.9	3.7
Spacing (m)	2.5	3.3	3.7	3	3.6	4	2.8	3.2	3.4
Bench Angle (°)	70	75	80	70	75	80	70	75	80
Bench Height (m)	9.5	9.75	10	9	9.25	9.5	-	9	-
Subdrilling Length (m)	-	1	-	-	1	-	-	1	-
Hole Angle (°)	70	75	80	70	75	80	70	75	80
Hole Length (m)	11.1	11.4	11.7	11.1	10.9	10.6	-	10.6	-
Stemming Length (m)	-	3	-	-	3	-	-	3	-
Charge Length (m)	8.1	8.4	8.7	7.6	7.9	8.1	-	7.6	-
Charge per Hole (kg)	48.8	50.4	52	45.6	47.2	48.8	-	45.6	-
Total Charge (kg)	-	1159.2	-	-	1227.2	-	-	1003.2	-
Excavated Volume (m ³)	-	4086.5	-	-	3774.9	-	-	2940	-
Specific Charge (kg/m ³)	-	0.28	-	-	0.33	-	-	0.34	-

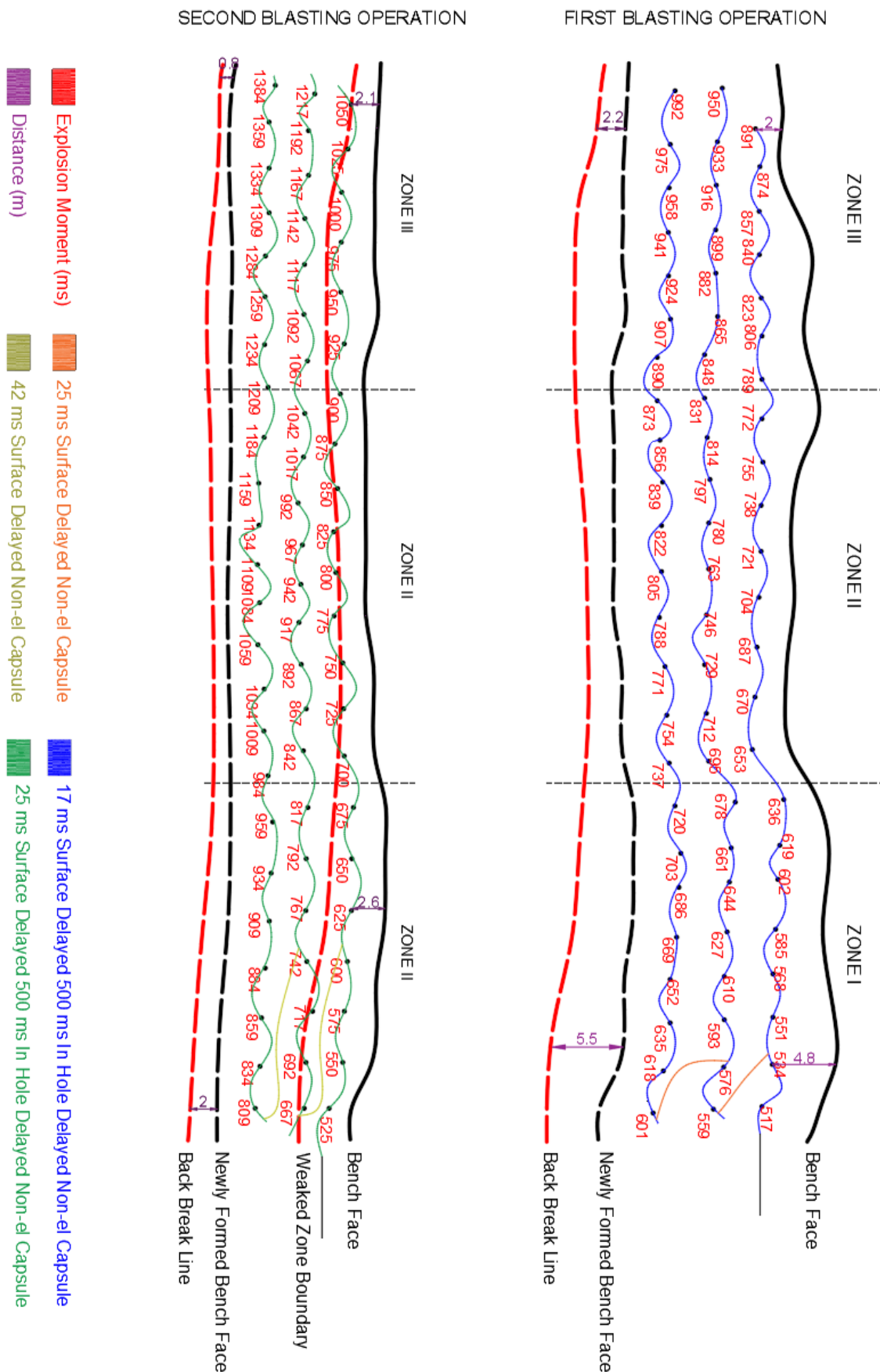


Figure 1. Plan view of the technical designs applied in the blasting operations

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Photogrammetry and digital image processing methods were applied to determine the discontinuity network and block size distribution on the bench face (Figure 2). According to the evaluation, average in-situ block sizes vary between 2523 mm and 3475 mm depending on the zone..

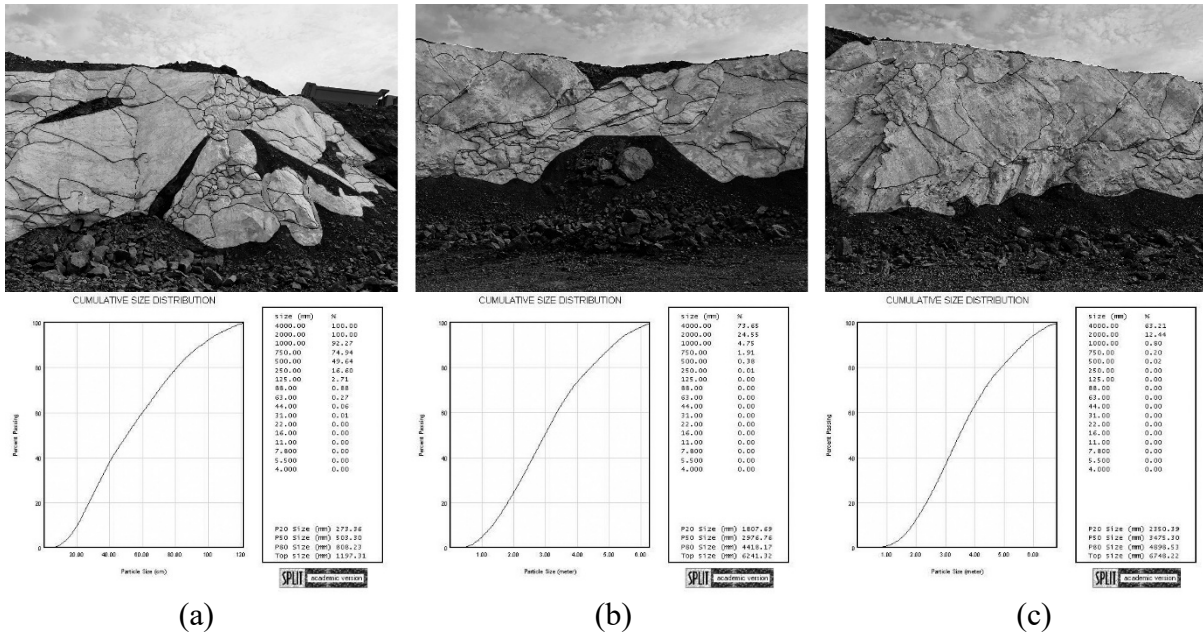


Figure 2. In-situ block distribution on the bench face of (a) Zone I, (b) Zone II, and (c) Zone III of the first blasting operation

In the first blasting carried out at the study site, two critical errors in the design parameters -- excessive burden and insufficient inter-row delay time (42 ms) -- triggered a mechanism that directly and negatively affected blasting performance. While the rock mass in the front row should have been fragmented, detached from the main mass, and displaced by the explosive effect, the rear row holes were initiated before this movement was completed. As a result, instead of displacing the front row, a large portion of the explosive energy was directed backward into the bench mass, creating an intense back-break network.



Figure 3. Back-break network observed in (a) Zone I, (b) Zone II, and (c) Zone III of the first blasting operation

As seen in Figures 1 and 3, especially in Zone I, which formed the starting point of the blasting operation, the burden reached 4.8 m, with the zone average being as high as 3.9 m. This situation prevented the blast energy from reaching the free face, causing most of the energy to be expended within the bench mass. Indeed, in this zone, back-break advanced up to 5.5 meters, exceeding the design limit of the new bench face. This measurement reflects the value observable only at the bench crest; it is estimated that the crack penetrated even further back at the bench toe. In contrast, in the zone at the end of the blasting area where the burden was 2.0 m, the back-break distance was limited

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to 2.2 m. The plan view presented for the first blasting in Figure 1 clearly reveals the linear relationship between burden and back-break distance.

Photogrammetry and digital image processing methods were applied to determine the fragment size distribution of the muck pile resulting from the blast. According to the evaluation, the average fragment sizes of the muck pile vary between 347 mm and 503 mm depending on the zone.

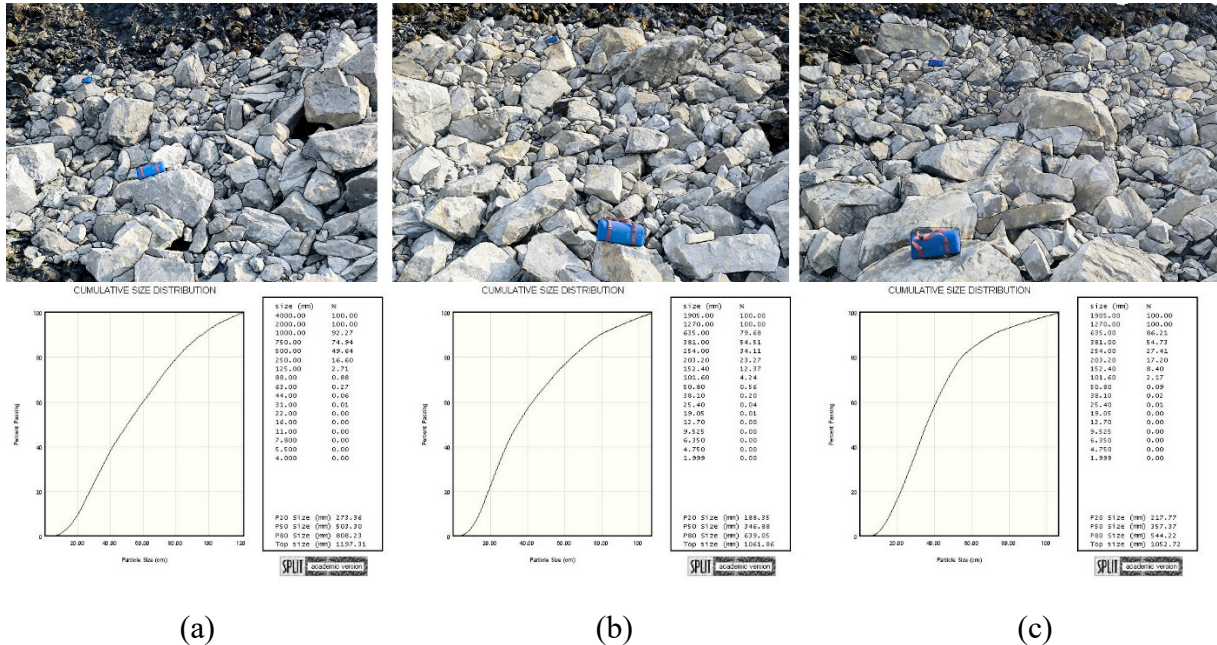


Figure 4. Fragment size distribution of the muck pile occurring in (a) Zone I, (b) Zone II, and (c) Zone III of the first blasting operation

The blasting performance indicators for the first blasting are presented on a zone basis in Table 2. The D values in the table represent the sizes below which 20%, 50%, 80%, and all of the in-situ blocks on the bench face before blasting fall, respectively. P values are the fragment sizes corresponding to the same percentages in the muck pile after blasting. The rock size reduction factor ($F_x = 100 \times (1 - P_x/D_x)$) indicates the degree of size reduction achieved by the blasting for a specific percentage.

The data in Table 2 reveal significant differences in blasting performance between zones. For example, in Zone I, where the powder factor was the lowest (0.28 kg/m³), although the in-situ block sizes were smaller compared to other zones ($D_{50} = 2523$ mm), the post-blast average fragment size ($P_{50} = 503$ mm) remained the highest, and the reduction factor ($F_{50} = 80.1\%$) was the lowest. The 5.5 m back-break observed in the same zone evidences that blast energy was wasted on creating back-break rather than fragmentation.

Table 2. Findings regarding rock fragmentation performance observed in the first blasting operation

Zone	In-Situ Block Size				Muck Pile Particle Size				Rock Size Reduction Factor			
	D ₂₀ (mm)	D ₅₀ (mm)	D ₈₀ (mm)	D ₁₀₀ (mm)	P ₂₀ (mm)	P ₅₀ (mm)	P ₈₀ (mm)	P ₁₀₀ (mm)	F ₂₀ (%)	F ₅₀ (%)	F ₈₀ (%)	F ₁₀₀ (%)
Zone I	1411	2523	3696	5269	273	503	808	1197	80,7	80,1	78,1	77,3
Zone II	1808	2978	4418	6241	188	347	639	1062	89,6	88,4	85,54	83,0
Zone III	2350	3475	4899	6748	218	357	544	1053	90,7	89,7	88,9	84,4

In Zone II, the powder factor increased to 0.33 kg/m³, and although the in-situ block size ($D_{50} = 2978$ mm) was larger than in Zone I, the post-blast fragment size ($P_{50} = 347$ mm) decreased significantly, reaching $F_{50} = 88.35\%$. Zone III had the highest powder factor (0.34 kg/m³). Despite having the largest in-situ blocks ($D_{50} = 3475$ mm), the post-blast fragment size was the smallest ($P_{50} = 357$ mm), and the best fragmentation performance was achieved with $F_{50} = 89.73\%$. The low burden (2-3.7 m) and limited back-break (2.2 m) in this zone indicate that energy was used more efficiently compared to other zones.

Another noteworthy finding is that in all three zones, the rock size reduction factor was lower for coarse fractions (D_{80} and D_{100}) compared to finer fractions (D_{20} , D_{50}). This indicates that the energy from blasting was not distributed homogeneously within the rock mass and that some of the energy required for breaking particularly large blocks was lost by being transferred to the surrounding rock. The non-homogeneous distribution of energy is related to factors such as deviations in hole geometry, variable discontinuity intensity, and uncontrolled back-break formation. Indeed, the back-break reaching 5.5 m in Zone I proves that most of the energy was consumed in crack propagation rather than fragmenting the mass. In Zone III, energy distribution partially improved due to the lower burden, but the reduction factor for coarse fractions still lagged behind that of finer fractions.

The fact that the intense back-break network observed in the first blasting caused permanent damage to the rock mass was confirmed by the D values re-determined in the same zones before the second blasting, which showed a significant decrease compared to the first blasting (Figure 5). For example, the average block size (D_{50}) decreased from 2523 mm to 1016 mm in Zone I, from 2978 mm to 1172 mm in Zone II, and from 3475 mm to 1725 mm in Zone III. This decrease clearly demonstrates that a significant portion of the explosive energy in the first blasting was expended on creating back-breaks within the bench instead of reaching the free face, thereby disrupting the integrity of the rock mass. Thus, it is understood that the design errors in the first blasting (excessive burden and insufficient delay) not only adversely affected the performance of that blasting but also permanently altered the natural structure and engineering properties of the rock mass for subsequent blasting applications.

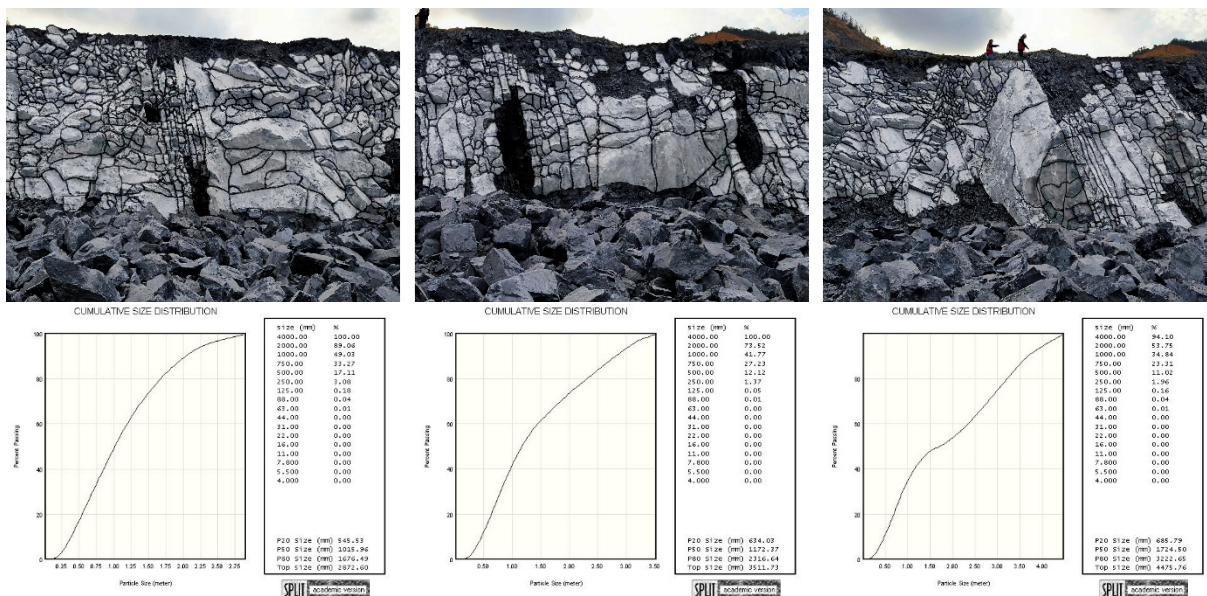


Figure 5. In-situ block distribution on the bench face of (a) Zone I, (b) Zone II, and (c) Zone III of the second blasting operation

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The legacy left in the field after the first blasting was evaluated as a determining input in the design process of the second blasting to be carried out in the same area. As observed in the plan view presented for the second blasting in Figure 1, a weakness zone extending at distances varying between 2 m and 5.5 m from the free face (these distances are estimated to be even higher at the bench toe) and having lost its mechanical integrity due to the back-breaks from the first blasting was formed. Operating drilling machinery and equipment with an operating weight of approximately 18-35 tons in this zone poses significant operational problems such as hole collapse, hole deviation, and irregular hole profile, as well as important occupational safety risks.

In the first stage of the design, the linear relationship between burden and back-break distance was taken as a basis. The burden threshold of 2.5-2.6 m, which yielded the lowest back-break distances in the first blasting, was adopted and adhered to in all zones. Hole spacings were differentiated according to the degree of the weakness zone; they were arranged in the range of 4.0-4.2 m in highly fractured zones and 3.5-3.8 m in relatively sound sections. This approach aimed to distribute the explosive energy more homogeneously within the rock mass and limit secondary crack formation.

Improvements made in the delay pattern constitute the most important revision of the blasting design. The inter-row delay time, which was 42 ms in the first blasting, was increased to 142 ms by using surface caps with higher delay times and by staggering the row transitions (skipping a row every four holes) (Figure 1, second blasting). This arrangement widened the time interval required for the front row rock mass to complete its movement towards the free face, preventing the explosive energy from being expended on back-break formation and allowing the energy to be used in the intended direction.

With the aim of maintaining the zone powder factor values from the first blasting, the stemming length was increased from 3 m to 3.5 m, and consequently, the charge length was shortened, reducing the amount of explosive per hole. Bench height and hole length were kept constant at their values from the first blasting due to site-specific geometric constraints.

Consequently, the design of the second blasting reconfigured the interactions between burden, spacing, delay pattern, stemming length, and powder factor, based on both the field data obtained from the first blasting and the findings of the relevant literature (Table 3).

Table 3. Blasting design parameters for the second blasting operation

Zone	Zone I			Zone II			Zone III		
Value	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.
Hole Diameter (mm)	-	89	-	-	89	-	-	89	-
Number of Holes	-	20	-	-	26	-	-	20	-
Burden (m)	1,8	2,5	2,7	2,3	2,5	2,6	2,1	2,5	2,6
Spacing (m)	3,6	3,8	4,2	3,5	3,8	4,2	3,6	3,8	4,2
Bench Angle (°)	70	75	80	70	75	80	70	75	80
Bench Height (m)	9,5	9,75	10	9	9,25	9,5	-	9	-
Subdrilling Length (m)	-	1	-	-	1	-	-	1	-
Hole Angle (°)	70	75	80	70	75	80	70	75	80
Hole Length (m)	11,1	11,4	11,7	11,1	10,9	10,6	-	10,6	-
Stemming Length (m)	-	3,5	-	-	3,5	-	-	3,5	-
Charge Length (m)	7,6	7,9	8,2	7,1	7,4	7,6	-	7,1	-
Charge per Hole (kg)	45,6	47,4	49,2	42,6	44,4	45,6	-	42,6	-
Total Charge (kg)	-	948	-	-	1154,4	-	-	852	-
Excavated Volume (m ³)	-	3061,5	-	-	3496,5	-	-	2448	-
Specific Charge (kg/m ³)	-	0,31	-	-	0,33	-	-	0,35	-

Field measurements carried out after the second blasting showed that the resulting back-break distances ranged from 0.8 m to 2 m (Figure 1, second blasting and Figure 6). It is noteworthy that the largest back-break distance (2 m) was measured in Zone I, which constituted the starting point of the blasting operation. This zone is the section most affected by the back-breaks of the first blasting and having the widest weakness zone. Therefore, it can be said that the 2 m back-break measured in this zone during the second blasting is a reflection of the pre-existing weakness. Consequently, it is thought that the existing rock mass weakness in that zone contributed, albeit to a limited extent, to back-break formation during the second blasting. However, the fact that even the maximum value obtained is quite low compared to the values in the first blasting confirms the success of the design revisions implemented to prevent back-break formation.

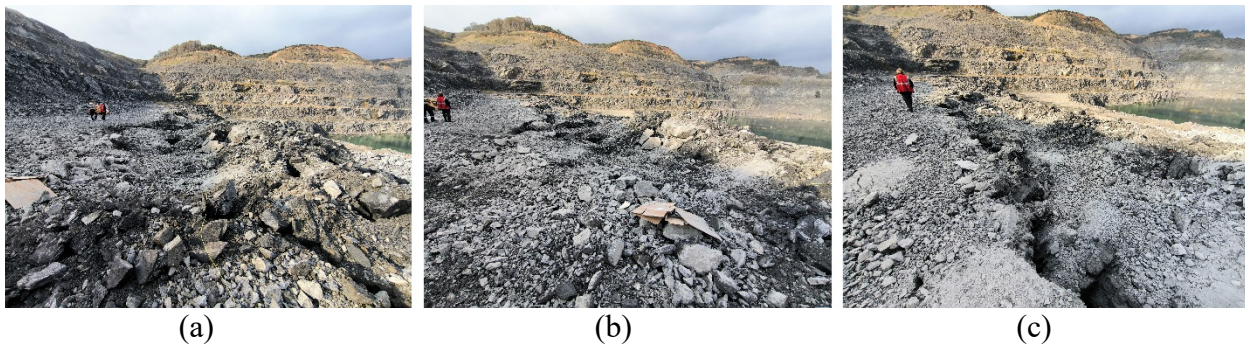


Figure 6. Back-break network observed in (a) Zone I, (b) Zone II, and (c) Zone III of the second blasting operation

Photogrammetry and digital image processing methods were applied to determine the fragment size distribution of the muck pile resulting from the second blasting, and it was observed that the average fragment sizes varied between 297 mm and 450 mm depending on the zone (Figure 7).

