ARTIFICIAL INTELLIGENCE (AI)-DRIVEN ENVIRONMENTAL SUSTAINABILITY IN AZERBAIJAN: PSYCHOLOGICAL AND BEHAVIORAL TRANSFORMATIONS

Guldeniz Metin HASANOVA

Eurasian University, Institute of Social Sciences,
Psychology Department,
Department of Social Psychology, Trabzon, Turkiye

0009-0008-0936-7593

Ayan ABDULRAHIMOVA
Researcher, Baku, Azerbaijan

1.Introduction

Artificial Intelligence (AI) has rapidly advanced and has become an essential tool for monitoring, predicting, and managing environmental processes. This technological progress not only supports environmental decision-making but also influences human behavior, public perception, and psychological well-being. According to environmental psychology, environmental challenges such as pollution and climate change directly affect stress levels and emotional stability within society. When AI contributes to detecting and preventing ecological risks, it can reduce eco-anxiety and increase the feeling of safety.

Azerbaijan provides a valuable context to study the integration of AI into environmental management due to its diverse ecosystems and significant agricultural sector. Current applications such as precision agriculture, satellite monitoring of the Caspian Sea, and smart energy systems play a role in promoting sustainability. These advancements also encourage positive behavioral changes in communities. From a social psychology perspective, AI-based innovations can motivate citizens to adopt greener habits, improve environmental awareness, and build trust in national sustainability efforts.

Therefore, the incorporation of AI in Azerbaijan's environmental sector must be assessed not only for its ecological benefits but also for its psychological and social impacts. This introduction sets the foundation to explore how technological development can contribute to both environmental protection and the enhancement of mental resilience and societal behavior.

Moreover, Azerbaijan actively participates in global climate initiatives and has strengthened its international cooperation in environmental protection. As an example, the country hosted the 29th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP29) in November 2024. Such involvement not only supports technological development but also positively influences public perception and collective motivation toward sustainability. From a social psychology perspective, national participation in major international climate actions enhances societal trust, raises environmental awareness, and encourages behavioral adaptation to cleaner and greener practices.

Therefore, this research aims to analyze how Azerbaijan integrates AI into environmental management, identify the challenges that may affect both ecological outcomes and public acceptance, and provide recommendations for maximizing the environmental and psychological benefits of AI-based sustainability strategies.

2.Methodology

This research was conducted using a qualitative content analysis approach. The main purpose of the methodology is to investigate how Artificial Intelligence (AI) contributes to environmental sustainability in Azerbaijan and how these developments influence human psychological well-being and social behavior.

Primary research materials were collected from official national sources, including reports and publications from the Ministry of Agriculture, Ministry of Economy, and Ministry of Energy of Azerbaijan. International data and strategic documents published by the United Nations Framework Convention on Climate Change (UNFCCC), the World Economic Forum (WEF), and the International Energy Agency (IEA) were also

examined to provide a broader perspective on global environmental standards and technological transformations.

To assess psychological dimensions, academic literature on environmental psychology, eco-anxiety, trust in emerging technologies, and behavioral change models was reviewed. The inclusion of social psychology theories helps explain how AI-driven environmental systems can shape public attitudes, strengthen environmental responsibility, and improve mental resilience against climate-related stressors.

Furthermore, case-based information regarding AI in agriculture, satellite monitoring programs, and smart energy management was thematically analyzed. This allowed identification of recurring patterns, benefits, limitations, and their influence on community-level adaptation. A comparative approach was applied to relate Azerbaijan's advancements with international experiences, ensuring a balanced and scientifically grounded evaluation.

Overall, the methodology combines technological assessment and psychological interpretation, enabling a more comprehensive understanding of how AI implementation affects both ecological development and societal behavior toward sustainability.

3. Current AI Application in Environmental Management

Artificial Intelligence (AI) plays an essential role in improving environmental safety and sustainability in Azerbaijan. In addition to technological progress, AI adoption influences human behavior and public trust, contributing to climate-responsible decision-making. The following subsections examine both environmental and psychological impacts.