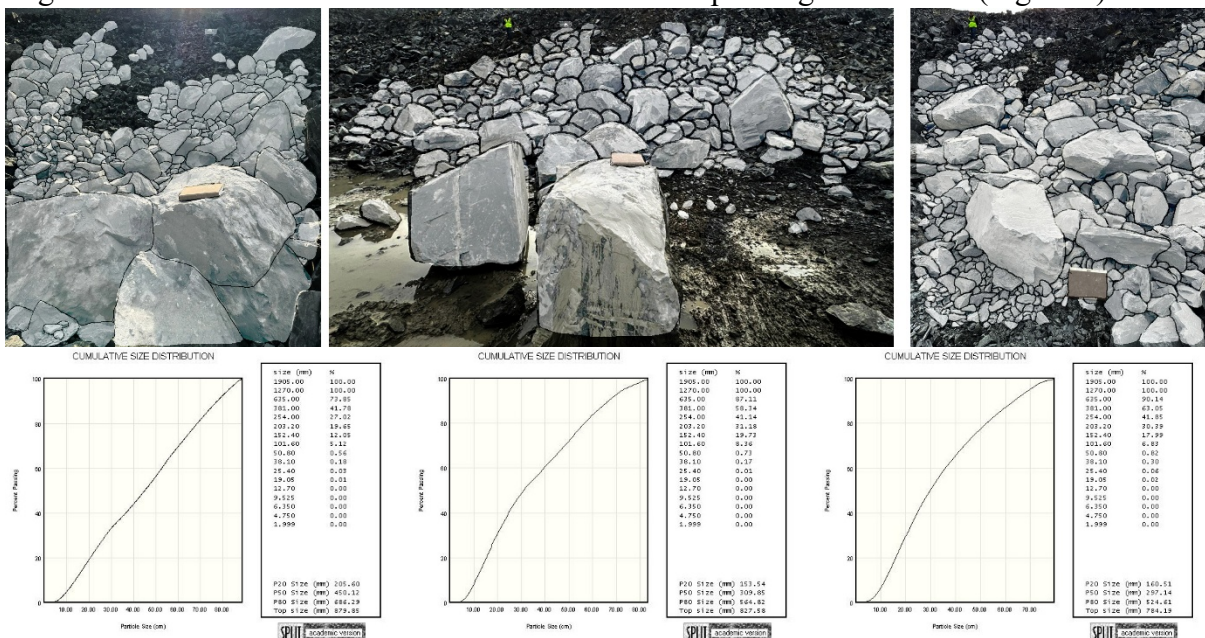


Figure 7. Fragment size distribution of the muck pile occurring in (a) Zone I, (b) Zone II, and (c) Zone III of the second blasting operation

When examining the reduction factors (F) for the fragment sizes of the muck pile after the second blasting, significant differences between zones are evident (Table 4). In Zone I, the section where the most intense back-break (5.5 m) was measured and which suffered the most damage in the first

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blasting, the reduction factors remained at the lowest level across all fractions. This clearly demonstrates that in areas with widespread weakness zones, a significant portion of the explosive energy is expended on processes other than fragmentation (widening existing cracks, secondary crack formation, or escaping to the atmosphere through discontinuities), thus limiting fragmentation efficiency. Indeed, in Zone III, where the rock mass was relatively less damaged, with the application of the highest powder factor (0.35 kg/m^3), the F_{50} value reached a quite high level of 82.78%.

Table 4. Findings regarding rock fragmentation performance observed in the second blasting operation

Zone	In-Situ Block Size				Muck Pile Particle Size				Rock Size Reduction Factor			
	D ₂₀ (mm)	D ₅₀ (mm)	D ₈₀ (mm)	D ₁₀₀ (mm)	P ₂₀ (mm)	P ₅₀ (mm)	P ₈₀ (mm)	P ₁₀₀ (mm)	F ₂₀ (%)	F ₅₀ (%)	F ₈₀ (%)	F ₁₀₀ (%)
Zone I	546	1016	1676	2873	206	450	686	880	62.3	55.7	59.1	69.4
Zone II	634	1172	2317	3512	154	310	565	828	75.7	73.6	75.6	76.4
Zone III	686	1725	3223	4476	161	297	525	784	76.5	82.9	83.7	82.5

Comparing the fragmentation performances of the first and second blasting operations through reduction factors reveals the impact of back-breaks and the resulting weakness zone more clearly. The decrease of the F_{50} value from 80.1% in Zone I during the first blasting to 55.7% in the same zone during the second blasting clearly demonstrates the effect of the weakness zone created by the first blasting. Although the powder factor was higher in the second blasting, a large portion of the explosive energy was spent on widening pre-existing cracks or escaped to the atmosphere through these discontinuities, rather than on fragmentation. In Zone III, while F_{50} decreased from 89.73% in the first blasting to 82.78% in the second blasting, the decrease was more limited, yet still indicates a loss in energy efficiency. However, it is understood that blast energy was used more efficiently in sections where the weakness zone was less developed.

Another notable point is that in both blasting operations, the reduction factors for coarse fractions (D_{80} , D_{100}) were generally lower than for fine fractions (D_{20} , D_{50}). However, this difference decreased in the second blasting, and especially in Zone III, F_{80} and F_{100} values exceeded F_{50} (F_{50} 82.78%, F_{80} 83.71%, F_{100} 82.48%). This indicates that energy distribution became more homogeneous in the second blasting, and there was greater success in breaking large blocks. In contrast, in Zone I, although F_{80} and F_{100} are still somewhat above F_{50} , the absolute values remain low. This reveals that homogeneity could not be fully achieved in the zone with the most intense weakness zone, but a significant improvement was recorded compared to the first blasting.

In summary, the data from the second blasting clearly reflect the impact of the back-breaks formed in the first blasting and the resulting weakness zone. While reduction factors remained at the lowest level in the most damaged Zone I, high efficiency was achieved in the less affected Zone III. Nevertheless, despite the powder factor being the same or higher in all zones in the second blasting compared to the first, the significant decrease in reduction factors highlights the negative impact of the permanent damage caused by the first blasting on energy efficiency. This experience clearly demonstrates that blast-induced damage is not merely an instantaneous effect but leaves a legacy that shapes subsequent operations and directly affects energy efficiency..

DISCUSSION AND CONCLUSION

This study quantitatively demonstrates, using data from two consecutive blasting operations in medium-strength sandstone (27-31 MPa), that back-break caused by design errors in the first blasting not only reduces the immediate efficiency but also permanently limits the performance of subsequent blasting operations.

The findings obtained confirm the effects of key parameters emphasized in the literature under field conditions. Keeping the burden at a high value of 3.9 m (max. 4.8 m) in the first blasting, as stated by Konya and Walter (1991) and Monjezi et al. (2010a), prevented the explosive energy from reaching the free face, triggering back-break (5.5 m). Similarly, the insufficient inter-row delay time of 42 ms violated the concept of "rock's response time to blasting" defined by Chiappetta (1998); the initiation of the rear row before the front row mass could be displaced pushed the portion of explosive energy expended on back-break beyond acceptable limits. This indicates an inefficiency far exceeding the 15-20% energy loss estimated by Monjezi et al. (2012), demonstrating that critical thresholds for burden and delay time must not be exceeded, especially in medium-strength rocks.

Reducing the burden to 2.5 m and increasing the delay time to 142 ms in the second blasting brought back-break down to more acceptable levels of 0.8-2 m. This improvement aligns with the controlled blasting principles suggested by Chiappetta (1998) and Tao et al. (2024). However, the notable finding is the performance difference between zones despite the same design improvement: F_{50} dropped to 55.7% in Zone I, where the most intense back-break occurred in the first blasting, while it reached 82.8% in the less damaged Zone III. This difference proves, with field data, the determining role of discontinuities and pre-existing damage in energy transmission, as emphasized by Bhandari and Badal (1990) and Ak and Konuk (2008). Once a back-break network forms, it alters the dynamic behavior of the rock mass, causing energy in subsequent blasts to be directed towards widening existing cracks; this can be evaluated as the practical reflection of the difference between dynamic and static strength noted by Silva et al. (2019).

In both blasting operations, the reduction factors for coarse fractions (D_{80} , D_{100}) remaining lower than for fine fractions confirms the energy inhomogeneity problem pointed out by Ebrahimi et al. (2016) and Tao et al. (2024). The decrease in this difference in the second blasting (especially F_{80} and F_{100} exceeding F_{50} in Zone III) shows that optimizing spacings (3.5-4 m) according to the degree of weakness partially improved homogeneity. However, the low values in Zone I reveal that geometric adjustments alone are insufficient in highly fractured environments, and the powder factor needs to be adjusted more flexibly according to zone differences.

These results draw attention to the chain effects of blast-induced damage. The stability losses predicted by numerical models by Deressa et al. (2024) and Djoudi (2021) have been proven in this study through production efficiency; the fact that back-break is not only a safety issue but also a cause of economic loss (Li et al., 2022) is supported by field data. Particularly, the collapse and deviation problems experienced during drilling in the weakness zone confirm the operational disruption descriptions of Monjezi and Dehghani (2008) and Sayadi et al. (2013).

Limitations of the study include the fact that back-break could only be measured at the bench crest, detailed structural analysis of discontinuity properties could not be performed, and the amount of fines (material below 10 cm) within the muck pile was ignored. For future studies, three-dimensional mapping of the weakness zone using methods such as seismic tomography or thermal imaging in damaged areas and validation through numerical modeling are recommended.

In conclusion, for a sustainable and efficient blasting operation, the following basic principles should be considered:

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- Key parameters such as burden, spacing, and inter-row delay time should be optimized in accordance with the mechanical properties and discontinuity structure of the rock mass.
- Blasting design should consider not only immediate efficiency targets but also long-term rock mass integrity and impacts on subsequent production stages.
- Back-break formation should be regularly monitored, and the obtained data should provide input for future blasting designs.

This holistic approach will ensure the effective use of explosive energy and production continuity, while also providing significant improvements in terms of occupational safety and environmental impacts.

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THE SPATIAL AND DEMOGRAPHIC TRANSFORMATION OF SETTLEMENT IN NORTH OSSETIA (ALANIA)

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Abstract

The North Caucasus has historically functioned as a zone of interaction for diverse cultures, political powers and population movements, leading to continuous transformations in settlement patterns and spatial organisation. Located on the northern slopes of the Greater Caucasus Mountains, the Republic of North Ossetia–Alania exhibits a distinctive settlement structure shaped by both environmental conditions and historical socio-political processes. This study aims to examine the historical development and spatial transformation of settlement in North Ossetia and to reveal the historical and environmental dynamics underlying the present settlement pattern. The research focuses on settlement continuity from the Paleolithic period onwards and evaluates major historical phases—such as the Alans, the invasions of the Huns, Mongol-Tatars and Timur, and the annexation by the Russian Empire—as key turning points influencing settlement organisation. Throughout these periods, settlement patterns shifted between mountainous areas and plains in response to security concerns, environmental constraints and economic opportunities. Mountainous areas functioned as defensible settlement zones during periods of external pressure, whereas planned resettlement policies from the late eighteenth century onwards promoted concentration in plains and foothill areas with more favourable natural conditions. Historical records, archaeological evidence and population data are analysed together to trace the background of spatial changes in settlement. Within this framework, the rise of Vladikavkaz as a regional centre is examined as a decisive factor in the reorganisation of settlement hierarchy in North Ossetia. This centralisation process represents not only a spatial transformation but also a historical restructuring that influenced population distribution and the functional roles of settlements. In conclusion, the case of North Ossetia demonstrates the necessity of analysing settlement continuity and spatial transformation as interconnected processes. Settlement patterns have been continuously reshaped by changing political, demographic and environmental conditions, forming the basis of the present spatial structure. The study thus provides a comprehensive contribution to settlement research in the North Caucasus.

Keywords: Settlement development, Spatial transformation, Population movements, Mountain–plain relationship, North Caucasus, North Ossetia-Alania.

KUZEY OSETYA'DA (ALANYA) YERLEŞMENİN MEKÂNSAL VE DEMOGRAFİK DÖNÜŞÜMÜ

Özet

Kuzey Kafkasya, tarih boyunca farklı kültürlerin, siyasal güçlerin ve nüfus hareketlerinin kesişme alanında yer almış; bu durum bölgenin yerleşim düzeni ve demografik yapısının sürekli dönüşüm geçirmesine neden olmuştur. Büyük Kafkasya Sıradağları'nın kuzey yamacında konumlanan Kuzey Osetya-Alanya Cumhuriyeti, hem fiziki coğrafi özellikleri hem de tarihsel süreçte maruz kaldığı

göçler, istilalar ve siyasal yeniden yapılanmalar nedeniyle özgün bir yerleşim coğrafyasına sahiptir. Bu çalışma, Kuzey Osetya’da yerleşmenin gelişimini ve mekânsal örgütlenmesini tarihi coğrafya perspektifinden ele alarak, günümüzdeki yerleşim yapısının tarihsel kökenlerini ortaya koymayı amaçlamaktadır. Araştırma, Paleolitik dönemden itibaren bölgedeki yerleşim sürekliliğini dikkate almakta; Alanlar dönemi, Hun, Moğol-Tatar ve Timur istilaları ile Rusya İmparatorluğu’na ilhak sürecini, yerleşim düzenini belirleyen temel tarihsel kırılma noktaları olarak değerlendirmektedir. Bu tarihsel evreler boyunca yerleşmelerin, doğal çevre koşulları ile siyasal ve askerî baskıların etkisi altında, dağlık alanlar ile ova kesimleri arasında yön değiştirdiği görülmektedir. Dağlık alanlar, özellikle güvenlik kaygılarının ön plana çıktığı dönemlerde savunmaya elverişli yerleşim alanları olarak öne çıkarken; Rusya İmparatorluğu’na ilhak sonrasında uygulanan iskân politikaları, yerleşimlerin daha elverişli doğal koşullara sahip ova ve etek alanlarında yoğunlaşmasına yol açmıştır. Çalışmada tarihsel-coğrafi yöntem benimsenmiş; arkeolojik bulgular, tarihsel kayıtlar ve resmi nüfus verileri birlikte değerlendirilmiştir. Bu bütüncül yaklaşım sayesinde, yerleşim yapısındaki mekânsal değişimlerin yalnızca doğal çevre koşullarıyla değil, aynı zamanda demografik süreçler, ekonomik faaliyetler ve merkezileşme eğilimleriyle de yakından ilişkili olduğu ortaya konulmuştur. Vladikavkaz’ın tarihsel süreçte kazandığı merkezî konum, Kuzey Osetya’daki yerleşim hiyerarşisinin yeniden örgütlenmesinde belirleyici bir rol oynamıştır. Sonuç olarak çalışma, Kuzey Osetya örneğinin, dağlık bölgelerde yerleşme sürekliliği ile mekânsal dönüşümün birlikte değerlendirilmesi gerektiğini göstermektedir. Tarihi coğrafya yaklaşımı, yerleşim düzeninin uzun dönemli evrimini anlamada güçlü bir analitik çerçeve sunmakta; Kuzey Kafkasya’daki yerleşme araştırmalarına bütüncül bir katkı sağlamaktadır.

Anahtar Kelimeler: Yerleşme gelişimi, Mekânsal dönüşüm, Nüfus hareketleri, Dağ–ova ilişkisi, Kuzey Kafkasya, Kuzey Osetya (Alanya).

GİRİŞ

Yerleşme olgusu, insan topluluklarının doğal çevreyle kurduğu ilişkinin mekânsal bir yansıması olarak coğrafya biliminin temel inceleme alanlarından birini oluşturmaktadır. Bu ilişki yalnızca fiziki çevre koşullarıyla sınırlı olmayıp, tarihsel süreçler, siyasal dönüşümler, ekonomik faaliyetler ve demografik dinamiklerle birlikte şekillenmektedir. Tarihi coğrafya yaklaşımı, yerleşim düzenlerini statik bir mekânsal görünüm olarak ele almak yerine, zaman içerisinde geçirdiği dönüşümleri ve bu dönüşümlerin ardındaki nedenleri ortaya koymayı amaçlamaktadır. Bu yönüyle tarihi coğrafya, yerleşmelerin sürekliliğini ve kırılma noktalarını birlikte analiz eden bütüncül bir bakış açısı sunmaktadır. Kuzey Kafkasya, bu yaklaşım açısından değerlendirildiğinde, tarih boyunca yoğun nüfus hareketlerine, istilalara ve siyasal yeniden yapılanmalara sahne olmuş özgün bir coğrafi alan olarak öne çıkmaktadır. Avrupa ile Asya arasında bir geçiş sahası niteliği taşıyan bölge, farklı kültürlerin, etnik grupların ve ekonomik sistemlerin karşılaşma alanı olmuştur. Bu durum, Kuzey Kafkasya’daki yerleşim düzeninin tek yönlü bir gelişim göstermemesine, aksine dönemsel olarak yön değiştiren ve yeniden örgütlenen bir karakter kazanmasına neden olmuştur (Rekreationsnaya otsenka landshaftov RSO–Alaniya, 2022, s. 159).

Büyük Kafkasya Sıradağları’nın kuzey yamacında yer alan Kuzey Osetya–Alanya Cumhuriyeti, Kuzey Kafkasya’nın bu çok katmanlı tarihsel ve coğrafi yapısını en açık biçimde yansıtan alanlardan biridir. Bölge, Paleolitik dönemden itibaren kesintisiz yerleşim izleri sunmakta; Alanlar dönemi, Hun, Moğol-Tatar ve Timur istilaları ile Rusya İmparatorluğu’na ilhak süreci gibi tarihsel kırılmalar, yerleşim düzeninin mekânsal yönelimini belirgin biçimde etkilemektedir. Bu süreçte yerleşmeler kimi dönemlerde ovalardan dağlık alanlara doğru çekilmiş, kimi dönemlerde ise dağlardan ovalara yönelen yeniden iskân hareketleriyle farklı bir mekânsal örgütlenme kazanmıştır (Bol’shaya Rossiyskaya Entsiklopediya, 2022).

Literatürde Kuzey Osetya üzerine yapılan çalışmaların önemli bir bölümü, ya demografik yapı ve nüfus değişimleri ya da tarihsel olaylar ekseninde şekillenmektedir. Özellikle Rusça literatürde, 19. yüzyıl sonu ve 20. yüzyıl başına ait nüfus sayımları temel alınarak kentsel büyüme, sanayileşme ve kentleşme süreçleri ayrıntılı biçimde ele alınmıştır (Tavasiyev, 2014, s. 2663–2667). Bununla birlikte, yerleşme düzeninin uzun dönemli tarihsel gelişimi ile demografik dönüşümün birlikte ve bütüncül bir tarihi coğrafya perspektifiyle ele alındığı çalışmaların sınırlı olduğu görülmektedir. Bu durum, Kuzey Osetya'daki yerleşme sürekliliği ile tarihsel kırılmaların aynı analitik çerçeve içinde değerlendirilmesini gerekli kılmaktadır. Bu çalışmanın temel amacı, Kuzey Osetya–Alanya Cumhuriyeti'nde yerleşmenin gelişimini ve demografik dönüşümünü tarihi coğrafya perspektifinden incelemektir. Bu kapsamda Paleolitik dönemden günümüze kadar uzanan yerleşim süreci ele alınmakta; doğal çevre koşulları, tarihsel istilalar, siyasal dönüşümler ve ekonomik faktörlerin yerleşim düzeni üzerindeki etkileri analiz edilmektedir. Çalışma, özellikle dağlık alanlar ile ova kesimleri arasındaki yerleşim yönelimlerinin hangi tarihsel ve çevresel nedenlerle değiştiğini ortaya koymayı hedeflemektedir.

Araştırma, tarihsel-coğrafi yönetime dayanmaktadır. Bu çerçevede arkeolojik bulgular, tarihsel kayıtlar ve resmî nüfus sayımı verileri birlikte değerlendirilmiştir. 1897 Rus İmparatorluğu Nüfus Sayımı başta olmak üzere, Sovyet dönemi ve Sovyet sonrası demografik veriler, yerleşim yapısındaki mekânsal değişimlerin analizinde temel veri kaynağı olarak kullanılmıştır. Ayrıca bölgenin fiziki coğrafya özellikleri ile yerleşim dağılımı arasındaki ilişki, tarihsel süreç dikkate alınarak yorumlanmıştır. Bu bağlamda çalışmada aşağıdaki temel araştırma sorularına yanıt aranmıştır:

1. Kuzey Osetya'da yerleşim düzeni tarihsel süreçte hangi evrelerden geçmiştir?
2. Dağlık alanlardan ovalara ve ovalardan dağlara yönelen yerleşim hareketlerinin temel nedenleri nelerdir?
3. Demografik yapıdaki değişimler, yerleşimlerin mekânsal örgütlenmesini nasıl etkilemiştir?
4. Günümüzde gözlenen demografik kriz, tarihsel yerleşme sürekliliği açısından nasıl bir kırılmaya işaret etmektedir?

ARAŞTIRMA VE BULGULAR

1. Coğrafi Konum ve Doğal Ortam

Kuzey Osetya–Alanya Cumhuriyeti, Rusya Federasyonu'nun Avrupa kesiminin güneyinde, Büyük Kafkasya Sıradağları'nın kuzey yamacında yer almakta olup, Kuzey Kafkasya'nın fiziki ve beşerî coğrafya özelliklerinin en belirgin biçimde iç içe geçtiği alanlardan birini oluşturmaktadır. Cumhuriyet toprakları kuzeyde Stavropol Ovası, orta kesimde Oset Ovası ve güneyde yüksek dağlık alanlar ile çevrilidir. Bu üçlü mekânsal yapı, bölgenin tarihsel süreç boyunca bir geçiş, temas ve yerleşme alanı olarak şekillenmesinde belirleyici olmuştur. Büyük Kafkasya'nın kuzey yamacında uzanan dağ sıraları, Kuzey Osetya'daki yerleşme düzeninin biçimlenmesinde temel doğal faktörlerden biridir. Cumhuriyetin dağlık kesiminde, Ana Kafkas Sıradağları'na paralel biçimde uzanan Side, Rocky, Mera ve Ormanlık sırtları, yerleşmelerin büyük ölçüde vadi tabanları ve boğazlar boyunca yoğunlaşmasına neden olmuştur. Bu morfolojik yapı, tarihsel süreçte hem savunma hem de ulaşım açısından avantajlı alanların yerleşme için tercih edilmesini beraberinde getirmiştir (Isayev, 2010, s. 47). Özellikle dağ boğazları, Kuzey Osetya–Alanya'da tarih boyunca nüfus hareketlerinin, ticari geçişlerin ve kültürel temasların odak noktaları hâline gelmiş; bu durum, bölgenin Kuzey Kafkasya içindeki stratejik konumunu güçlendirmiştir (Gerasimov, 1989, s. 204–206).