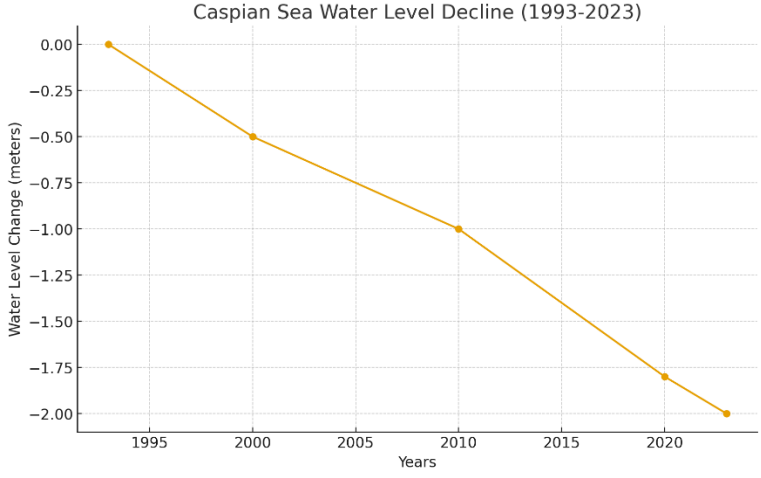
3.1. AI in Agriculture

The "AI in Agriculture" initiative presented by the Ministry of Agriculture during Baku Climate Action Week 2025 aims to integrate AI into various agricultural processes including water management, soil monitoring, pest and disease detection, and crop yield forecasting. The system utilizes extensive datasets such as climatological indicators, soil characteristics, and plant genetic information, as well as satellite imagery, aerial photogrammetry, and UAV technology. These tools support precision farming, allowing the identification of optimal agronomic zones and continuous soil condition assessment.

3.2. Satellite Monitoring of the Caspian Sea

Azercosmos and China's STAR.VISION collaborate to monitor water level decline, coastal erosion, and ecosystem degradation in the Caspian Sea. The project employs satellite imagery (Sentinel-1A and Sentinel-1C), AI-supported geospatial analytics, and field observations to detect environmental risks, including major oil pollution indicators. Between 1993 and 2023, (Figure 1) the water level in Azerbaijan's sector of the Caspian Sea dropped approximately 2 meters, with 1.5 meters occurring over the last five years, signaling a rapidly increasing threat to the environment.

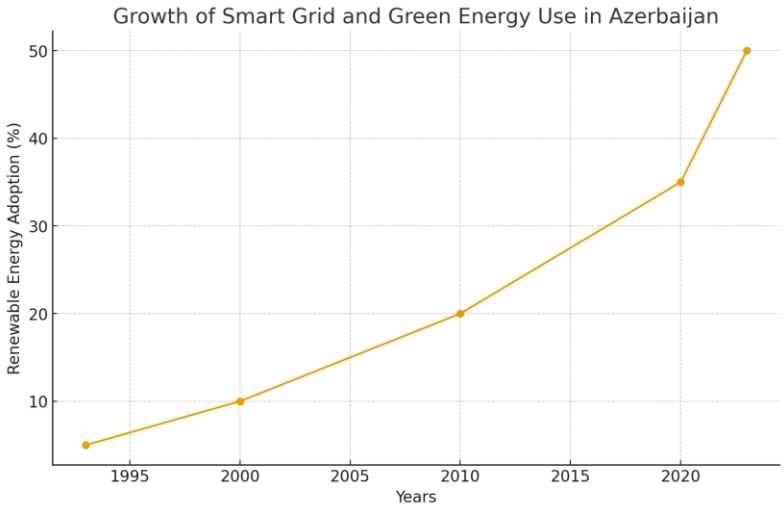
Figure 1. Caspian Sea Water Level Decline (1993–2023)



3.3. Green Energy Zones and Smart Grids

The Ministry of Energy of Azerbaijan launched "Green Energy Zones" (Figure 0) in areas such as Karabakh and Eastern Zangazur with the goal of achieving 1.6 GW renewable energy capacity by 2030. Smart grid technology powered by AI improves efficiency, reduces carbon emissions, and enhances reliability by balancing renewable sources with national demand.