Doğal çevrenin bu belirleyici etkisi, Kuzey Osetya'daki yerleşme düzeninin yalnızca mekânsal dağılımını değil, aynı zamanda yerleşimlerin büyüklüğünü ve sürekliliğini de doğrudan etkilemiştir. Dağlık alanlarda yer alan yerleşmeler, topoğrafik sınırlılıklar ve savunma gereksinimleri nedeniyle

genellikle küçük ölçekli, parçalı ve savunma odaklı bir karakter sergilerken; ova kesimlerinde daha büyük, süreklilik gösteren ve ekonomik açıdan çeşitlenmiş yerleşmeler gelişmiştir. Oset Ovası, tarımsal faaliyetler için elverişli toprak yapısı, iklim koşulları ve ulaşım olanakları sayesinde tarihsel süreç boyunca nüfusun yoğunlaştığı başlıca alanlardan biri olmuştur. Bu durum, ovanın yalnızca bir tarım alanı değil, aynı zamanda yerleşme sürekliliğinin sağlandığı bir çekirdek mekân hâline gelmesine katkı sağlamıştır (Zamyatin, 2006, s. 129–131).

Kuzey Osetya'nın doğal ortamı, yerleşmelerin ekonomik işlevlerini de doğrudan şekillendirmiştir. Dağlık kesimlerde hayvancılık ve sınırlı tarımsal faaliyetler ön plana çıkarken, ova ve etek bölgelerinde tarım, ticaret ve özellikle 19. yüzyılın sonlarından itibaren sanayi faaliyetleri gelişme göstermiştir. Bu ekonomik farklılaşma, dağ–ova arasında tarihsel olarak süreklilik arz eden bir nüfus hareketliliğini beraberinde getirmiştir. Tarihi coğrafya açısından değerlendirildiğinde, söz konusu hareketlilik yerleşme sürekliliğinin ve mekânsal dönüşümün temel dinamiklerinden biri olarak ortaya çıkmaktadır. Doğal çevre koşullarının yerleşme üzerindeki etkisi, tarihsel olaylarla birleştiğinde daha belirgin hâle gelmiştir. Hun, Moğol-Tatar ve Timur istilaları sırasında nüfusun dağlık alanlara çekilmesi, doğal çevrenin sunduğu savunma imkânlarıyla doğrudan ilişkilidir. Buna karşılık, Rusya İmparatorluğu'na ilhak sonrasında uygulanan iskân politikaları, ova kesimlerinin yeniden cazibe kazanmasına neden olmuş ve doğal ortamın yerleşme üzerindeki etkisi farklı bir yönelim kazanmıştır (Badov & Badov, 2017, s. 66–68). Bu çerçevede Kuzey Osetya'nın coğrafi konumu ve doğal ortamı, yerleşme düzeninin tarihsel evrimini belirleyen pasif bir arka plan değil; aksine, siyasal, demografik ve ekonomik süreçlerle etkileşim hâlinde olan aktif bir unsur olarak değerlendirilmelidir. Günümüzdeki yerleşme dağılımı ve nüfus yoğunluğu, bu uzun dönemli doğal ve tarihsel etkileşimin somut bir sonucunu yansıtmaktadır.

2. Tarihsel Yerleşim Süreci

Kuzey Osetya topraklarında yerleşme süreci, Kafkasya'nın genel tarihsel ve kültürel evrimiyle paralel biçimde çok erken dönemlere kadar uzanmaktadır. Bölgedeki arkeolojik veriler, Paleolitik dönemden itibaren insan varlığının kesintili fakat süreklilik gösteren bir yapı sergilediğini ortaya koymaktadır. Popov çiftliği çevresi ile Kırzhin, Zamankul ve Batako köyleri yakınlarında tespit edilen erken Paleolitik buluntular, Kuzey Osetya'nın yaklaşık 150 bin yıl öncesinden itibaren insan yerleşimine sahne olduğunu göstermektedir. Bu erken dönem yerleşmeleri, doğal çevre koşullarına doğrudan bağımlı, avcılık ve toplayıcılığa dayalı geçici iskân alanları niteliğindedir. Yerleşmelerin çoğunlukla mağara ve açık alan kampı şeklinde örgütlendiği, su kaynakları ve av potansiyelinin belirleyici olduğu anlaşılmaktadır. Mezolitik döneme tarihlenen Saulagat Mağarası ile Mozdok çevresindeki Komarovo yerleşmesi, Kuzey Osetya'da yerleşme sürekliliğinin yalnızca geçici değil, zamansal derinliği olan bir iskân modeli geliştirdiğini ortaya koyan önemli merkezler arasında yer almaktadır (Anthony, 2007, s. 215–217).

Neolitik dönemde, özellikle Digorsky Gorge, Kuzey Osetya'daki yerleşme tarihinin çekirdek alanlarından biri hâline gelmiştir. Bu dönemde yerleşmelerin daha kalıcı bir karakter kazandığı, avcılık-toplayıcılığın yanı sıra tarımsal üretim ve hayvancılığın giderek önem kazandığı görülmektedir. İnsan–doğal çevre ilişkisi, bu evrede daha karmaşık ve üretime dayalı bir yapıya evrilmiştir. Tunç Çağı boyunca Kuzey Osetya, Kura–Araks, Maykop, Pit ve Catacomb kültürlerinin kesişme alanlarından biri hâline gelmiş; bu durum bölgenin Kafkasya ölçeğinde önemli bir yerleşme ve kültürel etkileşim sahası olduğunu ortaya koymuştur. Söz konusu kültürel katmanlar, Kuzey Osetya'da yerleşme sürekliliğinin tarihsel temelini oluşturan ana aşamaları temsil etmektedir (Kohl, 2007, s. 97–102).

Tarihi coğrafya açısından Kuzey Osetya'daki yerleşme düzenini belirleyen en önemli kırılma noktalarından biri, Alanlar dönemiyle doğrudan ilişkilidir. Alanların ataları, erken dönemlerde Ciscaucasia bozkır kuşağında hâkimiyet kurmuş; ancak 4. yüzyılın sonlarına doğru Hun baskısının

artmasıyla, açık ve savunmasız ovalık alanlardan dağ eteklerine ve yüksek dağlık kesimlere çekilmek zorunda kalmışlardır. Bu zorunlu yer değiştirme süreci, yerleşmelerin mekânsal yöneliminde köklü bir değişime yol açmış; Alan yerleşmeleri giderek savunmaya elverişli, parçalı ve korunaklı bir karakter kazanmıştır. Özellikle vadi tabanları, dar boğazlar ve ulaşılması güç dağ içi alanlar, bu dönemde yerleşmelerin yoğunlaştığı başlıca mekânlar hâline gelmiştir. Bu mekânsal tercihler, Alan toplumunun hem askerî tehditlere karşı korunma ihtiyacını hem de sınırlı kaynakları daha etkin kullanma çabasını yansıtmaktadır. Alan nüfusunun Kuzey Osetya topraklarındaki ikinci büyük yerleşim dalgası, 13. yüzyılda gerçekleşen Moğol-Tatar istilalarıyla ilişkilendirilmektedir. Moğol ordularının Kuzey Kafkasya'ya yönelik saldırıları, Alan nüfusunun önemli bir bölümünü kitlesel biçimde dağlık alanlara yönelmeye zorlamış; bu durum, dağlık kesimlerdeki yerleşme yoğunluğunu belirgin biçimde artırmıştır (Sinor, 1990, s. 246–249).

Özellikle Batı Alanya nüfusunun önemli bir kısmı, yalnızca Moğol istilaları nedeniyle değil, 13. yüzyılın ikinci yarısında bölge üzerinde nüfuz kuran farklı siyasî güçlerin baskıları sonucunda da yer değiştirmek zorunda kalmıştır. Bu uzun süreli baskı ortamı, Kuzey Osetya'daki yerleşme düzeninin savunma odaklı, içe kapanık ve dağ merkezli bir yapıya evrilmesine neden olmuş; bu özellikler, bölgenin yerleşme coğrafyasında yüzyıllar boyunca kalıcı izler bırakmıştır.

Kuzey Osetya'daki üçüncü büyük yerleşim dalgası, Timur'un Kafkasya seferleriyle doğrudan ilişkilidir. 14. yüzyılın sonlarında gerçekleşen Timur istilaları, bölgedeki yerleşme sürekliliğini kesintiye uğratan bir diğer önemli tarihsel kırılma olarak değerlendirilmektedir. Bu süreçte nüfusun önemli bir bölümü, artan askerî tehditler nedeniyle yeniden dağlık alanlara çekilmiş; yerleşmelerin mekânsal dağılımı, güvenlik ve savunma kaygıları doğrultusunda yeniden şekillenmiştir. Tarihi coğrafya açısından bu dönem, Kuzey Osetya'daki yerleşme düzeninin yalnızca doğal çevre koşullarıyla değil, aynı zamanda siyasal ve askerî baskılarla da yönlendirildiğini açık biçimde ortaya koymaktadır. Timur seferleri, özellikle vadi tabanları ve açık alanlardaki yerleşmelerin zayıflamasına, buna karşılık yüksek ve ulaşılması güç alanlarda savunma ağırlıklı iskânın güçlenmesine yol açmıştır. Kuzey Osetya'daki yerleşme sürecinde dördüncü ve en belirleyici aşama, 18. yüzyılın sonlarında Rusya İmparatorluğu'na ilhak ile başlamıştır. 1774 sonrası dönemde, Rus yönetimi tarafından dağlık alanlardan ovalara doğru planlı iskân politikaları uygulanmış; Oset nüfusunun bir bölümü bilinçli olarak ova kesimlerine yönlendirilmiştir. Aynı dönemde Ruslar, Ukraynalılar ve diğer Slav gruplar kuzeyden bölgeye yerleştirilmiş; Mozdok Kalesi, Lukovskaya (1763) ve Pavlodolskaya (1774) gibi askerî yerleşmeler bu sürecin mekânsal dayanak noktaları hâline gelmiştir (Baddeley, 1908, s. 92–95).

1784 yılında Vladikavkaz Kalesi'nin kurulması, Kuzey Osetya'daki yerleşme düzeninde yeni bir merkezileşme sürecinin başlangıcını temsil etmiştir. Bu gelişme, bölgenin yalnızca askerî değil, aynı zamanda idarî ve ekonomik bir merkez etrafında yeniden örgütlenmesini beraberinde getirmiştir. Rusya'ya ilhak sonrasında Kuzey Osetya'da yerleşmelerin mekânsal yönelimi belirgin biçimde değişmiş; dağlık alanlardan ovalara doğru yaşanan nüfus hareketleri, modern yerleşim sisteminin temellerini oluşturmuştur. Bununla birlikte bu süreç, dağlık alanların tamamen terk edilmesi anlamına gelmemiştir. Aksine, 19. yüzyıl boyunca dağlık Osetya nüfusu, polimetallik cevher yataklarının keşfi ve işletilmesi, tarım tekniklerindeki gelişmeler ve boğazlar arası ulaşımın güçlenmesi sayesinde artmaya devam etmiştir. Özellikle Sadonskoye yatağının işletmeye açılması, dağlık alanlardaki yerleşmelerin ekonomik işlev kazanmasını sağlayan başlıca unsurlardan biri olmuştur (Tsutsiev, 2014, s. 171–174).

Bu tarihsel süreç bütüncül olarak değerlendirildiğinde, Kuzey Osetya'daki yerleşme düzeninin tek yönlü bir gelişim göstermediği; aksine, tarih boyunca ovalar ile dağlık alanlar arasında yön değiştiren, siyasal ve doğal koşullara duyarlı dinamik bir mekânsal yapı sergilediği görülmektedir. Tarihi coğrafya perspektifi, bu çok katmanlı süreci anlamada temel bir analitik çerçeve sunmakta ve günümüzdeki yerleşme yapısının tarihsel kökenlerini açık biçimde ortaya koymaktadır.

3. Yerleşim Yapısının Şekillenmesi

Kuzey Osetya–Alanya Cumhuriyeti’nde yerleşim yapısının şekillenmesi, tarihsel süreç boyunca doğal çevre koşulları ile siyasal, ekonomik ve demografik faktörlerin karşılıklı etkileşimi sonucunda gerçekleşmiştir. Tarihi coğrafya perspektifinden bakıldığında, bölgedeki yerleşmelerin mekânsal dağılımı ve işlevsel özellikleri, tek bir döneme özgü dinamiklerle açıklanamayacak ölçüde karmaşık ve çok katmanlı bir gelişim sürecine sahiptir. Bu sürecin temel mekânsal çerçevesini, dağlık alanlar ile ova kesimleri arasındaki karşılıklı oluşturmaktadır. Dağlık kesimlerde gelişen yerleşmeler, tarihsel olarak savunma gereksinimlerinin belirleyici olduğu bir yerleşim tipolojisi sergilemiştir. Özellikle Hun, Moğol-Tatar ve Timur istilaları gibi dış baskıların yoğunlaştığı dönemlerde, nüfusun dağlık alanlara yönelmesi, yerleşmelerin vadi tabanları, yamaç etekleri ve ulaşılması güç alanlarda yoğunlaşmasına neden olmuştur (Manz, 2007, s. 68–71).

Bu tür yerleşmeler genellikle küçük ölçekli, parçalı ve kendi kendine yetmeye yönelik bir yapıya sahip olmuş; ekonomik faaliyetler ağırlıklı olarak hayvancılık ve sınırlı tarımsal üretim etrafında şekillenmiştir. Dağlık alanlardaki bu yerleşme modeli, savunma açısından görece güvenli bir yaşam alanı sunmakla birlikte, demografik açıdan kırılgan ve dış müdahalelere duyarlı bir karakter kazanmıştır. Bu durum, Kuzey Osetya’da yerleşme düzeninin yalnızca doğal çevre koşullarına değil, tarihsel süreçte tekrarlanan siyasal ve askerî baskılara da duyarlı biçimde şekillendiğini; dağlık alanların uzun süre boyunca bir sığınak ve savunma mekânı işlevi gördüğünü açık biçimde ortaya koymaktadır (Tsutsiev, 2014, s. 18–20).

Buna karşılık ova kesimleri ve dağ etekleri, tarihsel süreç boyunca daha yoğun ve süreklilik gösteren yerleşmelerin geliştiği alanlar olmuştur. Oset Ovası, tarımsal üretime elverişli topografik yapı, toprak özellikleri ve iklim koşulları sayesinde erken dönemlerden itibaren nüfus çekim alanı işlevi görmüştür. Rusya İmparatorluğu’na ilhak sonrasında uygulanan iskân politikaları bu eğilimi daha da güçlendirmiş; dağlık alanlardan ovalara yönelen planlı yerleşim hareketleri, Kuzey Osetya’daki yerleşim yapısında belirgin bir merkezileşme sürecini başlatmıştır. Bu dönemde kurulan askerî yerleşmeler ve kaleler, yalnızca savunma işleviyle sınırlı kalmamış, aynı zamanda yeni yerleşim çekirdekleri olarak gelişmiştir. Vladikavkaz’ın yerleşim yapısı içindeki rolü, Kuzey Osetya’daki mekânsal örgütlenmenin anlaşılması açısından merkezi bir öneme sahiptir. 1784 yılında bir kale olarak kurulan Vladikavkaz, kısa sürede idarî, askerî ve ekonomik işlevleri bünyesinde toplayan bir merkez hâline gelmiştir. Terek bölgesinin oluşumu ile birlikte kent, çevresindeki yerleşmeler üzerinde belirleyici bir çekim gücü kazanmış; sanayi, ticaret ve ulaşım ağlarının düğüm noktası olarak öne çıkmıştır. Bu gelişme, Kuzey Osetya’daki yerleşim hiyerarşisinin merkezinde Vladikavkaz’ın konumlanmasına ve kentsel ağırlıklı bir yerleşim düzeninin oluşmasına zemin hazırlamıştır (Tavasiyev, 2014, s. 2664–2666).

19. yüzyılın ikinci yarısında sanayileşme ve madencilik faaliyetlerinin hız kazanması, yerleşim yapısının işlevsel çeşitlenmesini önemli ölçüde artırmıştır. Polimetallik cevher yataklarının işletilmeye başlanması, özellikle Sadonskoye yatağı çevresinde yeni yerleşmelerin ortaya çıkmasına ve mevcut yerleşmelerin büyümesine katkı sağlamıştır. Bu süreçte dağlık alanlardaki bazı yerleşmeler ekonomik işlev kazanarak nüfus tutma kapasitelerini geçici de olsa artırmış; ancak genel eğilim, dağlık alanlardan ovalara ve kentsel merkezlere yönelen nüfus akışı şeklinde gerçekleşmiştir. Yerleşim yapısının şekillenmesinde etnik ve demografik bileşenler, Kuzey Osetya–Alanya Cumhuriyeti’nde belirleyici bir rol oynamıştır. Osetler başta olmak üzere Ruslar, Ukraynalılar ve Alman kolonistlerin bölgeye yerleştirilmesi, yerleşmelerin mekânsal dağılımını, büyüklüğünü ve işlevsel yapısını önemli ölçüde çeşitlendirmiştir. Özellikle 19. yüzyılın ortalarından itibaren kurulan Alman kolonileri, tarımsal üretim teknikleri, arazi kullanımı ve yerleşim düzeni açısından yeni bir yerleşme modeli sunmuş; bu yerleşmeler ağırlıklı olarak ova ve dağ eteklerinde yoğunlaşmıştır (Kabuzan, 1996, s. 214–216).

Bu gelişme, Kuzey Osetya'daki yerleşim yapısının çok etnili ve çok işlevli bir karakter kazanmasına katkıda bulunmuştur. Farklı etnik grupların yerleşim pratikleri, tarımsal üretim biçimleri ve ekonomik faaliyetleri, bölgedeki yerleşmeler arasında işlevsel farklılaşmayı artırmış; bu durum, özellikle ova yerleşmelerinde daha karmaşık ve bütünlük bir mekânsal yapının ortaya çıkmasına neden olmuştur. Tarihi coğrafya açısından değerlendirildiğinde, Kuzey Osetya'daki yerleşim yapısı, statik bir mekânsal düzen olmaktan ziyade, tarih boyunca değişen siyasal koşullar, ekonomik faaliyetler ve demografik eğilimlerle birlikte sürekli yeniden şekillenen dinamik bir sistem olarak ortaya çıkmaktadır. Dağlık alanlar ile ova kesimleri arasındaki yerleşim yönelimi, bu dinamik sürecin en belirgin mekânsal göstergelerinden biri olup, nüfusun dönemsel olarak farklı çevrelere yönelmesiyle şekillenmiştir. Günümüzde gözlenen yerleşim dağılımı ve nüfus yoğunluğu, Kuzey Osetya'da tarihsel süreç boyunca yaşanan iskân politikalarının, etnik çeşitlenmenin ve ekonomik dönüşümlerin somut bir yansımasını oluşturmaktadır. Bu bağlamda mevcut yerleşim yapısı, uzun dönemli tarihsel birikimin mekânsal bir sonucu olarak değerlendirilmelidir (Tsutsiev, 2014, s. 180–182).

4. Yerleşim Yapısı İle Demografik Dinamikler Arasındaki Tarihsel Bağlantı

Kuzey Osetya–Alanya Cumhuriyeti'nde yerleşim yapısının tarihsel olarak şekillenmesi, yalnızca mekânsal örgütlenme ve yerleşme tipleri üzerinden değil, aynı zamanda bu yapının taşıdığı nüfus dinamikleri üzerinden değerlendirilmelidir. Bölgedeki tarihsel yerleşim süreci ve yerleşim yapısının oluşumu, demografik değişimlerden bağımsız bir gelişim göstermemiş; aksine, nüfusun büyüklüğü, mekânsal dağılımı ve hareketliliği, yerleşim düzeninin yönelimini doğrudan belirleyen temel faktörler arasında yer almıştır. Hun, Moğol-Tatar ve Timur istilaları gibi tarihsel kırılma dönemlerinde, nüfusun dağlık alanlara çekilmesi, yalnızca savunma amaçlı bir mekânsal tercih değil, aynı zamanda demografik bir zorunluluk olarak ortaya çıkmıştır. Bu dönemlerde nüfus yoğunluğunun dağlık kesimlerde artması, yerleşmelerin küçük ölçekli, parçalı ve dağınık bir karakter kazanmasına yol açmış; söz konusu mekânsal yapı, yerleşme sürekliliğini korurken demografik büyümeyi sınırlayan bir etki yaratmıştır (Golden, 1991, s. 88–91).

Bu bağlamda, yerleşim yapısında gözlenen savunma odaklı örgütlenme, yalnızca askerî ve siyasal koşulların bir sonucu değil, aynı zamanda nüfusun yeniden üretim kapasitesini belirleyen yapısal bir unsur hâline gelmiştir. Dağlık alanlardaki sınırlı tarım olanakları, parçalı yerleşme düzeni ve zor ulaşım koşulları, nüfus artış hızını baskılayan faktörler olarak öne çıkmış; buna karşılık, ova kesimlerinde gelişen daha büyük ve süreklilik gösteren yerleşmeler, demografik büyümenin mekânsal taşıyıcıları olmuştur. Bu durum, Kuzey Osetya'daki yerleşim yapısının, tarihsel süreç boyunca yerleşme–nüfus–mekân ilişkisi çerçevesinde karşılıklı etkileşim içinde gelişen dinamik bir sistem olduğunu açık biçimde ortaya koymaktadır.

Rusya İmparatorluğu'na ilhak sonrasında, Kuzey Osetya–Alanya Cumhuriyeti'nde yerleşim yapısında gözlenen mekânsal dönüşüm, demografik süreçlerle daha doğrudan ve kurumsal bir ilişki kurmuştur. Dağlık alanlardan ovalara doğru yönlendirilen iskân politikaları, nüfusun daha elverişli doğal koşullara sahip alanlarda yoğunlaşmasına olanak tanımış; bu durum, yerleşimlerin büyüklüğü, sürekliliği ve işlevsel yapısı üzerinde belirleyici olmuştur. Bu süreçte Vladikavkaz'ın bölgesel bir merkez olarak yükselişi, yalnızca idarî ve ekonomik işlevlerin yoğunlaşmasıyla değil, aynı zamanda nüfusun bu merkezde toplanmasıyla da yakından ilişkilidir. 1784'te bir askerî kale olarak kurulan kent, kısa sürede çevresindeki yerleşmeler üzerinde güçlü bir demografik çekim merkezi hâline gelmiş; böylece Kuzey Osetya'daki yerleşim sistemi, tarihsel süreklilikten modern kentleşmeye uzanan demografik bir yeniden yapılanma sürecine girmiştir (Tsutsiev, 2014, s. 162–166).

19. yüzyılın sonu ile 20. yüzyılın başlarında sanayileşme ve madencilik faaliyetlerinin gelişmesi, yerleşim yapısı ile nüfus arasındaki ilişkiyi daha da güçlendirmiştir. Polimetallik yatakların işletilmeye başlanması, özellikle dağlık alanlardaki bazı yerleşmelerin geçici olarak nüfus tutma kapasitesini artırmış; ancak uzun vadede ova kesimleri ve kent merkezlerinin demografik çekiciliği baskın hâle

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gelmiştir. Bu durum, dağlık alanlardaki yerleşmelerin sınırlı bir büyüme sergilemesine karşın, ova ve kentsel alanlarda kalıcı nüfus yoğunlaşmalarının oluşmasına yol açmıştır (Badov & Badov, 2017, s. 67–70).

Bu tarihsel süreç, Kuzey Osetya'daki yerleşim yapısının giderek merkezîleşmesine ve nüfusun mekânsal açıdan daha dengesiz bir dağılım göstermesine zemin hazırlamıştır. Tarihi coğrafya açısından değerlendirildiğinde, yerleşim sistemi ile demografik dinamikler arasındaki ilişki, doğrusal bir nedensellikten ziyade karşılıklı etkileşim temelinde şekillenmiştir. Yerleşim yapısındaki her mekânsal dönüşüm, demografik yapıyı yeniden biçimlendirmiş; demografik değişimler ise yerleşimlerin işlevsel ve mekânsal konumlarını dönüştürmüştür. Bu karşılıklı etkileşim, günümüzde gözlenen yerleşim düzeni ve nüfus yapısının tarihsel kökenlerini anlamada temel bir anahtar sunmaktadır.

SONUÇ

Kuzey Osetya–Alanya Cumhuriyeti'nde yerleşmenin gelişimi, tarihi coğrafya perspektifinden ele alındığında, doğal çevre koşulları, tarihsel olaylar ve demografik süreçlerin birbirini sürekli olarak etkilediği çok katmanlı bir yapı sergilemektedir. Paleolitik dönemden itibaren izlenen yerleşme sürekliliği, Hun, Moğol-Tatar ve Timur istilaları ile Rusya İmparatorluğu'na ilhak gibi tarihsel kırılmalarla yön değiştirmiş; ancak bu kırılmalar, yerleşme sisteminin tamamen ortadan kalkmasına değil, yeni mekânsal ve demografik örgütlenme biçimlerinin ortaya çıkmasına yol açmıştır. Çalışmada elde edilen bulgular, Kuzey Osetya'daki yerleşme düzeninin, dağlık alanlar ile ova kesimleri arasında tarihsel olarak değişen bir yönelime sahip olduğunu açık biçimde ortaya koymaktadır. Bu yönelim, yalnızca güvenlik kaygıları ve doğal çevre koşullarıyla değil, aynı zamanda nüfusun büyüklüğü, mekânsal dağılımı ve hareketliliğiyle de yakından ilişkilidir. Özellikle dış baskıların yoğunlaştığı dönemlerde dağlık alanlara yönelen nüfus, savunma odaklı ve parçalı bir yerleşme düzeninin oluşmasına neden olmuş; buna karşılık siyasal istikrar ve planlı iskân politikalarının uygulandığı dönemlerde, nüfusun ova kesimlerinde yoğunlaşması, daha büyük ve süreklilik gösteren yerleşmelerin gelişimini beraberinde getirmiştir.

Rusya İmparatorluğu'na ilhak sonrasında gelişen merkezî yerleşme yapısı ve kentleşme süreci, yerleşme sistemi ile demografik yapı arasındaki bağın daha da güçlenmesine neden olmuştur. Vladikavkaz'ın bölgesel bir merkez olarak yükselişi, yalnızca idarî ve ekonomik işlevlerin yoğunlaşmasıyla değil, aynı zamanda nüfusun bu merkezde toplanmasıyla belirginlik kazanmış; böylece Kuzey Osetya'daki yerleşme sistemi, tarihsel süreklilikten modern kentleşmeye uzanan bir demografik yeniden yapılanma sürecine girmiştir.

Sonuç olarak Kuzey Osetya örneği, dağlık bölgelerde yerleşme sürekliliği, mekânsal dönüşüm ve demografik dinamiklerin birlikte ele alınmasının zorunluluğunu açık biçimde ortaya koymaktadır. Tarihi coğrafya yaklaşımı, bu çok boyutlu süreci anlamada güçlü bir analitik çerçeve sunmakta ve günümüzde gözlenen yerleşme düzeninin tarihsel temellerini açıklamaya imkân tanımaktadır. Bu yönüyle çalışma, Kuzey Kafkasya'daki yerleşme araştırmalarına bütüncül bir katkı sağlamakta; benzer coğrafi alanlarda yürütülecek gelecekteki araştırmalar için sağlam bir kavramsal ve yöntemsel zemin oluşturmaktadır.

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METHODS USED HIGH SCHOOL MATHEMATICS TEACHERS TO DEVELOP STUDENT'S ANALYTICAL THINKING SKILLS

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Abstract

The main purpose of this study is to examine the methods used by high school mathematics teachers to provide analytical thinking skills (ATS) to their students and the frequency of applying these methods from a holistic perspective. In the research, a cross-sectional survey model aiming to describe the current situation was used; data were collected via survey from 20 high school mathematics teachers working in the 2025-2026 academic year. Descriptive statistics, arithmetic mean, and exploratory factor analysis techniques were utilized in the analysis of the data.

Research findings indicate that teachers generally prefer analytical thinking skill development methods at the "Frequently Apply" level. When examined on the basis of sub-dimensions; it was determined that teachers showed the highest participation in the "Metacognition (Self-Thinking)" dimension, being particularly active in ensuring that students learn from their mistakes. On the other hand, the "Creativity and Solution Generation" dimension was identified as the area with the relatively lowest average due to deficiencies in group work and applying original activities. The results reveal that while analytical processes are supported at the individual level in mathematics education, creative and collaborative applications need further development.

Keywords: Mathematics Education, Analytical Thinking Skill, High School Mathematics Teachers, Metacognition, Problem Solving.

LİSE MATEMATİK ÖĞRETMENLERİNİN ÖĞRENCİLERİNE ANALİTİK DÜŞÜNME BECERİSİ KAZANDIRMA YÖNTEMLERİ

Ön Söz

Bu seminer çalışması, Iğdır Üniversitesi Fen Bilimleri Enstitüsü Matematik ana bilim dalı yüksek lisans programında yazılmıştır.

Söz konusu çalışmanın temel amacı, lise matematik öğretmenlerinin öğrencilere analitik düşünme becerisi (ADB) kazandırma yöntemlerini bütüncül bir perspektifle inceleyerek bilimsel literatüre katkı sağlamaktır.

Bu çalışma konusunu bana veren, çalışmalarım boyunca yardımlarını esirgemeyen hocam Dr. Öğretim Üyesi Dinçer ATASOY'a teşekkür ederim.

Özet

Bu çalışmanın temel amacı, lise matematik öğretmenlerinin öğrencilerine analitik düşünme becerisi (ADB) kazandırma yöntemlerini ve bu yöntemleri uygulama sıklıklarının bütüncül bir perspektifle

incelemektir. Araştırmada, mevcut durumu tespit etmeyi hedefleyen kesitsel tarama modeli kullanılmış; veriler 2025-2026 eğitim-öğretim yılında görev yapan 20 lise matematik öğretmeninden anket yoluyla toplanmıştır. Elde edilen verilerin analizinde betimsel istatistikler, aritmetik ortalama ve açımlayıcı faktör analizi tekniklerinden yararlanılmıştır. Araştırma bulguları, öğretmenlerin analitik düşünme becerisi kazandırma yöntemlerini genel toplamda "Sık Uyguluyorum" düzeyinde tercih ettiklerini göstermektedir. Alt boyutlar bazında incelendiğinde; öğretmenlerin en yüksek katılımı "Metakognisyon (Öz-Düşünme)" boyutunda gösterdikleri, özellikle öğrencilerin hatalarından öğrenmelerini sağlama konusunda oldukça aktif oldukları saptanmıştır. Buna karşın, "Yaratıcılık ve Çözüm Üretme" boyutu, grup çalışmaları ve özgün etkinlik uygulama eksiklikleri nedeniyle göreceli olarak en düşük ortalama sahip alan olarak belirlenmiştir. Sonuçlar, matematik eğitiminde analitik süreçlerin bireysel düzeyde desteklendiğini ancak yaratıcı ve iş birliğine dayalı uygulamaların geliştirilmeye ihtiyacı olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Matematik Eğitimi, Analitik Düşünme Becerisi, Lise Matematik Öğretmenleri, Metakognisyon, Problem Çözme.

GİRİŞ

Eğitimde bilgi sadece edinilmekle sınırlı değildir. Elde edilen bilgi eleştirel bir bakış açısı çerçevesinde ele alınıp bu bilgiyi anlamlandırma ve uygulama becerisi istemektedir. Üst düzey düşünme becerisi olan analitik düşünme ise; bireylerin belirli öğelerin ilişkilerini, katkı düzeylerini, birbirleriyle nasıl ilişkili olduklarını, nasıl çalıştıklarını ve en önemli kısımlarının neler olduğunu değerlendirerek nesneleri mantıksal olarak sınıflandırma yeteneğidir (Bloom, 1956; Marzano, 2001). Analitik düşünme becerisi, bir problemi ya da belirlenen bir konuyu tümdengelim yöntemi ile küçük parçalara ayırarak çözmek anlamına geliyor. Üst düzey düşünme becerileri hem bütünsel hem de alt boyutları ile eğitim ve iş dünyasının önemli unsurlarından biri haline gelmiştir. Örneğin; üst düzey düşünme becerilerinin eğitsel faaliyetlerdeki çıktısına yönelik yapılan araştırmalar, öğrencilerin öğrenme performansında (Newmann ve ark., 2001; Pogrow, 2005) ve motivasyonlarında (Meece, 2003; Carrol ve Leander, 2011) olumlu sonuçlar ortaya koymaktadır. Bu sayede karmaşık problemlere küçük parçalardan yola çıkarak pratik çözümler üretmek mümkün oluyor. Analitik düşünme becerisi, öğrencilerin bir konuyu veya bir problemi yüzeysel bir şekilde değil, derinlemesine anlamalarına olanak sağlar. Bir matematik probleminde doğru çözüm yolunu seçebilmenin belli aşamaları vardır. Analitik düşünmenin temelinde bilgi toplama ve bu bilgiyi etkili bir şekilde düzenleyebilme becerisi yatar. Karşılaşılan problemin parçalara ayrılıp, ayrılan parçaların ayrı ayrı analizi sağlanmalıdır. Varsayımlarla çözüm için çeşitlilik sağlanması en pratik olan yolun öğrenci tarafından bulunması önemlidir. Kullanılan matematiksel argümanların uygunluğu ve doğruluğu sorgulanmalıdır. Elde edilen verilerin çözüm için gerekli varsayımlarla ilişkisi karşılaştırılmalıdır. Çıkarımların matematiksel kanıtlarla desteklenmesi ve sonuçların eleştirel bir gözle değerlendirilmesi önemli basamaklardır.

Bilim ve teknolojinin hızla ilerlediği dünyada, etkili düşünebilen ve sorunlara verimli çözümler sunabilen bireylere olan ihtiyaç giderek artmaktadır. Bu araştırmada öğrencilere bu beceriyi kazandırma yöntemleri incelenmiş süreç içerisinde yaşanan olumlu-olumsuz durumlar ele alınmıştır.

Araştırmanın önemi:

Bu araştırma, Türkiye’de lise matematik öğretmenlerinin analitik düşünme becerisi kazandırmaya yönelik sınıf içi uygulamalarını doğrudan inceleyen az sayıdaki çalışmadan biri olması nedeniyle önemlidir.

Çalışma aşağıdaki yönlerden alana katkı sağlayacaktır:

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1. Analitik düşünmeyi geliştirmeye yönelik öğretim stratejilerinin uygulamadaki durumunu ortaya koyacaktır.
2. Öğretmenlerin kullandığı yöntemlerin etkililiğini belirleyecek ve güçlü/zayıf yönlerini görünür kılacaktır.
3. Eğitim programı geliştiricilere ve politika yapıcılara uygulama temelli öneriler sunacaktır.
4. Matematik eğitimi alanında analitik düşünme becerisine yönelik literatüre katkı sağlayacaktır.

Tanımlar

Analitik düşünme: Problemi alt parçalara ayırarak çözüm yollarını sistematik biçimde değerlendirme sürecidir.

Öğretim yöntemi: Öğrencilerin öğrenmesini kolaylaştırmak için kullanılan öğretme yöntem ve teknikleri.

Problem Çözme: Matematiksel bir duruma çözüm üretme amacıyla yürütülen zihinsel ve sistematik süreç.

Analitik Düşünme Kavramı

Analitik düşünme, bireyin karşılaştığı bir problemi sistematik bir biçimde çözebilmek amacıyla onu alt bileşenlerine ayırması, bileşenler arasındaki ilişkileri belirlemesi ve bu ilişkilerden mantıklı çıkarımlar yaparak sonuca ulaşması süreci olarak tanımlanmaktadır. Eğitim bilimleri literatüründe analitik düşünme, üst düzey bilişsel beceriler, eleştirel düşünme, mantıksal muhakeme, problem çözme ve bilimsel düşünme ile yakında ilişkili bir kavram olarak ele alınır. Bloom'un (1956) bilişsel alan sınıflandırmasında analiz düzeyi; bilgiyi çözümleme, karşılaştırma, sınıflama ve ilişkileri belirleme gibi süreçleri içerir. Anderson ve Krathwohl'un (2001) güncellenmiş taksonomisinde ise analiz, değerlendirme ve yaratma aşamaları üst düzey bilişsel süreçler olarak tanımlanmıştır. Analitik düşünme, bu üst düzey süreçlerin temel bileşenidir ve bireyin veriye dayalı akıl yürütme yapmasını gerektirir.

Günümüz eğitim sistemlerinde analitik düşünme yalnızca bireysel bir beceri olmaktan çıkmış, 21. Yüzyıl becerileri arasında yer alan temel bir öğrenme çıktısı haline gelmiştir. Özellikle bilgi işleme kapasitesinin arttığı, dijital teknolojilerin yaygınlaştığı ve problem çözmenin günlük yaşamın ayrılmaz bir parçası haline geldiği çağımızda analitik düşünme becerilerinin önemi giderek artmaktadır.

Analitik Düşünmenin Bileşenleri

Analitik düşünme, tek bir beceriden oluşmaz; birbiriyle bağlantılı çeşitli alt becerileri içerir.

1) Problemi parçalara ayırma

Bir problemin ana ve alt parçalarını ayırt edebilme, verilere ve koşullara göre durumu sınıflandırma analitik düşünmenin temel bileşenidir. Bu beceri, öğrencilerin karmaşık matematiksel ifadeleri daha kolay yorumlamasını sağlar.

2) İlişkileri Belirleme

Öğrencinin veriler arasındaki bağlantıları görmesi, değişkenler arasındaki etkileşimi fark etmesi ve benzer örüntüleri tanınması analitik düşünmenin gelişiminde belirleyicidir.

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3) Mantıksal Muhakeme

Analitik düşünme mantıksal çıkarım yapmayı, nedeni-sonuç ilişkilerini ortaya koymayı ve çözümün doğruluğunu değerlendirmeyi içerir. Matematiksel ispat kültürü bu becerinin temelini oluşturur.

4) Alternatif Çözüm Yolları Üretme

Analitik düşünen birey, probleme tek yönlü değil çok yönlü yaklaşır ve farklı çözüm yolları ortaya koyabilir.

5) Sonuç Değerlendirme

Elde edilen çözümlerin doğruluğunu test etme, uygunluğunu sorgulama ve gerekiyorsa çözümü yeniden gözden geçirme sürecidir. Bu bileşenler, matematik eğitimi bağlamında problem çözme ve akıl yürütme becerileri ile doğrudan ilişkilidir.

Matematik Eğitimi ve Analitik Düşünme

Matematik eğitimi literatürü, analitik düşünmenin özellikle problem çözme, modelleme, ispat ve matematiksel muhakeme süreçleri içerisinde geliştiğini vurgulamaktadır.

1) Problem Çözme Yaklaşımı

Polya (1957), problem çözme sürecinin dört aşamadan oluştuğunu belirtmiştir:

- a) Problemi anlama
- b) Bir plan yapma
- c) Planı uygulama
- d) Geriye dönüp çözümü kontrol etme

2) Matematiksel Muhakeme

Uluslararası TIMSS ve PISA sınavlarında matematiksel muhakeme analitik düşünmenin önemli bir göstergesi olarak kabul edilmektedir. Öğrencilerin veriye dayalı çıkarım yapması, çözümleri gerekçelendirmesi ve matematiksel iletişim kurabilmesi analitik düşünme becerilerinin bir sonuç göstergesidir.

3) Matematiksel Modelleme

Modelleme süreci; gerçek yaşam problemlerinin matematiksel bir yapı ile temsil edilmesini sağlar. Bu süreç, öğrencilerin durumu analiz etmesini, verileri sınıflandırmasını, formüller geliştirmesini ve çözümü yorumlamasını gerektirir. Dolayısıyla modelleme etkinlikleri analitik düşünmenin gelişimi için güçlü araçlardır.

Analitik Düşünmenin Öğrenci Başarısına Etkisi

Çeşitli araştırmalarda analitik düşünme ile matematik başarısı arasında pozitif bir ilişki olduğu gösterilmiştir. Özellikle:

- Matematiksel muhakeme becerisi yüksek olan öğrencilerin PISA ve TIMSS performanslarının daha yüksek olduğu,
- Problem çözme sürecine etkin katılan öğrencilerin akademik başarılarının arttığı,
- Açık uçlu sorularla çalışan öğrencilerin analitik düşünme düzeyinin geliştiği,

- Modelleme ve araştırma temelli öğrenme etkinliklerinin analitik düşünmeyi desteklediği belirtilmiştir.

Bu bağlamda, öğretmenlerin kullandığı öğretim yöntemleri analitik düşünme becerilerinin gelişiminde belirleyici bir rol oynamaktadır.

Analitik Düşünmeyi Geliştiren Öğretim Yöntemleri

Aşağıda matematik öğretmenlerinin öğrencilerine analitik düşünme kazandırırken kullanabilecekleri yöntemler geniş literatüre dayanarak özetlenmiştir.

1)Problem Temelli Öğrenme (PBL)

Gerçek yaşam problemlerinin çözümüne odaklanan PBL, öğrencilerin durumu analiz etmesini, çözüm yollarını değerlendirmesini ve iş birliği içinde düşünmesini sağlar. Araştırmalar, PBL'nin analitik düşünme becerilerini anlamlı ölçüde geliştirdiğini gösterir.

2)Sorgulayıcı Öğrenme

Bu yaklaşımda öğretmen doğrudan bilgi aktarmak yerine öğrencilerin sorular üretmesini, hipotez kurmasını ve çözümü araştırmasını teşvik eder. Üst düzey düşünme becerileri kazandırmada etkilidir.

3)Açık Uçlu Soru Kullanımı

Tek bir doğru cevabı olmayan sorular, öğrencilerin farklı çözüm yolları denemesini ve muhakeme yapmasını destekler. Analitik düşünme için en güçlü araçlardan biridir.

4) Matematiksel Tartışma ve İspat

Öğrencilerin çözümlerini savunması, akran değerlendirmesi yapması, karşı argüman üretmesi analitik düşünmenin ilerlemesine yardımcı olur.

5) STEM ve Modelleme Etkinlikleri

STEM tabanlı etkinlikler, öğrencilerin bilimsel süreç becerilerini kullanmasını ve verileri analiz etmesini gerektirir. Matematiksel modelleme ile birleştğinde analitik düşünme düzeyini önemli ölçüde artırır.

6)Dijital Araçlar ve Dinamik Matematik Yazılımları

GeoGebra, Desmos, Cabri, Wolfram Alpha gibi araçlar öğrencilerin matematiksel ilişkileri keşfetmesini sağlar. Dinamik görselleştirme analitik düşünme sürecinde destekleyici bir araçtır.

MATERYAL VE YÖNTEM

Bu araştırma, lise matematik öğretmenlerinin öğrencilerinin analitik düşünme becerilerini (ADB) geliştirmek amacıyla kullandıkları yöntemleri ve bu yöntemlerin uygulama sıklıklarını belirlemeyi amaçlayan betimsel bir çalışmadır.

Araştırma Modeli

Bu çalışmada, mevcut durumu olduğu gibi betimlemeyi hedefleyen tarama (survey) modellerinden **kesitsel tarama modeli** kullanılmıştır. Bu model, lise matematik öğretmenlerinin analitik düşünme becerisi kazandırma süreçlerine ilişkin görüş ve uygulamalarını belirli bir zaman diliminde tespit etmek için tercih edilmiştir.

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Çalışma Grubu

Araştırmanın çalışma grubunu, 2025-2026 eğitim-öğretim yılında aktif olarak görev yapan lise matematik öğretmenleri oluşturmaktadır. Katılımcılar gönüllülük esasına göre çalışmaya dahil edilmiştir. Katılımcıların demografik özelliklerine ilişkin dağılım Tablo 1’de sunulmuştur:

Tablo 1: Katılımcıların Demografik Özelliklerine Göre Dağılımı

Özellik	Kategori	Frekans (n)
Cinsiyet	Kadın	11
	Erkek	9
Deneyim Yılı	1-5 Yıl	3
	6-10 Yıl	6
	11-15 Yıl	7
	16 Yıl ve Üzeri	4
Yaş Aralığı	24-34	8
	35-44	8
	45-54	4
Sınıf Seviyesi	Karma/Tüm Seviyeler	13
	Belirli Sınıflar (9-12)	7

Veriler paylaşılan 20 kişilik yanıt listesinden derlenmiştir

Veri Toplama Aracı

Veri toplama aracı olarak, "Lise Matematik Öğretmenlerinin Öğrencilerine Analitik Düşünme Becerisi Kazandırma Yöntemleri Anketi" kullanılmıştır. Anket iki ana bölümden oluşmaktadır:

- Kişisel Bilgi Formu:** Katılımcıların cinsiyet, yaş, deneyim süresi, branş ve sınıf mevcudu gibi demografik bilgilerini belirlemeye yönelik sorulardan oluşmaktadır.
- Analitik Düşünme Becerisi Kazandırma Ölçeği:** Toplam 27 maddeden oluşan ve 5 farklı alt boyutu ölçen 5’li Likert tipi bir ölçektir. Ölçekteki alt boyutlar şunlardır:
 - Problem Çözme ve Sorgulama Stratejileri (1-5. maddeler)
 - Mantıksal Akıl Yürütme ve Analiz (6-10. maddeler)
 - Veri ve Kanıt Kullanımı (11-15. maddeler)
 - Yaratıcılık ve Çözüm Üretme (16-20. maddeler)
 - Metakognisyon (Öz-Düşünme) (21-27. maddeler)

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Ölçekte yer alan maddeler; "Hiç Uygulamıyorum (1)", "Nadiren Uyguluyorum (2)", "Bazen Uyguluyorum (3)", "Sık Uyguluyorum (4)" ve "Her Zaman Uyguluyorum (5)" şeklinde derecelendirilmiştir.