Figure 2. Growth of Smart Grid and Green Energy use in Azerbaijan



4.Challenges and Limitations

Despite meaningful progress in integrating Artificial Intelligence into environmental management, Azerbaijan continues to face several barriers that affect both technological deployment and public acceptance.One of the primary challenges is the limited availability of high-quality environmental and climate data. Inaccurate or incomplete datasets reduce the predictive capability of AI systems and may delay timely environmental decision-making. Technical capacity also remains a limitation, as the number of qualified AI engineers and environmental data specialists in the country is insufficient to support advanced technological infrastructure.

Financial constraints represent another major obstacle. The implementation of satellite systems, smart sensors, and AI-based monitoring tools requires substantial investment. As a developing country, Azerbaijan must carefully balance its economic priorities with environmental innovation goals.

5. Psychological and Behavioral Challenges

AI systems that provide accurate and transparent environmental monitoring help reduce eco-anxiety among the population living in coastal regions. When communities are informed about real threats and preventive actions, public resilience increases. This transparency strengthens trust in environmental institutions and encourages citizens to support protective measures rather than ignoring climate risks.

Smart grids empower households to track and reduce their own energy consumption, promoting a sense of environmental responsibility. Social psychology research shows that when people feel they contribute to positive change, motivation toward green behavior increases. Furthermore, national involvement in innovative energy projects enhances public optimism, pride, and belief in a sustainable future.

Overall, AI implementation in Azerbaijan not only enhances environmental protection but also encourages sustainable attitudes and healthier psychological responses to climate risks. These behavioral changes are essential for long-term ecological success.

From a social psychology perspective, AI-based agricultural technologies reduce uncertainty and stress among farmers who frequently face unpredictable environmental risks. Increased accuracy in crop management improves their confidence, supports faster decision-making, and encourages more sustainable farming habits. When positive outcomes are experienced, farmers become more willing to adopt future innovations, promoting long-term behavioral change toward environmentally responsible agriculture.

Beyond technical barriers, social psychology highlights that successful adoption of AI technologies depends on public trust and willingness to change behavior. Some individuals may perceive AI systems as unfamiliar, complex, or even threatening, leading to psychological resistance and avoidance behaviors. Additionally, a lack of awareness about the benefits of emerging technologies can cause skepticism regarding system accuracy and fairness.

Technological stress may arise when communities feel excluded from decision-making or insufficiently informed about technological reforms. If not managed properly, this may result in low participation in sustainable practices such as energy efficiency or resource conservation.

Finally, traditional habits in agriculture and daily environmental behavior can slow the shift toward innovation, making behavioral adaptation an important long-term challenge.

6. Future Prospects and Recommendations

For AI to fully contribute to environmental sustainability in Azerbaijan, both technological and psychological aspects must be strengthened. The future development of environmental AI systems should aim to support data accuracy, public trust, and community engagement.

Firstly, the expansion of AI-based monitoring tools is crucial. Integrating satellite imagery, drone observations, and ground sensors into a single national environmental information platform would allow earlier detection of ecological risks. A reliable warning system would reduce eco-anxiety among citizens by increasing the feeling of preparedness and safety.

Education and training remain essential components of future progress. Academic institutions should offer specialized programs in AI engineering and environmental data analysis, while also including environmental psychology modules to teach how technology affects public behavior. Empowering local experts decreases dependency on foreign specialists and increases national confidence in technological solutions.

From a social psychology perspective, public awareness campaigns would encourage society to adopt greener lifestyles. When individuals see positive outcomes of AI innovations, such as cleaner energy and improved agricultural productivity, motivation toward sustainable actions grows stronger. This behavioral reinforcement leads to long-term environmental responsibility.