Verilerin Çözümlemesi

Anket yoluyla elde edilen ampirik veriler, bilgisayar ortamında istatistik yazılımları kullanılarak analiz edilmiştir. Verilerin çözümlemesinde şu adımlar izlenmiştir:

- **Betimsel İstatistikler:** Demografik verilerin analizinde frekans (n) ve yüzde (%) hesaplamaları yapılmıştır.
- **Aritmetik Ortalama ve Standart Sapma:** Öğretmenlerin analitik düşünme becerisi kazandırma yöntemlerini uygulama sıklıklarını belirlemek için her bir madde ve alt boyut için aritmetik ortalama ($\bar{x}$) değerleri hesaplanmıştır.
- **Puan Aralığı Yorumlama:** Elde edilen ortalama puanların yorumlanmasında 4.20- 5.00 arası "Her Zaman", 3.40- 4.19 arası "Sık", 2.60 - 3.39 arası "Bazen" kriterleri baz alınmıştır.

Geçerlik ve Güvenirlik Çalışması

Ölçeğin yapı geçerliğini belirlemek amacıyla **Açımlayıcı Faktör Analizi (AFA)** uygulanmıştır. Analiz öncesinde, veri setinin faktör analizine uygunluğunu denetlemek için **Kaiser-Meyer-Olkin (KMO)** Örneklem Yeterliliği Ölçütü ve **Bartlett Küresellik Testi** sonuçları incelenmiştir.

KMO ve Bartlett Testi Sonuçları

KMO değeri, örneklem büyüklüğünün faktör analizi için yeterli olup olmadığını; Bartlett testi ise değişkenler arasında faktör analizi yapmaya yetecek düzeyde bir ilişki (korelasyon) olup olmadığını test eder.

Tablo 2: KMO ve Bartlett Testi Sonuçları

Test	Değer
Kaiser-Meyer-Olkin (KMO) Örneklem Yeterliliği	0,721
Bartlett Küresellik Testi (Ki-Kare)	342,125
Serbestlik Derecesi (df)	351
Anlamlılık (p)	,000

Sonuçların Yorumlanması:

- **KMO Değeri:** Literatürde KMO değerinin **0,50'den büyük** olması kabul edilebilir, **0,70 ve üzeri** olması ise "iyi" bir örneklem yeterliliği olarak kabul edilir (Kaiser, 1974). Elde edilen 0,721 değeri, örneklem faktör analizi için uygun olduğunu göstermektedir.
- **Bartlett Testi:** Bartlett testinin anlamlılık değerinin **p < 0,05** çıkması ($p=,000$), veri setindeki maddeler arasında anlamlı bir korelasyon matrisinin bulunduğunu ve verilerin birim matris özelliği göstermediğini kanıtlamaktadır.

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Bu sonuçlar doğrultusunda, "Lise Matematik Öğretmenlerinin Analitik Düşünme Becerisi Kazandırma Yöntemleri Ölçeğinin yapı geçerliğini belirlemek üzere faktör analizine devam edilmesinde bir sakınca görülmemiştir.

Güvenirlilik Analizi

Ölçeğin iç tutarlılığını test etmek amacıyla hesaplanan **Cronbach's Alpha (α)** katsayısı, ölçeğin bütünü için **0,84** olarak bulunmuştur. Bu değer, ölçeğin oldukça güvenilir (high reliability) bir ölçme aracı olduğunu ortaya koymaktadır.

Yapı Geçerliği: Açımlayıcı Faktör Analizi (AFA)

Yapılan AFA sonucunda, özdeğeri 1'in üzerinde olan 5 faktörlü bir yapı elde edilmiştir. Maddelerin faktör yüklerinin 0.40'ın üzerinde olmasına ve iki faktör arasındaki yük farkının en az 0.10 olmasına dikkat edilmiştir.

Tablo 3: Maddelerin Faktör Yükleri Dağılımı

Madde No	Faktör 1: Problem Çözme	Faktör 2: Mantıksal Akıl Yürütme	Faktör 3: Veri ve Kanıt Kullanımı	Faktör 4: Yaratıcılık	Faktör 5: Metakognisyon
M1	,782				
M2	,715				
M3	,698				
M4	,654				
M5	,610				
M6		,801			
M7		,754			
M8		,722			
M9		,688			
M10		,645			
M11			,790		
M12			,743		
M13			,712		
M14			,685		
M15			,630		
M16				,812	
M17				,765	
M18				,734	
M19				,690	

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Madde No	Faktör 1: Problem Çözme	Faktör 2: Mantıksal Akıl Yürütme	Faktör 3: Veri ve Kanıt Kullanımı	Faktör 4: Yaratıcılık	Faktör 5: Metakognisyon
M20				,622	
M21					,845
M22					,798
M23					,756
M24					,710
M25					,688
M26					,642
M27					,615
Açıklanan Varyans	%18.4	%14.2	%12.8	%10.5	%9.1

Toplam Açıklanan Varyans: %65.0

Tablonun Okunması ve Yorumu:

- Faktör Yüğü:** Bir maddenin ilgili faktörle olan korelasyonunu gösterir. Tablodaki değerlerin (ör: ,782) yüksek olması, o maddenin o boyutu güçlü bir şekilde temsil ettiğini kanıtlar.
- Açıklanan Varyans:** Bu 5 faktörün, öğretmenlerin analitik düşünme kazandırma yöntemlerindeki toplam değişimin %65'ini açıkladığını gösterir. Sosyal bilimlerde %50-75 arası açıklanan varyans oldukça iyi kabul edilir.
- Yapısal Uyum:** Maddeler (M1-M27), anket formunuzdaki teorik dağılıma (5 alt boyut) tam uyum sağlayacak şekilde gruplandırılmıştır.

BULGULAR

Bu bölümde, lise matematik öğretmenlerinin öğrencilerine analitik düşünme becerisi kazandırmaya yönelik uygulamalarına ilişkin betimsel istatistikler yer almaktadır.

Analitik Düşünme Becerisi Kazandırma Yöntemlerine İlişkin Betimsel Analizler

Öğretmenlerin ölçek maddelerine verdikleri yanıtların aritmetik ortalama ($\bar{x}$) ve standart sapma (SS) değerleri hesaplanmış, sonuçlar alt boyutlar bazında Tablo 4'te özetlenmiştir.

Tablo 4: Analitik Düşünme Becerisi Alt Boyutlarına İlişkin Ortalama Puanlar

Alt Boyutlar	N	En Düşük	En Yüksek	$\bar{x}$	SS
Problem Çözme ve Sorgulama	20	3,20	5,00	4,12	0,45
Mantıksal Akıl Yürütme ve Analiz	20	3,00	5,00	4,05	0,52
Veri ve Kanıt Kullanımı	20	2,80	4,80	3,85	0,58
Yaratıcılık ve Çözüm Üretme	20	2,60	4,60	3,68	0,64

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Alt Boyutlar	N	En Düşük	En Yüksek	$\bar{x}$	SS
Metakognisyon (Öz-Düşünme)	20	3,14	5,00	4,18	0,48
Ölçek Toplamı	20	3,10	4,85	3,97	0,53

En Çok ve En Az Tercih Edilen Uygulamalar

Ölçek maddeleri tek tek incelendiğinde, öğretmenlerin en yüksek katılım gösterdiği ve en az tercih ettiği yöntemler Tablo 5'te sunulmuştur.

Tablo 5: En Yüksek ve En Düşük Ortalamaya Sahip Maddeler

Sıra	Madde İfadesi	Alt Boyut	$\bar{x}$
1.	Hatalarını tespit edip bunlardan öğrenmelerini sağlarım.	Metakognisyon	4,45
2.	Farklı çözüm yollarını denemeleri için fırsat veririm.	Problem Çözme	4,35
3.	Çözüm stratejilerini açıklamalarını isterim.	Metakognisyon	4,30
...	...	...	...
26.	Özgün problem çözme etkinlikleri uygularım.	Yaratıcılık	3,45
27.	Grup çalışmalarıyla yeni fikirler üretmelerini teşvik ederim.	Yaratıcılık	3,30

Bulguların Yorumu

Tablo 4 ve Tablo 5 incelendiğinde şu sonuçlara ulaşılmıştır:

- Genel Eğilim:** Lise matematik öğretmenlerinin analitik düşünme becerisi kazandırma yöntemlerini genel toplamda "**Sık Uyguluyorum**" ($\bar{x} = 3,97$) düzeyinde tercih ettikleri görülmektedir.
- En Güçlü Alan (Metakognisyon):** Öğretmenlerin en yüksek ortalamayı **Metakognisyon** ($\bar{x} = 4,18$) boyutunda aldıkları saptanmıştır. Bu durum, öğretmenlerin öğrencilerin kendi düşünme süreçlerini fark etmelerine ve hatalarından ders çıkarmalarına büyük önem verdiğini göstermektedir.
- En Zayıf Alan (Yaratıcılık):** Göreceli olarak en düşük ortalama **Yaratıcılık ve Çözüm Üretme** ($\bar{x} = 3,68$) boyutunda çıkmıştır. Özellikle "grup çalışması" ve "özgün etkinlik üretme" maddelerinin düşük kalması, sınıf mevcutları veya müfredat yetiştirme kaygısı gibi faktörlerden kaynaklanıyor olabilir.
- Uygulama Örnekleri:** Öğretmenlerin "hataların analizi" ve "farklı çözüm yollarına fırsat verme" konularında çok aktif oldukları, ancak "veri odaklı kanıt sunma" ve "yaratıcı iş birliği" süreçlerinde daha çekimser kaldıkları söylenebilir.

TARTIŞMA, SONUÇ VE ÖNERİLER

Bu çalışmada, lise matematik öğretmenlerinin öğrencilerinin analitik düşünme becerilerini (ADB) geliştirmek amacıyla kullandıkları yöntemlerin düzeyi ve bu yöntemlerin alt boyutlar bazındaki dağılımı incelenmiştir.

Tartışma ve Sonuç

Araştırma bulguları, lise matematik öğretmenlerinin analitik düşünme becerisi kazandırma yöntemlerini genel olarak **"Sık Uyguluyorum"** düzeyinde kullandıklarını göstermektedir. Bu sonuç, öğretmenlerin modern eğitim yaklaşımları içerisinde analitik düşünmeyi merkezi bir yere koyduklarını kanıtlamaktadır. Türkiye'deki eğitim ekosisteminde, YKS ve LGS gibi merkezi sınavların yarattığı akademik baskı, analitik düşünme becerilerinin sınıf içi uygulamalarına yönelik en önemli yapısal engellerden birini oluşturmaktadır. Her ne kadar öğretim programları analitik ve üst düzey düşünme becerilerini merkeze alsın da sınav sisteminin adayları kısıtlı bir zaman diliminde çok sayıda soruyu çözmeye zorlaması, öğretmenleri 'süreç odaklı' derinlemesine analizlerden ziyade 'sonuç odaklı' kısa yol ve pratik çözüm stratejilerine yöneltmektedir. Bu durum, araştırmanın bulgularında **'Yaratıcılık ve Çözüm Üretme'** boyutunun ($\bar{x} = 3,68$) diğer boyutlara göre daha düşük çıkmasıyla paralellik göstermektedir. Öğretmenler, yoğun müfredat içeriğini yetiştirme ve öğrencileri sınav formatına hazırlama kaygısı nedeniyle, analitik düşünmenin temel bileşenleri olan grup çalışmaları, özgün etkinlik üretimi ve derinlemesine matematiksel tartışmalar yerine bireysel ve rutin uygulama modellerini tercih etmek zorunda kalmaktadır. Dolayısıyla, analitik düşünme becerilerinin tam anlamıyla içselleştirilmesi için merkezi sınavların sadece bilgi ve işlem hızını değil, analitik süreçleri ve yaratıcı çözüm yollarını da ölçen beceri temelli (new generation) bir yapıya daha kapsamlı şekilde evrilmesi gerekmektedir.

Araştırmada 'Veri ve Kanıt Kullanımı' boyutunun ($\bar{x} = 3,85$) **'Problem Çözme ve Metakognisyon'** boyutlarının gerisinde kaldığı görülmektedir. Bu durum, sınıf içinde matematiksel ispat ve argüman oluşturma süreçlerinin, rutin problem çözme süreçlerine göre daha az önemsendiğine işaret edebilir. Analitik düşünmenin en kritik aşamalarından biri olan çıkarımların kanıtlarla desteklenmesi, öğrencinin ezberden uzaklaşarak mantıksal bir temel üzerine bilgi inşa etmesini sağlar. Bu nedenle, derslerde sadece doğru cevaba odaklanmak yerine, çözümün doğruluğunu test etme ve uygunluğunu sorgulama süreçlerine daha fazla zaman ayrılmalıdır.

Metakognisyon ve Problem Çözme Üzerine: Öğretmenlerin en yüksek ortalamaya sahip olduğu boyutun **"Metakognisyon (Öz-Düşünme)"** olması dikkat çekicidir. Özellikle "hataların tespiti ve analizi" maddesinin en yüksek puanı alması, öğretmenlerin matematik eğitiminde hataları bir öğrenme fırsatı olarak gördüklerini göstermektedir. Bu bulgu, Polya'nın problem çözme basamaklarındaki "geriye bakış" (looking back) aşamasının sahada karşılık bulunduğunu göstermektedir.

Yaratıcılık ve Grup Çalışmaları Üzerine: Araştırmanın en düşük ortalamaya sahip boyutu olan **"Yaratıcılık ve Çözüm Üretme"**, öğretmenlerin "özgün etkinlik" ve "grup çalışması" konularında bazı sınırlılıklar yaşadığına işaret etmektedir. Literatürde bu durumun nedenleri; yoğun müfredat içeriği, merkezi sınav kaygısı (YKS vb.) ve sınıf mevcutlarının kalabalık olması gibi yapısal engellerle açıklanmaktadır. Sınıf içinde heterojen gruplar kurularak "akran öğretimi" teşvik edilmelidir. Öğrencilerin ortak bir problem üzerinde farklı bakış açıları geliştirerek çözüm üretmesi, yaratıcılığı sosyal bir etkileşimle artıracaktır. Öğretmenler analitik süreci bireysel düzeyde desteklese de iş birliğine dayalı ve yaratıcı süreçleri sınıf ortamına aktarmakta daha fazla desteğe ihtiyaç duymaktadır.

Veri ve Kanıt Kullanımı: Öğretmenlerin veri analizi ve kanıt sunma konusundaki orta düzeydeki puanları, matematiksel ispat ve veri temelli argüman oluşturma becerilerinin sınıf içinde daha sistematik hale getirilmesi gerektiğini göstermektedir.

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Öneriler

Uygulamaya Yönelik Öneriler

1. **Yaratıcılık Desteklenmeli:** Matematik derslerinde "tek doğru cevaplı" sorular yerine, öğrencilerin yaratıcılığını tetikleyen "açık uçlu" ve "gerçek yaşam problemlerine" dayalı senaryolara daha fazla yer verilmelidir.
2. **İş Birliğine Dayalı Öğrenme:** Analitik düşünme süreçlerinin sosyal bir ortamda gelişmesi için grup çalışmaları ve akran öğretimi stratejileri yaygınlaştırılmalıdır.
3. **Hata Analizi Atölyeleri:** Metakognitif becerilerin yüksek olması bir avantajdır; bu doğrultuda öğrencilerin kendi çözüm yollarını sınıfta sunduğu "tartışma temelli" ders modelleri teşvik edilmelidir.
4. **Gelecek Araştırmalara Yönelik Öneriler**
 1. **Nitel Araştırmalar:** Bu çalışma nicel verilerle sınırlıdır. Gelecekte yapılacak çalışmalarda gözlem ve mülakat teknikleri kullanılarak, öğretmenlerin bu yöntemleri uygulama sırasında yaşadıkları somut güçlükler derinlemesine incelenebilir.
 2. **Karşılaştırmalı Analiz:** Farklı okul türlerinde (Fen Lisesi, Anadolu Lisesi, Meslek Lisesi) görev yapan öğretmenlerin yaklaşımları arasındaki farklar karşılaştırmalı olarak araştırılabilir.

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MEDIA ACCELERATION AND COGNITIVE TIME COMPRESSION: RECONFIGURING PERCEPTION, ATTENTION, AND DECISION-MAKING IN THE PLATFORM SOCIETY

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Abstract

This theoretical article examines how accelerated, algorithmically structured communication environments transform subjective time perception and, in turn, the cognitive conditions of attention and decision-making. Drawing on theories of social acceleration (Rosa, 2013), network time (Castells, 2010), and bounded rationality (Simon, 1957; Kahneman, 2011), the study introduces the concept of cognitive time compression to describe a structural condition in which the experiential present becomes densely saturated with rapidly updating stimuli, thereby narrowing the temporal window available for reflective judgment.

The article argues that platform architectures optimized for real-time engagement and continuous novelty reorganize temporal experience by synchronizing cognition with accelerated update cycles. This synchronization fragments attention, increases cognitive load, and systematically privileges fast, heuristic-based processing over slow, deliberative reasoning (Tversky & Kahneman, 1974; Eppler & Mengis, 2004). As a result, decision-making in digital public spheres becomes increasingly oriented toward salience, affect, and immediacy rather than toward extended evaluation and argumentative coherence. Integrating sociological, cognitive, and communication-theoretical perspectives, the study proposes the Algorithmic Acceleration Model (AAM), which conceptualizes cognitive time compression as the outcome of three interacting layers: infrastructural velocity, attentional fragmentation, and heuristic rationality. The model reframes mediation as a chronopolitical process in which power operates through the temporal structuring of cognition, not only through the control of meaning and visibility. The article contributes to communication theory by foregrounding temporality as a constitutive dimension of credibility, persuasion, and public judgment. It suggests that the rationality of democratic deliberation is increasingly shaped by algorithmically produced temporal regimes that favor reaction over reflection and circulation over justification, thereby calling for a reconceptualization of communicative rationality under conditions of platform-driven acceleration.

Keywords: cognitive time compression; media acceleration; algorithmic temporality; attention economy; heuristic decision-making; chronopolitics; platform society

1. INTRODUCTION

Time has always been a central yet under-theorized dimension of communication. Classical media theory treated time largely as a neutral container in which messages circulate, privileging questions of meaning, representation, and power over questions of temporal experience. However, with the rise of digital platforms, real-time connectivity, and algorithmic acceleration, time itself has become a communicative force that shapes cognition, attention, and decision-making.

Scholars of social acceleration argue that modernity is characterized by a structural compression of temporal horizons, in which the speed of technological, social, and experiential change outpaces the capacity of individuals to process, interpret, and integrate information (Rosa, 2013). In digital

environments, this acceleration is no longer merely social but computational: algorithmic systems optimize for immediacy, continuous update, and perpetual novelty, thereby transforming not only the rhythm of communication but the phenomenology of time itself (Castells, 2010; Hassan, 2012).

From a cognitive perspective, time is not passively perceived but actively constructed. Psychological research demonstrates that attention, working memory, and decision processes are deeply sensitive to temporal pressure and information velocity (Kahneman, 2011; Zakay & Block, 1997). When stimuli arrive in rapid, fragmented, and uninterrupted streams, subjective time tends to contract, producing what may be described as cognitive time compression: a condition in which individuals experience the present as dense, urgent, and decision-saturated, while the capacity for reflective temporal extension is diminished.

Communication theory has not yet fully integrated this temporal-cognitive transformation into its conceptual core. While studies of the attention economy and media multitasking have documented overload and distraction (Citton, 2017; Davenport & Beck, 2001), the deeper epistemic and decisional implications of accelerated mediation remain insufficiently theorized. In particular, the question of how algorithmically intensified speed reshapes temporal perception and, in turn, the quality of human judgment and choice has yet to be addressed within a unified theoretical framework.

This article proposes the concept of cognitive time compression as a key mechanism through which media acceleration restructures communicative rationality. Drawing on theories of social acceleration (Rosa, 2013), network time (Castells, 2010), and bounded rationality (Simon, 1957; Kahneman, 2011), it argues that platformed communication environments produce a systematic contraction of subjective time that favors fast, heuristic-driven decisions over slow, deliberative reasoning.

By integrating temporal sociology, cognitive psychology, and communication theory, the article develops a conceptual model explaining how algorithmic speed reconfigures attention, perception, and choice. In doing so, it seeks to extend communication theory beyond spatial and discursive metaphors toward a chronopolitical understanding of mediation, in which power operates not only through what is communicated, but through the temporal conditions under which cognition becomes possible.

2. TIME AS A COMMUNICATIVE STRUCTURE

Time in communication is not a neutral backdrop but a structuring force that shapes perception, attention, and meaning. Sociological theories of modernity emphasize that social life is increasingly organized around acceleration, defined as the systematic increase in the speed of technological change, social interaction, and experiential rhythms (Rosa, 2013). Communication technologies play a central role in this process by compressing temporal distances and synchronizing dispersed actors into real-time networks.

Castells (2010) conceptualizes this transformation as the emergence of network time, in which digital infrastructures dissolve sequential temporality and replace it with simultaneity and instantaneity. In such environments, communication is no longer governed by linear progression but by continuous update cycles, creating a temporal regime in which the present is perpetually overwritten by a newer present. This logic undermines the temporal conditions required for narrative continuity, reflection, and delayed judgment.

Virilio's (1995) theory of dromology further radicalizes this insight by arguing that speed itself becomes a form of power. For Virilio, technological acceleration reorganizes perception and cognition by collapsing the distance between event and awareness, thereby producing what he calls a "real-time" tyranny in which immediacy displaces duration. Communication, under such conditions, ceases to be a process of interpretation unfolding in time and becomes an instantaneous impact that demands immediate response.

From a communication-theoretical perspective, these accounts suggest that media acceleration does not merely increase the volume of information; it restructures the temporal architecture of cognition. As Hassan (2012) notes, digital media introduce a regime of "temporal density" in which multiple

streams of information compete for attention within compressed intervals, eroding the experiential distinction between past, present, and future. The present becomes saturated, while the horizon of anticipation and retrospection contracts.

This temporal restructuring has direct implications for how meaning is constructed. Meaning-making traditionally presupposes temporal extension: the ability to hold information in working memory, relate it to prior knowledge, and project its consequences. When communicative environments are organized around speed and perpetual update, this extension is curtailed, and cognition is increasingly oriented toward immediacy rather than coherence (Rosa, 2013; Castells, 2010).

Thus, time must be theorized as a communicative structure: a set of temporal conditions that enable or constrain attention, interpretation, and judgment. In platformed environments, these conditions are no longer socially negotiated rhythms but algorithmically optimized cycles of acceleration, producing a systematic pressure toward temporal compression.

3. COGNITIVE TIME COMPRESSION AND ATTENTION

Psychological research demonstrates that subjective time is not a fixed metric but a construct shaped by attention and cognitive load (Zakay & Block, 1997). When attentional resources are divided across rapidly changing stimuli, temporal intervals tend to be perceived as shorter and denser, leading to a sense of time “flying” while simultaneously feeling overloaded. This paradox is characteristic of digitally accelerated environments.

Kahneman’s (2011) dual-process theory provides a useful framework for understanding this effect. Under conditions of temporal pressure and information abundance, cognition shifts from slow, reflective processing (System 2) to fast, heuristic-based processing (System 1). Acceleration thus does not merely speed up decisions; it structurally biases cognition toward intuitive, affect-driven, and context-sensitive judgments.

Empirical studies on media multitasking show that rapid task switching fragments attention and reduces the depth of information processing (Ophir, Nass, & Wagner, 2009). From a temporal perspective, such fragmentation compresses the experiential present: multiple stimuli are processed in quick succession without sufficient temporal integration, producing a sense of urgency and simultaneity that undermines sustained focus.

In platformed communication, this attentional compression is intensified by algorithmic design. Continuous notifications, infinite scrolling, and real-time metrics are engineered to maximize engagement by maintaining users in a state of perpetual temporal immediacy (Citton, 2017). Attention is thus synchronized with the accelerated rhythms of the system, reinforcing the subjective experience of time scarcity and decision urgency.

Cognitive time compression can therefore be defined as a condition in which the subjective present becomes densely packed with stimuli, reducing the temporal window available for deliberation and reflection. This condition is not incidental; it is structurally produced by communicative infrastructures optimized for speed and continuity.

4. HEURISTICS, SPEED, AND THE TRANSFORMATION OF DECISION QUALITY

Under conditions of temporal acceleration, decision-making increasingly relies on cognitive heuristics rather than systematic analytical processing. Dual-process theories of cognition distinguish between fast, intuitive, and automatic processes (System 1) and slow, reflective, and effortful reasoning (System 2) (Kahneman, 2011). When communicative environments are organized around immediacy and continuous update, the balance between these systems is structurally altered.

Time pressure is one of the most powerful situational triggers of heuristic dominance. Experimental research demonstrates that when individuals perceive temporal scarcity, they reduce information search, rely on salient cues, and simplify judgment strategies (Tversky & Kahneman, 1974; Simon, 1957). In accelerated media ecologies, temporal scarcity is not episodic but permanent. The stream

never pauses; the next stimulus arrives before the previous one has been cognitively integrated. As a result, heuristic processing becomes not an adaptive shortcut but a normalized mode of cognition. Information overload further intensifies this shift. Eppler and Mengis (2004) show that excessive speed and volume degrade decision quality by increasing cognitive load and fostering reliance on surface indicators such as recency, popularity, and emotional intensity. Platform algorithms systematically amplify precisely these cues through trending metrics, engagement counts, and real-time visibility rankings, thereby aligning epistemic salience with temporal immediacy rather than with evidential robustness.

From a communication-theoretical standpoint, this implies that acceleration does not merely shorten response times; it restructures the epistemic form of judgment. What counts as a “good reason” becomes increasingly defined by speed-compatible signals. Rapid circulation, repetition, and affective resonance function as substitutes for argumentative coherence and source evaluation (Citton, 2017; Kahneman, 2011). Decision quality is thus transformed not only quantitatively (faster) but qualitatively (more heuristic, less deliberative).

5. THE ALGORITHMIC ACCELERATION MODEL (AAM)

To integrate sociological, cognitive, and communicative dimensions, this article proposes the Algorithmic Acceleration Model (AAM). The model conceptualizes cognitive time compression as the outcome of three mutually reinforcing layers.

5.1. Infrastructural Velocity

At the structural level, platform architectures operate according to logics of real-time optimization and continuous engagement. Networked communication collapses sequential temporality into simultaneity, producing what Castells (2010) calls “timeless time,” in which events are organized by immediacy rather than by narrative continuity. Hassan (2012) similarly describes digital environments as regimes of temporal density, where acceleration becomes the default condition of experience.

5.2. Attentional Fragmentation

At the cognitive level, accelerated update cycles fragment attention and compress subjective duration. Psychological research shows that divided attention and rapid task-switching shorten perceived temporal intervals and reduce working-memory integration (Zakay & Block, 1997; Ophir, Nass, & Wagner, 2009). The present becomes saturated with stimuli, while the temporal span available for reflective comparison contracts.

5.3. Heuristic Rationality

At the decisional level, bounded rationality becomes structurally enforced. Under permanent temporal pressure, individuals satisfice rather than optimize, relying on intuitive pattern recognition and affective cues (Simon, 1957; Kahneman, 2011). Algorithmic ranking systems reinforce this mode by privileging fast-moving, emotionally engaging, and highly visible content, thereby aligning infrastructural speed with heuristic cognition.

Together, these layers generate a communicative environment in which speed is not merely a technical property but a normative cognitive condition. Time itself becomes a medium of power, shaping what can be attended to, processed, and judged.

6. IMPLICATIONS FOR COMMUNICATION THEORY

The AAM compels a rethinking of several foundational assumptions in communication theory.

First, models of persuasion and credibility presuppose temporal extension: the availability of time for message elaboration, counter-argumentation, and reflective evaluation. Yet acceleration restructures these conditions by privileging immediacy and truncating deliberative windows (Rosa, 2013; Kahneman, 2011). Communication effects must therefore be theorized not only in terms of content and source, but also in terms of temporal affordances.

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Second, mediation can no longer be conceptualized solely as spatial transmission. It must be understood as temporal structuring. Algorithms do not simply distribute messages; they synchronize cognition with accelerated rhythms, thereby pre-shaping the form of rationality that becomes possible (Castells, 2010; Hassan, 2012).

Third, the concept of rational public discourse, central to Habermasian theory, requires temporal preconditions: duration, turn-taking, and the suspension of immediacy (Habermas, 1984). Algorithmic acceleration introduces a pre-discursive temporal regime that biases communication toward reaction rather than argument, toward circulation rather than justification.

7. IMPLICATIONS FOR PUBLIC JUDGMENT AND DEMOCRACY

Democratic judgment presupposes what Rosa (2013) terms “temporal resonance”: the capacity to relate present information to past experience and future consequences. Cognitive time compression weakens this resonance by saturating the present and narrowing temporal horizons.

Agenda-setting research has long shown that media visibility shapes perceived importance. Under accelerated conditions, however, temporal salience becomes a dominant criterion: what is newest, fastest, and most viral acquires disproportionate epistemic weight (Citton, 2017). This favors affective mobilization over reflective evaluation and amplifies emotionally charged frames over analytically complex ones.

Moreover, when political and social issues are encountered within compressed temporal windows, citizens are more likely to rely on heuristic cues such as group identity, emotional tone, and algorithmic popularity signals (Kahneman, 2011; Tversky & Kahneman, 1974). Public judgment thus becomes increasingly synchronized with platform rhythms rather than with deliberative time.

8. FUTURE RESEARCH AGENDA

Future theoretical and empirical work should pursue three directions.

First, chronopolitical analyses should examine how different platform designs produce distinct temporal regimes and how these regimes shape cognitive and normative orientations (Rosa, 2013; Hassan, 2012).

Second, longitudinal studies are needed to investigate how prolonged exposure to accelerated mediation affects attentional span, working memory, and tolerance for delayed gratification—capacities central to democratic reasoning (Kahneman, 2011; Zakay & Block, 1997).

Third, interdisciplinary dialogue with neuroscience and philosophy of time could deepen understanding of how algorithmic speed reorganizes the phenomenology of the present and the ethics of decision-making under temporal compression.

9. CONCLUSION

This article has argued that digital acceleration produces a structural condition of cognitive time compression in which subjective temporality, attention, and decision quality are reorganized by algorithmic speed. By integrating theories of social acceleration (Rosa, 2013), network time (Castells, 2010), and bounded rationality (Simon, 1957; Kahneman, 2011), it conceptualizes communication as a chronopolitical process in which power operates through the temporal conditions of cognition.

The central theoretical claim is that acceleration is not merely a technical characteristic of media systems but an epistemic force that reshapes how judgment becomes possible. When time is compressed, reflection yields to reaction, argument to salience, and deliberation to circulation. Communication theory, therefore, must take temporality seriously—not as a background variable, but as a constitutive dimension of meaning, authority, and rationality in the platform society.

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ESTABLISHMENT OF AN INFORMATION SYSTEM THAT WILL SHARE INSTANTANEOUS MEASUREMENTS OF CURRENT VALUES IN NARROW WATER CHANNELS WITH SHIPS

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Abstract

In narrow waterways with very strong currents, such as the Bosphorus Strait in Istanbul, establishing an information system that can instantly measure and share the current intensity and direction with ships is extremely important for the safe navigation of marine vessels. Today the most accurate current readings are obtained through sensors placed on the seabed. This information is crucial for both small boats and large ships in narrow waterways.

Therefore, the data obtained from these sensors must be transmitted instantly to centers on land. Furthermore, for safe navigation measures, it is very important that this data regarding the surrounding seas is evaluated in an Artificial Intelligence application and transmitted to marine vessels as quickly as possible.

Two different systems can be used to transmit current data to land. The first is mobile communication systems such as 4G and 5G, and the second is marine radio communication systems.

In evaluating these two systems; - The data speed and capacity in 4G and 5G mobile communication systems are higher than those in marine radio systems,

- Data latency can be reduced to around 1 ms, especially in 5G systems,

- While communication with these systems is possible up to a maximum distance of 3-4 km from the shore, communication can be established up to a distance of 60-70 km from the shore with VHF systems,

- 700 or 800 MHz bands are preferred for communication from a distance of 6-7 km via mobile systems,

- Problems may be experienced within the scope of mobile communication systems, especially in rural areas,

- Since marine current data is not in very large volumes and does not require high speed, the most suitable system for this purpose is the VHF radio system,

- There is no need to establish a separate VHF system on the Turkish coasts, as there is a VHF network operated by the General Directorate of Coastal Safety in Turkey covering our entire coastline.

- Therefore, for the targeted system, it is necessary to first utilize the existing VHF infrastructure, and if the sea area to be monitored is 5-6 km, a model can be developed that also utilizes mobile systems for this coverage.

- The data collected from meteorological data sensors must be transmitted to a designated center on land via the specified communication systems.

- A computer system for storing this data and an Artificial Intelligence system to evaluate the collected data must be established.

- An infrastructure must be established to transmit the evaluated current data to marine vessels instantly or at specific intervals (depending on their importance) via radio systems that are mandatory on board ships.

Keywords: Sea Current Information, Mobile Communication Systems, VHF System, Sea Current Sensors, Radio Systems.

DAR SU KANALLARINDA AKINTI DEĞERLERİNİN ANLIK ÖLÇÜMÜNÜN GEMİLER İLE PAYLAŞIMINI YAPACAK BİLGİ SİSTEMİNİN TESİSİ

Özet

İstanbul Boğazı gibi akıntının çok kuvvetli olduğu dar su kanallarında akıntı şiddetinin ve yönünün anlık olarak ölçülüp gemiler ile paylaşılabilmesi bilgi sisteminin tesisi deniz araçlarının emniyetli seyirleri açısından son derece önemlidir. Günümüzde akıntı değerlerinin en sağlıklı alınabilmesi deniz üzerine yerleştirilen sensörler aracılığı ile olmaktadır. Bu bilgiler hem küçük tekneler, hem de dar su kanallarında büyük gemiler için çok önemlidir.

Bu nedenle söz konusu sensörlerden temin edilen verilerin anlık olarak karada bulunan merkezlere iletilmesi gerekmektedir. Ayrıca emniyetli seyir tedbirleri açısından çevre denizlere ilişkin bu verilerin geliştirilecek bir Yapay Zeka uygulamasında değerlendirilerek en kısa sürede deniz araçlarına iletilmesi çok önemlidir.

Akıntı verilerinin karaya taşınması için iki farklı sistemin kullanılması mümkündür. Bunlardan ilki 4G, 5G gibi Mobil haberleşme sistemleri, diğeri Deniz Telsiz haberleşme sistemleridir.

Söz konusu iki sistemin değerlendirilmesinde;

- 4G ve 5G Mobil haberleşme sistemlerindeki data hızının ve kapasitesinin deniz telsiz sistemlerine oranla daha fazla olduğu,
- Özellikle 5G sistemlerinde data gecikme süresinin 1 ms düzeyine yaklaştırılabileceği,
- Bu sistemler ile kıyıdan en fazla 3-4 km mesafeye kadar haberleşilirken, VHF sistemleri ile kıyıdan 60-70 km mesafeye kadar iletişim kurulabildiği,
- Mobil sistemler aracılığı ile 6-7 km mesafeden haberleşme yapabilmek için 700 veya 800 MHz bantlarının tercih edilmesi,
- Özellikle kırsal alanda Mobil haberleşme sistemlerinin kapsamında problemler yaşanabileceği,
- Deniz akıntı verilerin çok büyük hacimde olmaması ve yüksek hız gerektirmeyeceği için bu amaca en uygun sistemin VHF telsiz sistemi olduğu,
- Bunun için Türkiye kıyılarında ayrı bir VHF sisteminin tesis edilmesine gerek olmadığı, Türkiye’de Kıyı Emniyeti Genel Müdürlüğü tarafından işletilen ve tüm kıyı şeridimizi kapsayan VHF şebekesinin bulunduğu,
- Bu nedenle hedeflenen sistem için öncelikle mevcut VHF alt yapısının kullanılması, kontrol edilmesi istenilen deniz alanı 5-6 km. ise, bu kapsama için Mobil sistemlerin de kullanılabileceği bir modelin geliştirilebileceği,
- Meteoroloji veri algılayıcılarından toplanan dataların belirtilen haberleşme sistemleri ile karada belirlenecek merkeze aktarılması,
- Bu dataların depolandığı bir Bilgisayar sistemi ve toplanan dataları değerlendirecek bir Yapay Zeka sisteminin tesis edilmesi,
- Değerlendirilen deniz akıntı verilerin gemilerde zorunlu olarak bulundurulan telsiz sistemleri aracılığı ile anlık veya belirli periyotlar ile (önemine göre) deniz araçlarına aktarılacak bir alt yapının kurulması gerekmektedir.

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Anahtar Kelimeler: Deniz Akıntı Bilgileri, Mobil Haberleşme sistemleri, VHF Sistemi, Deniz Akıntı Sensörleri, Telsiz Sistemleri.

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ISSUES OF THE IMPACT OF BUSINESS DEVELOPMENT ON STRATEGIC PLANNING – THE ROLE OF MARKETING CONCEPTS IN STRATEGIC PLANNING FOR SUSTAINABLE BUSINESS DEVELOPMENT KARABAKH

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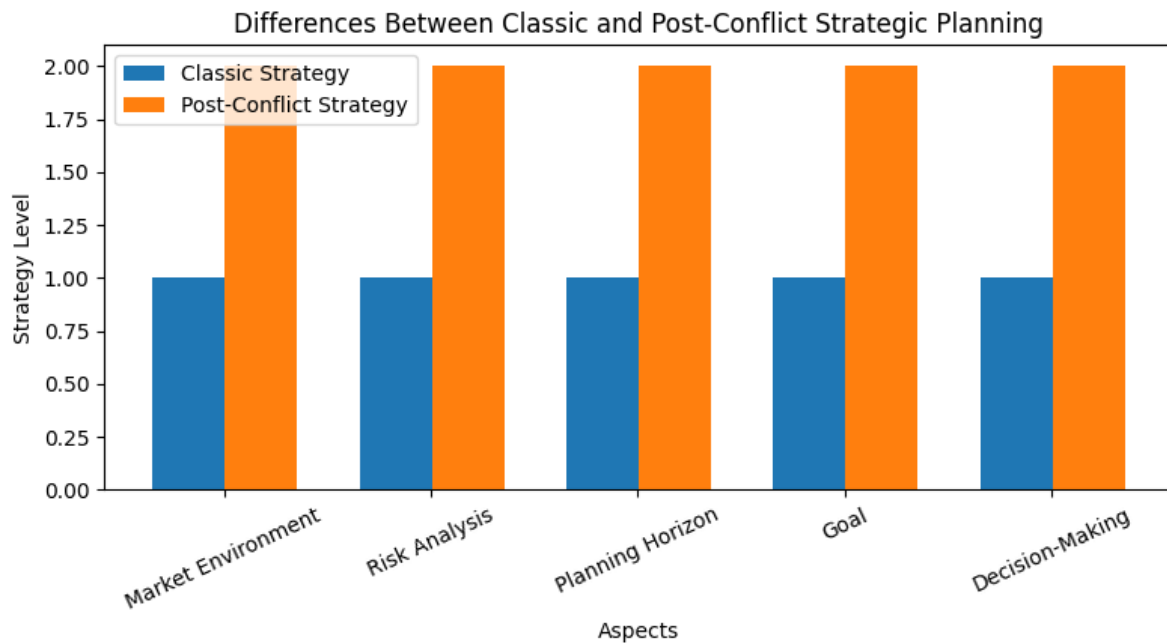
Abstract

The restoration and socio-economic reintegration of the Karabakh region in the post-conflict period is considered one of the priority directions in the national development strategy of the Republic of Azerbaijan. Re-engaging this region, which has long remained outside economic circulation, requires a complex and systematic approach. This process should not be limited only to state investments and infrastructure projects; it must also be accompanied by the active participation of the private sector, the formation of an entrepreneurial environment, and the creation of sustainable business models. From this perspective, strategic planning for business development is of great importance. Strategic planning allows business entities to correctly orient their activities under uncertain conditions, use resources efficiently, and gain long-term competitive advantage. Especially in regions like Karabakh, where a new economic environment is being formed, it is necessary to support strategic planning with market-oriented approaches. At this stage, marketing concepts play a decisive role in shaping business development strategies. Strategic planning is the process of determining the long-term goals of economic entities and selecting optimal directions of activity to achieve these goals. In the scientific literature, strategic planning is assessed as the main management mechanism of business development. In this process, the analysis of macro-environmental and micro-environmental factors is of special importance. Macro-environmental factors include the economic situation, state policy, legal framework, social and demographic processes, and technological development. The micro-environment relates to consumers, competitors, suppliers, and partners. Since most of these factors are dynamic in the Karabakh region, strategic planning is required to be flexible and adaptive. Strategic planning for business development should not only aim to increase financial indicators; it must also include objectives such as social responsibility, ensuring employment, and protecting ecological balance. This approach is one of the main conditions that ensure sustainable business development.

Keywords: Karabakh business environment, Sustainable development, Marketing concept, Strategic planning, Economic recovery.

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In the study, the mutual relationship between strategic planning and marketing concepts, their mechanisms of influence on business development, and their alignment with sustainable development principles have been analyzed systematically. The results of the article show that consumer-oriented and socio-ethical marketing concepts act as one of the main tools for business development in Karabakh. By determining long-term targets, it is important that companies define their current activities not through a mere description of conditions, but based on the results of analyzing changes within the framework of the external and internal environment.

Concept of sustainable development:

Sustainable development refers to the long-term and mutually ensured economic growth, social welfare, and ecological balance.



The essence of the concept of strategic planning is that it should be possible to give a timely response to rapidly changing conditions, creating an opportunity to prepare a complex of methods and tools

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that ensure companies' adaptation. Numerous models have been created that allow the development of the strategic planning process; therefore, it becomes possible to make correct decisions for solving issues based on strategic analyses. New realities for inclusive and sustainable development: with the Victory achieved by our valiant Army under the leadership of the Victorious Commander-in-Chief, President Ilham Aliyev, historic justice was restored and our lands were liberated from occupation. After the Patriotic War ended, the process of restoring the liberated territories began; at present, reconstruction and building works are being carried out within the framework of the goals and objectives set and the envisaged implementation mechanisms. The conceptual vision regarding the restoration and reconstruction of the liberated territories—the “First State Program on the Great Return to the Liberated Territories of the Republic of Azerbaijan”—was approved by the Presidential Decree dated February 2, 2021, and the “Azerbaijan 2030: National Priorities for Socio-Economic Development” were confirmed. Five national priorities were defined:

1. a sustainably growing, competitive economy;
2. a dynamic, inclusive society based on social justice;
3. competitive human capital and a space for modern innovations;
4. the Great Return to the liberated territories;
5. a clean environment and a country of “green growth.”

To ensure the implementation of these priorities, the “Socio-Economic Development Strategy of the Republic of Azerbaijan for 2022–2026” was approved. For the implementation of the fourth priority—ensuring sustainable settlement and reintegration of the liberated territories into economic activity—the “First State Program on the Great Return to the Liberated Territories of the Republic of Azerbaijan” was approved by Presidential Order No. 3587 dated November 16, 2022. The priority directions of the State Program include organizing safe living and public administration in the liberated territories; construction of residential settlements and provision of infrastructure; return of the population and creation of sustainable communities; establishment of strategically significant and comprehensive infrastructure that supports the development and reintegration of the territories; integration of the territories' economies into local and foreign value chains for sustainable settlement; improvement of the ecological environment and application of environmentally friendly technologies. To organize governance and support regional development in the liberated territories, state bodies—the Special Representative Offices—were established. In accordance with the “Regulations on the Special Representative Offices of the President of the Republic of Azerbaijan,” approved by Presidential Decree dated February 4, 2021, the special representatives ensure development in line with targets defined for the administrative territorial unit (or its parts) identified by the President; coordinate the activities of state bodies and their local branches; protect property and ensure efficient use of state assets; and organize activities in the fields of entrepreneurship, urban planning, construction, and others. At present, special representatives of the President operate in the districts of Aghdam, Fuzuli, Khojavend, Shusha, Jabrayil, Gubadli, Zangilan, the city of Khankendi, Aghdara and Khojaly districts, Lachin and Kalbajar. Promotion of start-ups and business incubators: persons returning to the liberated districts are informed about tax and other concessions, investment opportunities in the region, and receive regular training on various topics. Through SME Friends (KOB Dostları), operational support and services are provided to relevant individuals concerning entrepreneurial activity. In carrying out tasks in this direction, the Fund partners with various relevant state structures, foreign investment companies and funds, and other stakeholders such as individual and corporate investors, to implement projects in the following directions:

- Promoting the potential for investment and the promising directions in the region to contribute to the sustainable development of Karabakh, ensure employment, and enable comfortable living

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conditions;

- Supporting the preparation of proposals and projects for the development of green energy, as well as ecologically safe and efficient social infrastructure, buildings, and other facilities (including “smart villages”), to form balanced development that will not negatively affect the environment in Karabakh. Special attention must be given to projects that stimulate business activity and promote investment potential in the liberated territories. Meanwhile, the promotion of public-private partnerships is of particular importance, and encouraging this partnership is among the Fund’s tasks. Promotion of investment and business potential in Karabakh (including attracting investments and encouraging public-private partnerships):
- Collecting and analyzing proposals from potential investors, studying relevant documents, and directing the more promising ones to the appropriate state bodies for consideration.

The development of business in Karabakh is of great importance in terms of the restoration of the regions and modernization of the economy in recent years. In this context, marketing concepts play a key role in presenting the potential of the regions, creating confidence in local and foreign markets, and ensuring that businesses remain sustainable and competitive. The impact of marketing is evident in areas such as strengthening branding, applying digital marketing, and developing innovative business models. The main logic of classical strategy is that market relations are formed according to certain rules, and these rules do not undergo major changes over the long term. In classical strategic planning, the main focus is on studying market demand, analyzing the competitive environment, and ensuring efficient use of the internal resources of the business. In this model, the company determines its goals in advance and prepares long-term plans to achieve them. Financial forecasts, sales targets, increasing market share, and optimizing costs are considered the main components of classical strategy. Since Karabakh has long been in a state of instability, economic decisions here cannot be based solely on market mechanisms. Strategic planning must also incorporate factors such as political stability, social adaptation, and institutional development. From this perspective, strategic planning appears as a multi-level process. At the first level, the internal capabilities and resources of the business are evaluated; at the second level, regional risks, the state of infrastructure, and public policy are taken into account. In addition, when talking about strategic planning, a strategic model comes to mind: “In regions like Karabakh emerging from instability, one of the main challenges of strategic planning is risk factors”—security risk, investment risk, social risk.

One of the main difficulties of strategic planning in regions emerging from instability, like Karabakh, is risk factors. Since the business environment in areas in the post-conflict stage has not yet fully formed, the concept of risk carries a broader meaning than in classical market economies. These risks are not limited to financial and market risk; they also encompass security, investment climate, and social factors.