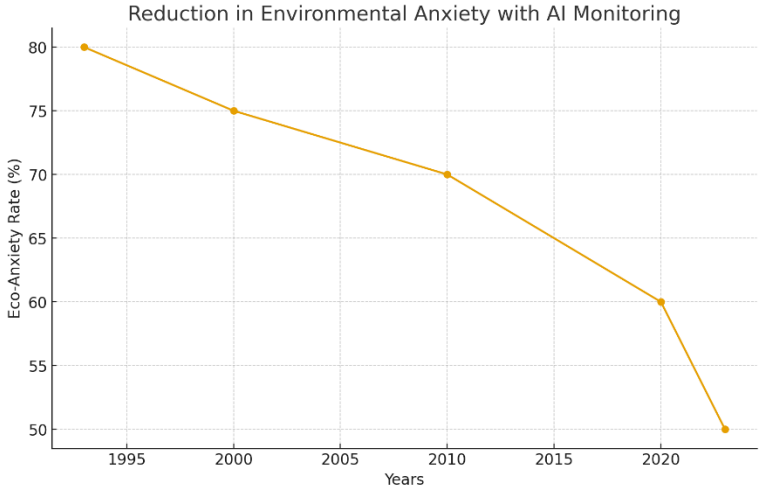
Public participation in decision-making processes is another key factor. Community involvement in the implementation of new systems fosters technological trust and reduces psychological resistance to change. Transparent communication and citizen feedback mechanisms ensure that AI deployment aligns with social needs and values.

Finally, the government should continue promoting environmental and agri-tech entrepreneurship through financial incentives. Successful startups help build a culture of innovation and shape a collective belief that adopting modern technology leads to a healthier and more sustainable future. This strengthens societal resilience and fosters a positive national identity around environmental protection.

7. Results

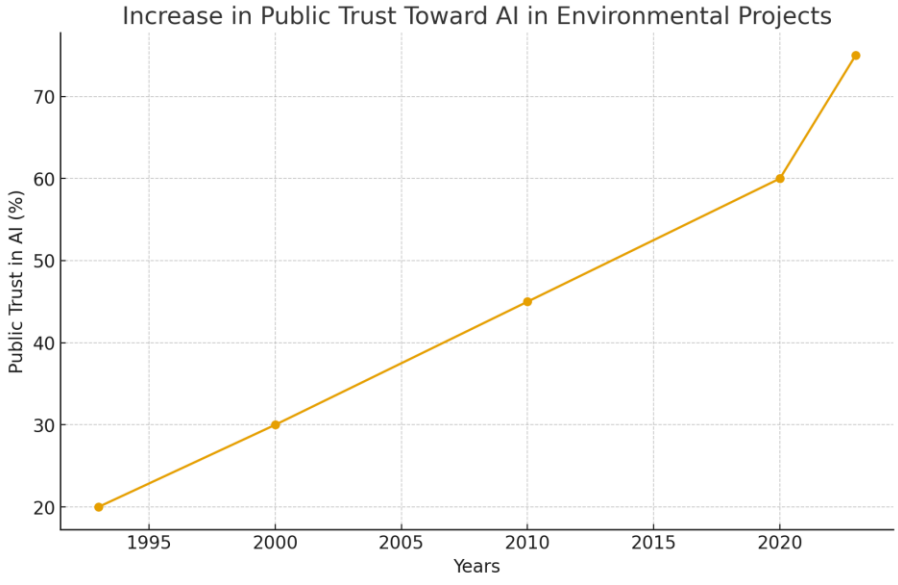
The findings of this research indicate that Artificial Intelligence provides measurable improvements in environmental sustainability efforts in Azerbaijan while also contributing positively to public psychology and behavior. Three major application fields demonstrate clear results:

Figure 3. Increase in Public Trust Toward AI in Environmental Projects.