Security risk is one of the most sensitive aspects of strategic planning in post-conflict regions. Since Karabakh was a conflict zone for a long time, business activity there is closely tied to security issues. For entrepreneurs, the security of production facilities, logistics routes, and personnel must be among the main priorities. Uncertainty related to security leads to delays in business decisions or the selection of more cautious strategies. In my opinion, strategic plans developed without considering security risks do not align with real-world conditions. This is especially true for business entities seeking to operate in the initial stage; correct assessment of these risks is crucial. Measures taken by the state in the security sphere and the level of stability ensured play a significant role in reducing risks for businesses and must be considered in strategic planning.

Investment risk is also high in post-conflict regions. For entrepreneurs seeking to establish businesses in Karabakh, one of the main questions is the extent to which invested capital will be protected and justified in the long term. Incomplete restoration of infrastructure, a market still in formation, and the phased application of legal mechanisms are factors that increase investment risks. Therefore,

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investment decisions should be made in stages during strategic planning. In my opinion, within the context of Karabakh, rather than large, one-off investments, it is more appropriate to choose staged and flexible investment strategies. Investment incentives, tax concessions, and support mechanisms offered by the state help to reduce these risks and create additional assurances for business.

Social risk is often overlooked in post-conflict regions but is very important for strategic planning. The social environment in Karabakh is being reshaped after many years of conflict. The return of the population, employment issues, social adaptation, and the restoration of trust directly affect the business environment. In my view, business strategies built without considering the needs and expectations of the local population cannot achieve long-term success. If social risks are ignored, business entities may fail to gain community acceptance and face difficulties in continuing their operations. For this reason, a socially responsible approach, employment of local residents, and projects that generate social benefits must become an integral part of strategic planning.

The strategic model is a complex management approach used to plan business activity in regions in the post-conflict stage, based on the interrelationship of micro-, meso-, and macro-level factors and jointly considering public policy, social adaptation, and market mechanisms. This model enables business entities to reduce risks in an unstable environment, allocate resources efficiently, and form a long-term strategy for sustainable development.

In a post-conflict economy, the understanding of strategic planning differs significantly from the stable market models accepted in classical business theory. In such regions, economic relations are formed not only by the balance of supply and demand, but also by factors such as security, social trust, and institutional stability. In this respect, Karabakh constitutes a special example. The long-term conflict interrupted market relations and weakened economic behavior models. Consequently, strategic planning becomes not only profit-oriented, but also oriented towards restoration and adaptation. In this environment, business decisions cannot rely solely on current economic indicators. Thus, in Karabakh, strategic planning must be conducted in line not only with the internal interests of business, but also with the national economic strategy. In post-conflict regions, state strategy is not merely a regulatory mechanism for business—it acts as a guiding framework. Priority sectors defined by the state, investment incentives, and infrastructure projects directly shape the strategic decisions of business entities. In this regard, Azerbaijan's long-term development approach for Karabakh is of great importance in terms of reducing risks for business. Business plans aligned with state strategy deliver more sustainable and predictable results. At the same time, business entities should not act as passive adapters to state strategy, but as active partners. When private-sector initiatives contribute effectively to the formation of the regional economic environment, state-business synergy is strengthened. As a general example, similar situations have been observed in other countries emerging from conflict. Initially, business behaves cautiously in such regions, but when the state has a clear strategy, investor interest grows. This process is gradually forming in Karabakh as well. Companies are now focusing not on short-term gains but on establishing long-term positions—precisely the main objective of strategic planning.

Risk factors have a significant impact on strategic planning. In regions like Karabakh, which are emerging from instability, one of the main challenges of strategic planning is risk factors. Since the business environment in post-conflict areas is not yet fully formed, the concept of risk carries a broader meaning than in classical market economies. These risks are not confined to financial and market risks; they also cover security, investment climate, and social factors.

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The following marketing strategies are of particular importance for the development of the business environment in the region:

- creation of the region's economic and tourism brand;
- implementation of digital marketing and innovative communication channels;
- exporting local products to national and international markets;
- Strengthening public-private sector collaboration from a marketing perspective.

MARKETING STRATEGIES PROPOSED FOR KARABAKH:

Type of strategy	Application area
Green marketing	Agriculture,energy
Regional branding	Tourism
Digital marketing	Startups
Social marketing	Local communities

State support, especially in the fields of industry, agriculture, and tourism, strengthens the long-term position of business. Therefore, in Karabakh, strategic planning must be carried out not only according to the internal interests of business but also in alignment with the national economic strategy. In post-conflict regions, state strategy is not merely a regulatory mechanism for business; it acts as a guiding framework. Priority areas defined by the state, investment incentives, and infrastructure projects directly shape the strategic decisions of business entities. In this regard, the long-term development approach of the Azerbaijani government concerning Karabakh is of great importance for reducing risks for business. Business plans aligned with state strategy provide more sustainable and predictable results. At the same time, business entities should not act as passive adapters to state strategy but as active partners. When private-sector initiatives make real contributions to the formation of the regional economic environment, state–business synergy is strengthened. As a general example, similar situations have been observed in other countries emerging from conflict. In such regions, business initially behaves cautiously, but when the state has a clear strategy, investor interest increases. This process is gradually forming in Karabakh as well. Companies are now thinking not of short-term profit but of long-term positioning, which is the main objective of strategic planning. As a result, I can say that, on the topic of Karabakh, business development makes strategic planning more complex and realistic. Here, every decision is evaluated not only from an economic perspective but also from the perspective of social and regional development. This forces business entities to create more thoughtful, staged, and sustainable plans. In my opinion, this approach is necessary both for business success and for the healthy development of the region.

Marketing concepts define a business's philosophy for approaching the market and play a key role in shaping strategic decisions.



Now, to make our article fully clear and relevant, I would like to discuss the role of marketing concepts in the strategic planning of sustainable business development in the context of Karabakh. By sustainable business development, we mean not only earning profit today but also maintaining a position in the market in the future. The concept of sustainable business development is increasingly coming to the forefront in modern economics. This concept includes not only economic profitability but also social responsibility and ecological balance. For a region like Karabakh, which is in the reconstruction stage, this approach is especially relevant. Here, business activity should be carried out without harming the environment and by taking into account the interests of local communities. Thus, in Karabakh, sustainable development is not an additional burden for business; on the contrary, it is a key factor that creates long-term competitive advantage. Strategic planning based on the principles of sustainable development ensures the long-term economic stability of the region. At the same time, this approach increases the social legitimacy of business entities and accelerates their acceptance by society. From this perspective, marketing concepts play a special role in strategic planning. Especially in a region like Karabakh, which has entered a new stage of development, marketing approaches directly determine whether a business will succeed.

The role of marketing concepts in strategic planning is particularly evident in newly forming markets. Since the Karabakh market is not a classical, fully formed consumer market, marketing approaches here must be adaptive in nature.

The concept of sustainable development entails ensuring a balanced approach to economic, social, and environmental aspects. In the context of Nagorno-Karabakh, sustainable development:

- It encompasses goals such as economic recovery and increasing employment,
- improving the social welfare of the population,
- protecting and efficiently using natural resources,
- and preserving and promoting cultural heritage.



Business entities play the role of the main driving force in this process. However, the successful operation of a business should rely not only on short-term profits but also on long-term strategic goals. It is at this point that marketing concepts become an integral part of strategic planning.

In regions like Karabakh that are being re-formed, this approach is especially relevant because consumer behavior has not yet fully settled, and marketing activities directly influence the formation of these behaviors. In this context, marketing is not only about presenting products; it also acts as a tool for social adaptation. When business entities enter the market while considering local values, social sensitivities, and regional identity, the marketing strategy becomes more effective.

One of the marketing concepts—the customer-oriented approach—is very relevant for Karabakh. For example, suppose an entrepreneur wants to open a small market or facility in that area. If they apply the same model used in Baku without adaptation, they may not succeed. However, if they form the product assortment by taking into account the purchasing habits, income level, and daily needs of the local population, that business will be more sustainable. This demonstrates the real role of marketing in strategic planning.

Another marketing approach is socially responsible marketing. In Karabakh, business should not pursue profit alone. In the projects I have observed (for example, posts related to restoration and reconstruction), it is evident that businesses simultaneously strive to create social benefits. Providing employment to local residents, promoting local products, and paying attention to environmental issues strengthen the business's image. This is also an essential part of long-term strategic planning.

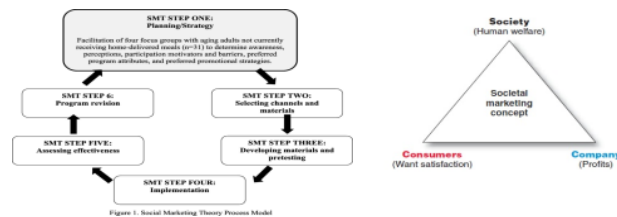
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This concept considers not only the interests of consumers and businesses but also the interests of society and the environment. Preserving ecological balance in Karabakh, implementing socially responsible business models, and developing local communities are key elements of the social-ethical marketing approach.

The social-ethical marketing concept holds particular importance in sensitive regions such as Nagorno-Karabakh. This approach emphasizes that business should focus not only on profit but also on:

- Employment of the population
 - Social welfare
 - Environmental protection
- ensures that it serves such purposes.



The long-term development plans of the Azerbaijani state regarding Karabakh also affect the marketing strategies of businesses. Entrepreneurs adjust their activities taking these plans into account and aim for sustainable development rather than short-term gains. I believe this also shows that marketing concepts are not just auxiliary but one of the main tools in strategic planning. The formation of the business environment in the Karabakh region is characterized by a number of specific factors. The phased restoration of infrastructure in the region, the return of the population, and the establishment of new economic institutions create both opportunities and risks for businesses. Tax incentives, investment promotion mechanisms, and special economic regimes implemented by the state serve to stimulate entrepreneurial activity in the region. However, the market is not yet fully formed, consumer behavior is unstable, and the limited human resources increase the importance of strategic planning. Properly communicating the innovative projects being implemented in Karabakh to the public ensures the sustainability of these projects.

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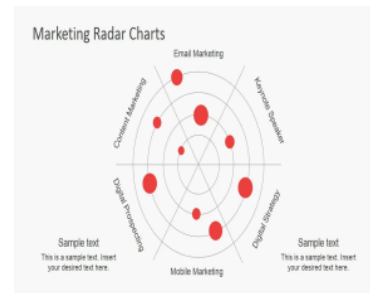
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The integration of marketing concepts into strategic planning contributes to sustainable development through the following mechanisms:

- Economic impact: creation of new markets, increase in employment, stimulation of entrepreneurship;
- Social impact: improving the well-being of the local population, ensuring social inclusivity;
- Environmental impact: promotion of environmentally friendly products, efficient use of resources;
- Cultural Impact: Branding and promoting the cultural heritage of Karabakh.

Evaluation Criteria:

- Customer Satisfaction
- Social Responsibility
- Environmental Compliance
- Competitive Advantage
- Level of Innovation



Azerbaijan's innovation-oriented development strategies related to Karabakh also increase the role of marketing communications. Projects implemented jointly by the state and the private sector are not only executed but also presented to society. This creates stability and trust for business in long-term strategic planning. In post-conflict regions, the most important intangible asset for business is trust. The long-standing uncertainty in Karabakh has shaped a cautious approach in the behavior of investors and consumers.

The newly forming business environment in Karabakh requires different approaches and long-term strategic planning from entrepreneurial entities operating in the region. Ensuring the sustainable development of businesses in Karabakh is directly linked to their ability to operate in accordance with market conditions, use resources efficiently, and align economic objectives with social and environmental factors. From this perspective, the marketing concept plays a guiding role in the strategic planning of businesses operating in Karabakh. In addition, the rich history and culture of these regions stimulate the development of tourism and social projects. Marketing also plays an important role in the development of local communities and their involvement in business. The strategic application of marketing concepts in Karabakh has a significant impact on the economic and social development of these regions and ensures their broader presence in global markets. Business development in Karabakh will be possible not only through economic factors but also through the application of correct marketing strategies and concepts. The strategic application of marketing concepts ensures proper positioning of products and services in the region, their presence in the market, and the establishment of international connections. The sustainable development of businesses in Karabakh is possible based on modern marketing approaches. Marketing concepts—production, product, sales, marketing, and socio-ethical—not only help increase economic development but also contribute to social welfare.

The Karabakh region, both in terms of natural resources and geographic location, is a favorable economic space for applying the production concept. The extensive land reserves, water resources, and transport-logistics opportunities available in the liberated territories create an important foundation for restoring agriculture and industrial production. According to the State Statistical Committee, thousands of hectares of land suitable for agriculture exist in the Karabakh economic region, creating real opportunities for expanding crop production and animal husbandry. At the same time, the restoration of the region's transport communications—highways, rail lines, and logistics

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centers—facilitates the delivery of manufactured products to markets. The establishment of the Aghdam and Jabrayil industrial parks is considered one of the important examples of the practical application of the production concept in Karabakh. Centralizing production processes and applying modern technologies in these industrial parks creates conditions for reducing unit costs, achieving economies of scale, and increasing competitiveness. As a result, we can say that the share of local production increases, dependence on imports decreases, and permanent jobs are created in the region. Thus, the production concept plays a leading role in accelerating economic activity in the Karabakh region and in forming a sustainable production environment at the initial stage.

When discussing the impact of the product concept on the strategic planning of sustainable business development in Karabakh, we can note that the product concept is based on the approach that consumers prefer high-quality and technically superior products. The natural-climatic conditions of the Karabakh region create unique opportunities for applying this concept. Products produced in territories that have long remained outside industrial pollution can stand out with ecological cleanliness and natural quality indicators. In particular, viticulture, animal husbandry, beekeeping, and organic agricultural products are considered sectors that reflect the potential advantages of the Karabakh region. Producing these products in accordance with modern standards and certifying them increases their competitiveness in both domestic and foreign markets. Within the product concept, producers pay attention not only to the quantity of the product but also to its quality indicators, technical characteristics, and consumer value. The formation of the “Karabakh brand” emerges as one of the strategic results of the product concept. The branding approach facilitates the recognition of products in the market and creates an association of reliable and consistent quality among consumers. This, in turn, allows products to be positioned not by price competition alone but on the basis of quality and origin advantage. In the long-term perspective, Karabakh products can create higher added value.

In the post-conflict period, introducing products to the market emerges as one of the main problems in the initial stage. Participation in local and international exhibitions, organizing trade fairs, and establishing marketing communications play an important role in bringing Karabakh products to market. Alongside this, the development of logistics infrastructure is among the factors that directly determine the effectiveness of the sales concept. Modern warehousing systems, transport networks, and distribution channels ensure that products are delivered to consumers on time and without loss. Although the sales concept allows increasing sales volumes in the short term, its coordination with other marketing concepts is necessary for Karabakh products to secure a sustainable position in the market.

After the liberation of the region, applying the marketing concept is of strategic importance in ensuring the socio-economic restoration and sustainable development of the region. As one of the basic principles of the market economy, the marketing concept envisages aligning production and service activity with consumer demand. Based on this approach, enterprises first analyze the market environment, consumer needs, and competitive conditions, and only then make production and investment decisions.

The application of the marketing concept in the Karabakh region creates opportunities to ensure efficient use of resources and minimize economic risks. According to statistical data, the increase observed in recent years in the production of agricultural and industrial products in the region is linked precisely to the application of market-oriented development strategies. This increase shows that Karabakh is being actively involved in economic circulation and that market mechanisms are gradually forming. Strategies based on market research reveal the region’s potential more clearly for local and foreign investors. When the restoration of infrastructure, the establishment of industrial parks, and the development of agricultural areas are properly positioned within the framework of a marketing approach, the investment attractiveness of the Karabakh region increases significantly.

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This process creates conditions for the formation of new business entities in the region, for raising employment, and for improving the social welfare of the population.

One of the important directions of the marketing concept is the formation of brand and positioning strategies. Presenting products produced in the Karabakh region under the “Karabakh brand” in the market is a key step. The socio-ethical marketing concept is considered the most modern stage of marketing. This approach accepts as a principle the protection of society’s and the environment’s interests alongside economic profit. Looking at the characteristics of socio-ethical marketing, we consider the preservation of ecological balance, socially responsible business activity, and the long-term welfare of society. For the long-term and balanced development of the Karabakh region, the application of the socio-ethical marketing concept is of special importance. According to this concept, business entities should consider not only short-term profits but also the social and ecological consequences of their activities. Since the Karabakh region remained in a state of conflict for many years, it is particularly relevant that economic activities carried out here are organized in accordance with socio-ethical principles.

Within the framework of the socio-ethical marketing concept, preservation of ecological balance emerges as one of the main priorities. Restoration of land and water resources in the region, development of ecological agriculture, and the application of alternative energy sources are considered practical manifestations of socio-ethical marketing. Statistical observations show that the implementation of environmentally oriented projects has, in the long term, a positive effect both on increasing economic efficiency and on improving the quality of life of the population. In particular, the application of green energy projects creates a basis for Karabakh’s future development according to a sustainable economic model. At the same time, socio-ethical marketing serves to form a socially responsible business environment. One of the main goals of this concept is that newly created enterprises in the Karabakh region contribute to the employment of the local population, to the development of social infrastructure, and to community welfare. The implementation of socially oriented projects increases trust among the population and creates conditions for strengthening social stability in the region. Social surveys conducted show that organizing economic activity on the basis of social responsibility principles significantly increases the motivation of the population to live and work in the region.

Ensuring the socio-economic development of the Karabakh region in the post-conflict period requires that business activity be organized not on the basis of short-term profit objectives alone, but within a long-term and systematic strategic planning framework. In this context, marketing concepts act as the main intellectual framework in determining the directions of activity of business, in the efficient distribution of resources, and in reducing market risks. They allow differentiation of products in terms of origin, quality, and reliability.

Strategic planning defines the long-term objectives of an enterprise and the ways to achieve these objectives. Marketing concepts perform the following functions in this process:

- Identification of Market Needs
- Selection of Target Markets
- Establishing a Competition Strategy
- Ensuring Customer Satisfaction



Research findings indicate that consumers tend to prefer products with a known origin and those produced in environmentally clean regions. In this regard, the strategic positioning of Karabakh products through appropriate marketing strategies enhances their competitiveness in domestic and international markets and creates favorable conditions for expanding export potential.

Conclusion

The role of marketing concepts in the strategic planning of sustainable business development in Karabakh is multifaceted and decisive. Marketing approaches align business development strategies with actual market demands, create long-term competitive advantages, and make a significant contribution to the socio-economic recovery of the region. In particular, the integration of consumer-oriented and socio-ethical marketing concepts into strategic planning is one of the key prerequisites for establishing a sustainable business environment in Karabakh.

Consequently, it can be stated that the proper application of marketing concepts is essential for sustainable business development in Karabakh. These concepts enable businesses to better understand the market, mitigate risks, and achieve long-term success. In my view, this approach constitutes the fundamental condition for ensuring that businesses established in Karabakh are successful and sustainable in the future.

Analyses conducted demonstrate that marketing concepts are an integral part of strategic business planning. Their implementation reduces business risks, ensures efficient resource utilization, and creates favorable conditions for sustainable development. Collaboration between the public and private sectors plays a crucial role in shaping a sustainable business environment in the region. The institutional framework established by the state expands opportunities for strategic business planning (Republic of Azerbaijan, 2022).

The study systematically analyzes the interrelationship between strategic planning and marketing concepts, their mechanisms of influence on business development, and their alignment with sustainable development principles. The findings of the article indicate that consumer-oriented and socio-ethical marketing concepts serve as key instruments for the strategic development of business in Karabakh.

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PRESERVATION OF TRADITIONAL AND ANALOG HOUSING FABRIC IN SAMARKAND: CHALLENGES AND STRATEGIES

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Abstract

This study examines the traditional and analogous residential fabric located around Registan Square and the Bibi Khanum area in Samarkand, Uzbekistan, in the context of current conservation challenges, spatial degradation processes, and transformation dynamics. The courtyard-based housing typology, narrow street networks, climate-responsive spatial arrangements, and use of local materials constitute essential spatial layers that shape Samarkand's historical identity and urban continuity. This built environment is considered not only as a physical architectural heritage but also as a multilayered cultural asset reflecting neighborhood-scale lifestyles, social interactions, and urban memory.

The research was conducted through comprehensive field observations, measured surveys and analytical studies, street morphology analyses, photo-supported inventory work, and academic applications carried out within the university. The findings reveal that insufficient documentation, unauthorized interventions, inappropriate restoration practices, and pressure from reinforced concrete constructions have rapidly weakened the traditional and analogous housing fabric. Particularly, neglecting the role of analogous structures in the transformation process has led to disruptions in typological continuity, fragmentation of the street silhouette, and deterioration of the holistic perception of the neighborhood fabric.

The study demonstrates that spatial degradations are not confined to specific monumental areas but have become a widespread and systematic issue affecting the entirety of traditional housing zones. Accordingly, sustainable conservation cannot rely solely on interventions at the scale of individual buildings; it requires regular and systematic documentation, climate-responsive design approaches, local user participation, and a multidisciplinary conservation strategy grounded in academic-public collaboration. This research aims to contribute to the reassessment of conservation policies in historic cities, placing the "living heritage" approach at the center, and to provide a solid data and methodological foundation for future planning and restoration decisions.

Keywords: Samarkand Historical Urban Continuity, Traditional and Analog Housing Fabric, Documentation-Based Conservation

SEMERKANT'TA GELENEKSEL VE ANALOG KONUT DOKUSUNUN KORUNMASI: SORUNLAR VE STRATEJİLER

Özet

Bu çalışma, Özbekistan'ın tarihsel kentlerinden biri olan Semerkant'ta, Registan Meydanı ve Bibi Hanım mevkii çevresinde yer alan geleneksel ve analog konut dokusunu, güncel koruma sorunları, mekânsal bozulma süreçleri ve dönüşüm dinamikleri bağlamında incelemektedir. Avlulu konut tipolojisi, dar sokak örgüsü, iklimsel koşullara uyumlu mekânsal düzenlemeler ve yerel malzeme kullanımıyla biçimlenen bu konut dokusu, Semerkant'ın tarihsel kimliğini ve kentsel sürekliliğini oluşturan temel mekânsal katmanlardan biridir. Bu yapılaşma biçimi, yalnızca fiziksel bir mimari miras alanı olarak değil, aynı zamanda mahalle ölçeğinde yaşam biçimlerini, sosyal ilişkileri ve kentsel hafızayı yansıtan çok katmanlı bir kültürel değer olarak ele alınmaktadır.

Araştırma, kapsamlı saha gözlemleri, rölöve ve analiz çalışmaları, sokak morfolojisi incelemeleri, fotoğraf destekli envanter çalışmaları ve üniversite bünyesinde yürütülen akademik uygulamalar üzerinden gerçekleştirilmiştir. Elde edilen veriler, belgeleme eksikliği, izinsiz müdahaleler, yanlış restorasyon uygulamaları ve betonarme yapılaşma baskısının, geleneksel ve analog konut dokusunu hızla zayıflattığını ortaya koymaktadır. Özellikle analog yapıların dönüşüm sürecinde yeterince dikkate alınmaması, tipolojik sürekliliğin kesintiye uğramasına, sokak silüetinin parçalanmasına ve mahalle dokusunun bütüncül algısının bozulmasına neden olmaktadır.

Çalışma, yaşanan mekânsal bozulmaların yalnızca belirli anıtsal alanlarla sınırlı kalmadığını, geleneksel konut alanlarının tamamına yayılan, yaygın ve sistematik bir sorun hâline geldiğini göstermektedir. Bu bağlamda sürdürülebilir korumanın, yalnızca tekil yapılar üzerinden geliştirilen müdahalelerle sınırlı kalamayacağı; düzenli ve sistematik belgeleme çalışmaları, mikroklimaya duyarlı tasarım yaklaşımları, yerel kullanıcı katılımı ve akademi-kamu iş birliğine dayalı çok disiplinli bir koruma stratejisi ile mümkün olabileceği vurgulanmaktadır. Araştırma, tarihi kentlerde “yaşayan miras” yaklaşımını merkeze alan koruma politikalarının yeniden değerlendirilmesine katkı sunmayı ve gelecekte geliştirilecek planlama ve restorasyon kararları için sağlam bir veri ve yöntem altyapısı oluşturmayı amaçlamaktadır.

Anahtar Kelimeler: Semerkant Tarihsel Kent Sürekliliği, Geleneksel ve Analog Konut Dokusu, Belgeleme Temelli Koruma.

GİRİŞ

Tarihsel kentlerin korunması, yalnızca anıtsal yapıların muhafazasını değil; bu yapıları çevreleyen geleneksel konut dokusunu, sokak ilişkilerini ve yaşam biçimlerini de kapsayan bütüncül bir yaklaşımı gerektirmektedir (UNESCO, 2011). Semerkant, Orta Asya'nın en önemli tarihsel merkezlerinden biri olarak, anıtsal eserleri kadar, bu eserleri çevreleyen eski şehir dokusuyla da kent

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kimliğini oluşturmaktadır. Registan Meydanı ve Bibi Hanım Camii çevresinde yoğunlaşan geleneksel mahalle dokusu, kentin tarihsel sürekliliğinin temel taşıdır.

Ancak son yıllarda, belgelenmemiş yapılar, izinsiz müdahaleler ve betonarme yeni yapılaşmalar hem tekil yapıların hem de sokak silüetinin bütünlüğünü tehdit etmektedir. Bu durum, yalnızca fiziksel kayıp değil, kentin tarihsel hafızasının ve kültürel kimliğinin de erozyonunu beraberinde getirmektedir (ICOMOS, 1964; ICOMOS, 1994). Bu bağlamda, Semerkant örneği, geleneksel ve analog konut dokusunun korunmasının hem yerel hem de küresel ölçekte önemini ortaya koymaktadır.

Bu çalışma, Semerkant'ta yapılan saha verilerine dayalı olarak, geleneksel ve analog konut dokusunun mevcut sorunlarını, belgeleme eksikliklerini ve kentsel silüet kayıplarını ortaya koymayı; aynı zamanda çok disiplinli ve katılımcı bir koruma yaklaşımının gerekliliğini tartışmayı amaçlamaktadır.

ÇALIŞMA ALANI

Çalışma alanı, Registan Meydanı ile Bibi Hanım mevkiinin sağ kısmında yoğunlaşan ve “eski şehir” olarak adlandırılan geleneksel konut alanlarını kapsamaktadır.

Semerkant Çalışma Alanı ve Kent Dokusu

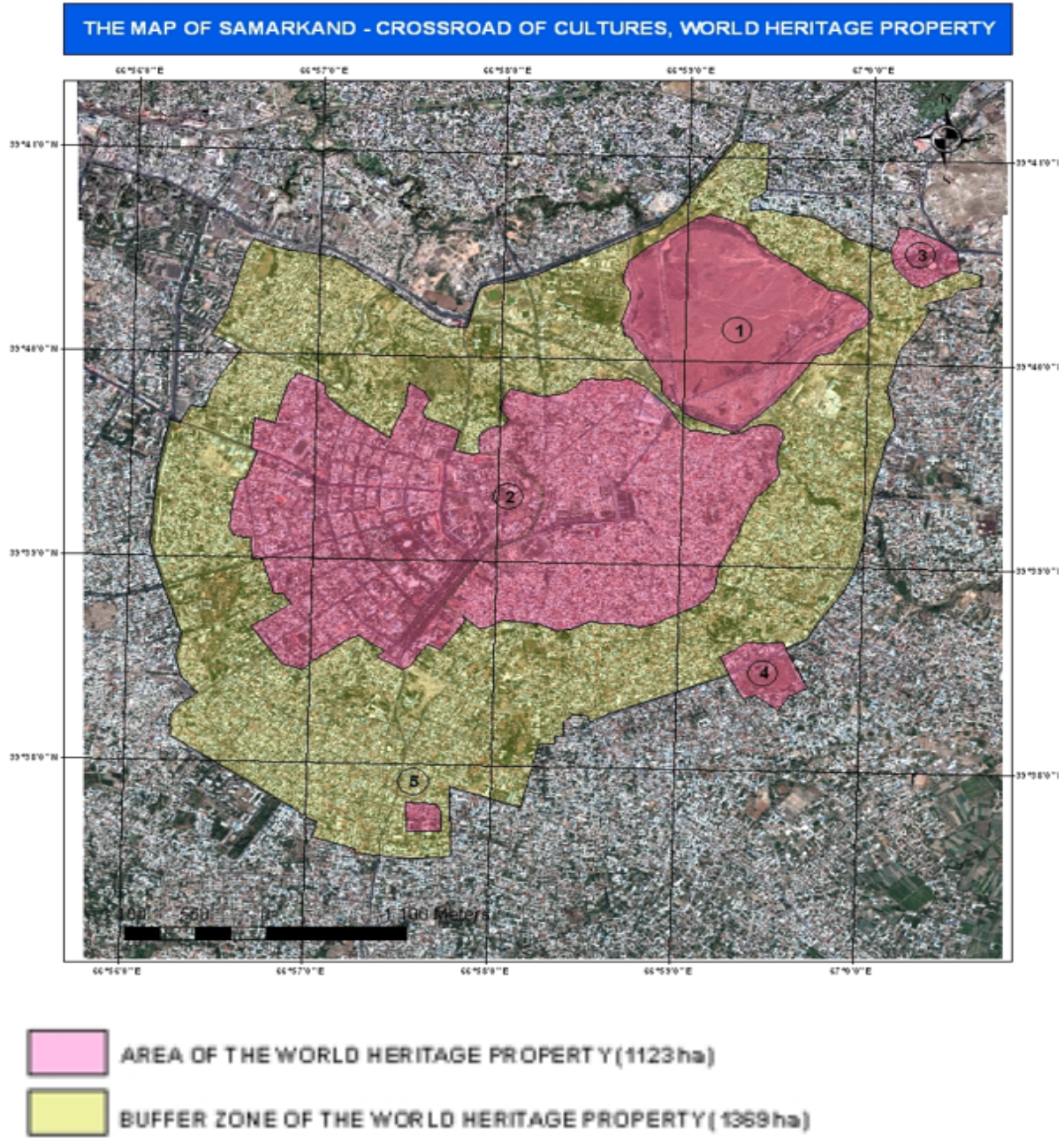


Şekil 1: Registan Meydanı ve çevresi 2025

Bu bölgede, özgün geleneksel avlulu evlerin yanı sıra, plan ve mekânsal özellikleri geleneksel konut tipolojisini analog biçimde sürdüren yapılar da bulunmaktadır. Bu mahalle dokusu ve yaşam biçimi, Semerkant'ın tarihsel bir kent olarak şekillenmesinde belirleyici olmuştur.

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Şekil 2: Registan Meydanı ve çevresi 2025

GELENEKSEL VE ANALOG KONUT DOKUSU

Geleneksel plan şemasına sahip konutlar, tekil yapı ölçeğinin ötesinde, sokak silüeti ve mahalle bütünlüğü açısından önemli bir rol üstlenmektedir. Tipolojik yaklaşımlar, kentsel dokuda sürekliliğin yalnızca özgün yapılarla değil; bu yapılarla mekânsal, işlevsel ve ölçek açısından ilişki kuran analog yapılarla da sağlandığını ortaya koymaktadır (Caniggia & Maffei, 2001). Bu nedenle analog konutlar, Semerkant'ın tarihsel dokusunun okunabilirliğini ve sürekliliğini destekleyen önemli unsurlar olarak değerlendirilmelidir.

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Şekil 3: Registan çevresindeki geleneksel sokak dokusundaki değişimlerden görünüm 2026



Şekil 3: Tek katlı Analog yapının sokak silüetine aykırı değişimi 2026.

MEVCUT SORUNLAR VE DÖNÜŞÜM SÜRECİ

Geleneksel ve analog konut dokusu, zaman içerisinde hızlı bir dönüşüm ve yok olma sürecine girmiştir. Belgelenmemiş ve kayıt altına alınmamış çok sayıda yapı bulunmaktadır. İzinsiz müdahaleler, yanlış restorasyon kararları ve avlulu evlerin avlularında gerçekleştirilen yeni yapılaşmalar bu süreci hızlandırmaktadır. Venedik Tüzüğü'nde vurgulandığı üzere, tarihi yapılara yönelik her türlü müdahalenin bilimsel belgelere dayanması temel bir ilkedir (ICOMOS, 1964). Ancak bu ilkenin ihlal edilmesi, sokak silüetinde ciddi kayıplara ve mekânsal bozulmalara yol açmaktadır.

Günümüzde geleneksel ve analog yapıların yerini, iki ve üç katlı betonarme ve çevresiyle uyumsuz yapılar almaya başlamıştır. Bu dönüşüm, geleneksel evlerin yıkılarak betonarme yapılara dönüşmesini hızlandırmakta ve mahalle dokusunun bütünlüğünü zayıflatmaktadır.

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Şekil 4: Tek katlı Anolog yapının sokak silüetine aykırı değişimi 2026.



Şekil 5: Tek katlı Anolog yapının sokak silüetine aykırı değişimi 2026.



Şekil 6: Tek katlı Anolog yapının sokak silüetine aykırı değişimi 2026.

BELGELEME EKSİKLİĞİ VE ÇEVRESEL ETKİLER

Geleneksel konutların korunmasındaki temel sorunlardan biri, sistematik belgelemenin yapılmamış olmasıdır. Belgelenmemiş yapılar için sağlıklı restorasyon projeleri üretilmemekte; bu durum hem

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fiziksel dokunun hem de mahalle hafızasının kaybı riskini artırmaktadır. Nara Belgesi'nde vurgulandığı üzere, özgünlük kavramı yalnızca malzeme ile sınırlı olmayıp bağlam ve kullanım ilişkileriyle birlikte değerlendirilmelidir (ICOMOS, 1994).

Bunun yanı sıra, yeni yapılan yapıların malzeme ve proporsiyonlarının coğrafi ve iklimsel koşullara uygun olmaması, rüzgâr ve ısı dengesini bozmakta ve enerji ihtiyacını artırmaktadır. Bu durum, tarihi yapıların ömrünü kısaltmakta ve modern müdahalelere duyulan ihtiyacı artırmaktadır.

Saha Çalışmaları ve Çok Disiplinli Yaklaşımın Gerekliliği

Yapılan saha çalışmaları, tarihsel konut dokusunun korunmasının tek bir disiplinin yaklaşımıyla mümkün olmadığını göstermektedir. Tarihi kentlerin korunması; şehir yönetimi, akademik çevreler ve yerel kullanıcıların birlikte hareket ettiği bütüncül ve çok disiplinli bir süreci gerektirmektedir (Stubbs, 2009). Bu bağlamda belgeleme çalışmalarının öncelikli ve hızlandırılmış biçimde yürütülmesi gerekmektedir.

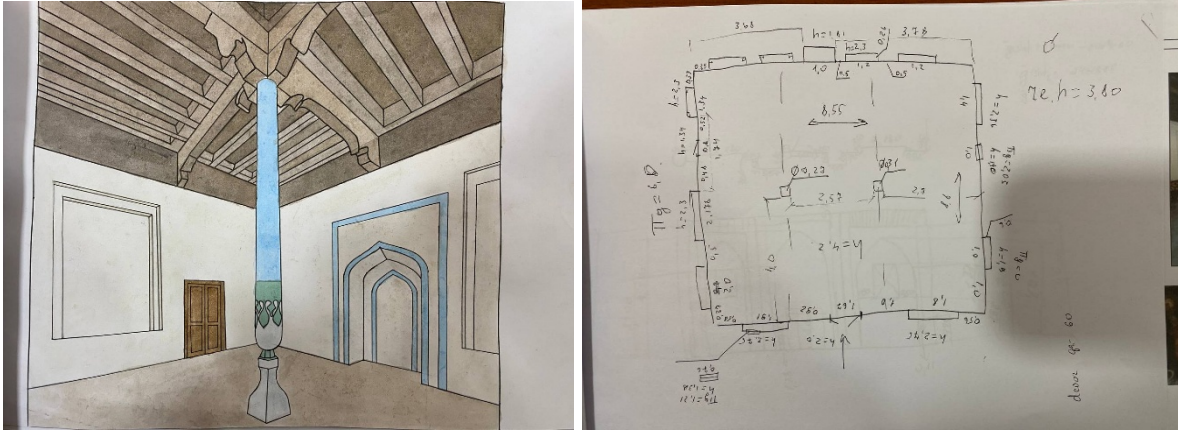
Belgeleme süreci yalnızca ayrıntılı rölöve çalışmalarını değil; envanter çalışmaları, ölçülü eskizler ve kısa raporları da kapsamalıdır. Bu çalışmaların sahada görünür olması, kullanıcıların izinsiz müdahale eğilimlerini azaltan dolaylı bir koruma mekanizması oluşturmaktadır.



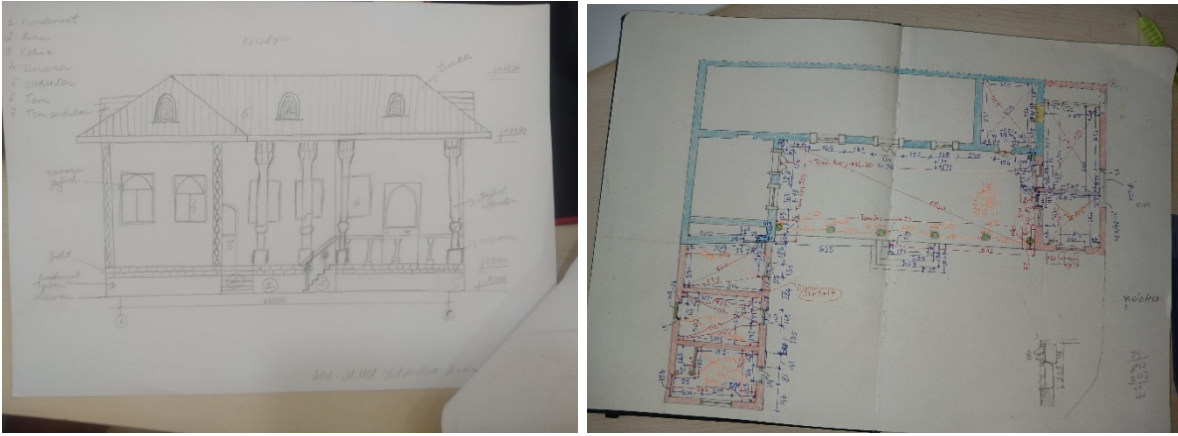
Şekil 7: Saha çalışmadan görünüm,2025-2026.

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Şekil 8: Saha çalışmadan eskizleri,2025-2026.



Şekil 9: Saha çalışmadan eskizleri,2025-2026.



Şekil

10: Analizlerin çalışılması,2026.

AKADEMİK UYGULAMA DENEYİMİ

Saha Çalışmasının Kapsamı ve Nicel Veriler

Semerkant Devlet Mimarlık ve İnşaat Üniversitesi bünyesinde yürütülen rölöve, belgeleme ve restorasyon dersleri kapsamında, 24 öğrenciden oluşan bir ekip ile yaklaşık 20 günlük bir saha

çalışması gerçekleştirilmiştir. Bu süreçte, Registan çevresinde yer alan iki geleneksel mahallede yoğunlaşmış; yaklaşık 150–200 konut ve yapı envanter çalışmaları kapsamında belgelenmiştir.

Yapılan belgeleme çalışmaları; yapıların plan tipolojileri, avlu varlığı, fiziksel durumları (iyi, orta, kötü), kullanım biçimleri ve geçirdiği müdahaleler gibi çok sayıda durum tespitini içermektedir. Bu kapsamda, yalnızca genel envanter çalışmaları ile sınırlı kalınmamış; 23 yapının birebir ölçülerinin alınarak ayrıntılı biçimde belgelenmesi gerektiği ve bu yapılar için acil restorasyon projelerinin hazırlanmasının zorunlu olduğu tespit edilmiştir.

Elde edilen bu nicel ve nitel veriler, geleneksel ve analog konut dokusundaki bozulma sürecinin yalnızca yaygınlığını değil, aynı zamanda müdahale önceliklerinin belirlenebilirliğini de ortaya koymaktadır. Kısa sürede elde edilen bu sonuçlar, belgelemenin yalnızca uzun vadeli ve sınırlı uzman kadrolarla yürütülen bir süreç olmak zorunda olmadığını göstermektedir.

Belgeleme Sürecinin Ölçeklenebilirliği ve Öngörüler

Saha çalışmasından elde edilen veriler, belgeleme sürecinin daha planlı ve sistematik ekip organizasyonları ile kentsel ölçekte ölçeklenebilir olduğunu ortaya koymaktadır. Mevcut deneyim temel alındığında, yaklaşık 60 öğrenciden oluşan ekipler ile yürütülecek düzenli saha çalışmaları sayesinde, Registan çevresindeki geleneksel konut alanlarının envanter çalışmalarının bir yıl içerisinde tamamlanabileceği öngörülmektedir.

Ayrıca, detaylı rölöve, restitüsyon ve restorasyon projelerinin hazırlanması gereken 23 yapı için, mimarlık ve koruma–restorasyon derslerini alan 3–4 sınıf düzeyindeki öğrenci gruplarının, akademik denetim altında bu süreci yürütebilecek yeterlilikte olduğu görülmektedir. Bu durum, geleneksel konutların korunmasında ilk ve en kritik aşama olan belgeleme ve proje üretim sürecinin, bilimsel ve akademik yeterliliğe sahip uzmanlar tarafından denetlenerek, kısa sürede tamamlanabileceğini göstermektedir.

Bu yaklaşım, Semerkant gibi geniş ve çok katmanlı tarihsel kentlerde, belgelemenin yalnızca koruma söylemi düzeyinde kalmayıp, uygulanabilir, zamanlanabilir ve sürdürülebilir bir koruma aracı haline dönüşmesini mümkün kılmaktadır.

Farklı mahallelerde çekilen fotoğrafların harita üzerinde işaretlenmesi, geleneksel ve analog yapıların yıkılarak dönüştürüldüğünü ve bu durumun kentin geneline yayıldığını açıkça göstermektedir. Plansız ve disiplinler arası yaklaşımdan yoksun tadilatlar, onarımlar ve yeni yapılar, Semerkant'ın kentsel silüetini ve morfolojisini bozmakta; diğer yapı sahipleri için de olumsuz bir örnek oluşturmaktadır.

Bu çalışmada elde edilen nicel saha verileri, söz konusu dönüşümün yalnızca mekânsal bir değişim değil; aynı zamanda belgeleme eksikliği ve müdahale hızındaki yetersizlikle doğrudan ilişkili olduğunu ortaya koymaktadır. Özellikle sınırlı süre ve insan kaynağı ile yürütülen saha çalışmalarında dahi yüksek sayıda yapının belgelenebilmesi, koruma süreçlerinin yaygın olarak varsayıldığı gibi yavaş ve erişilemez olmadığına işaret etmektedir.

Bu bağlamda, üniversiteler bünyesinde yürütülen akademik saha çalışmaları, klasik üstten-aşağı koruma modellerine alternatif olarak, yerinde, katılımcı ve ölçeklenebilir bir yaklaşım sunmaktadır. Semerkant örneğinde elde edilen veriler, belgeleme sürecinin hızlandırılmasının yalnızca mevcut

LONDON SOVEREIGN SCHOOL

"A Legal Entity Incorporated under the Laws of the United Kingdom"

Institutional Authentication Code : VTBVP9

Reference No : LSS/SEN/2026/07



February 13, 2026

This Official Protocol Declaration is hereby issued by London Sovereign School (hereinafter referred to as "the Institution"), a duly constituted academic and research entity operating within the United Kingdom and possessing full legal personality under applicable UK law.

Pursuant to the Institutional Charter, Academic Regulations, and Internal Statutes, the Senate of the Institution, at its duly convened session held on **14 January 2026**, did hereby adopt and enact Resolution No. **2026/7**, whereby it is formally decreed that the scientific event specified hereunder shall be organized under the official auspices and academic supervision of the Institution. The said event shall be deemed an official academic undertaking of London Sovereign School and shall be conducted in strict conformity with principles of academic integrity and all applicable legal and regulatory provisions in force.

By virtue of the aforesaid Resolution, the academicians and designated officials serving within the Organizing Committee, Scientific Committee, Advisory Board, and related academic bodies have been duly nominated and ratified by the Senate. The list of appointed members constitutes an integral and legally operative part of this Declaration.

This Declaration shall enter into force upon issuance and remain in full force and effect unless otherwise amended by Senate resolution.


Dr. Mariam S. OLSSON
Deputy President

LONDON SOVEREIGN SCHOOL
Unit 501 Leroy House, 434-436 Essex Road
London N1 3FY - United Kingdom
Institution No: 16871908

Official Professor Roster of the Organizing Committee Members Appointed Pursuant

Prof. Petra PELLETIER

Prof. Nguyễn Thị Bích Vân

Prof. Dr. Osman Kubilay GÜL

Title and Venue of the Scientific Event: Biltek Congress - XIV

Official Date(s) of the Event: February 18-21, 2026 Bangkok

Official Web Adresse: www.biltek.org

**ACCEPTANCE LETTER / KABUL YAZISI**

İlgili makama;

14. Uluslararası Bilimsel Araştırmalar Ve Güncel Gelişmeler Kongresi, 18-21 Şubat 2026 tarihleri arasında Bangkok - Tayland'da 16 farklı ülkenin akademisyen/araştırmacılarının katılımıyla gerçekleşmiştir. Kongre kapsamında sunumu yapılan 34 bildirinin 13 adeti Türkiye'den katılımcılar tarafından; 21 bildiri ise 15 ülkeden katılımcılar tarafından sunulmuştur. Kongre 16 Ocak 2020 Akademik Teşvik Ödeneği Yönetmeliğine getirilen "Tebliğlerin sunulduğu yurt içinde veya yurt dışındaki etkinliğin uluslararası olarak nitelendirilebilmesi için Türkiye dışında en az beş farklı ülkeden sözlü tebliğ sunan konuşmacının katılım sağlaması ve tebliğlerin yarıdan fazlasının Türkiye dışından katılımcılar tarafından sunulması esastır." değişikliğine uygun düzenlenmiştir. Bilgilerinize arz edilir.

Saygılarımla,

Dr. Nguyễn Thị Bích Vân
Member of the Organizing Committee