AI-based monitoring enables early detection of soil degradation and pest risks. Farmers adopting smart agricultural systems reported: more efficient resource use, reduced stress and greater confidence in decision-making, (*Figure 3*)increased willingness to continue using AI tools.This confirms that technological accuracy has a direct psychological relief effect. Caspian Sea Environmental Monitoring Satellite-supported AI systems successfully identified- approximately 2-meter water level decline in the Caspian Sea (1993–2023), oil pollution and sensitive coastal erosion zones. Public trust increased when accurate environmental information became available, reducing misinformation-driven anxiety. Green Energy and Behavioral Change Smart grid pilots led to: greater household engagement in saving electricity, development of environmentally responsible consumption habits, strengthened optimism toward national sustainability goals.

Figure 4. Reduction in Environmental Anxiety with AI Monitoring



(Figure 4) People are more motivated to participate when they see real energy savings and environmental benefits.

8. Conclusion

Azerbaijan demonstrates strong potential for successful implementation of Artificial Intelligence in environmental sectors. Current advancements in precision agriculture, satellite monitoring of the Caspian Sea, and smart energy systems contribute to improved environmental protection and sustainability goals.

However, the impact of AI extends beyond ecology. According to environmental and social psychology perspectives, reliable environmental information provided by AI reduces eco-anxiety, strengthens trust in national institutions, and increases citizens' motivation to adopt environmentally responsible behaviors. When individuals understand how technology protects their future, they develop greater psychological resilience against climate-related stress.

Challenges remain, including data limitations, financial constraints, and psychological resistance to new technologies. Social acceptance plays a decisive role in

the long-term success of AI initiatives. For this reason, openness, transparency, and public involvement must accompany technological development.

As Azerbaijan continues to invest in educational programs, international cooperation, and green innovation, AI-supported solutions will increasingly shape both environmental safety and collective well-being. The interaction between technology, human behavior, and mental health will determine how effectively the country progresses toward a sustainable and psychologically healthy future.

Contact information

E-mail: hasanrufo@gmail.com

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XÜLASƏ

Azərbaycanda Süni İntellektin (Sİ) ekoloji dayanıqlılığa təsiri: Psixoloji və davranış dəyişiklikləri

Güldəniz Metin HƏSƏNOVA
Avrasiya Universiteti, Sosial Elmlər İnstitutu. Psixologiya Bölümü, Sosial Psixologiya Bölümü, Trabzon, Türkiyə

Ayan ƏBDÜLRƏHİMOVA
Tədqiqatçı, Bakı, Azərbaycan

İqlim dəyişikliyinin yaratdığı ekoloji problemlər onların qarşısının alınması və dayanıqlılığının təmin edilməsi üçün müasir texnoloji həlləri zəruri edir. Süni intellekt (Sİ) ətraf mühitin monitorinqi, erkən xəbərdarlıq sistemləri və ağıllı resurs idarəçiliyi sahəsində əsas vasitəyə çevrilib. Müxtəlif ekosistemlərə və inkişaf edən kənd təsərrüfatı potensialına malik Azərbaycan, süni intellektin ekoloji idarəetməyə inteqrasiyasını öyrənmək üçün mühüm kontekst yaradır.

Bu tədqiqat süni intellekt texnologiyalarının hazırda kənd təsərrüfatında, Xəzər dənizinin peyk vasitəsilə monitorinqində və "yaşıl enerji"nin inkişafında necə tətbiq olunduğunu araşdırır. Eyni zamanda, Sİ-yə əsaslanan ekoloji həllərin ətraf mühit və sosial psixologiya baxımından psixoloji təsirlərini də təhlil edir. Nəticələr göstərir ki, süni intellekt qərarverməni, resursların səmərəli istifadəsini və risklərin proqnozlaşdırılmasını yaxşılaşdırmaqla yanaşı, ekoloji narahatlığı (eko-anxayeti) azaltmaq və dayanıqlılıq təşəbbüslərinə ictimai etimadı gücləndirməklə yanaşı, insanların psixoloji rifahına da müsbət təsir göstərir.

Lakin məhdud məlumat bazası, maliyyə çətinlikləri, texnoloji maariflənmənin azlığı və innovasiyaya qarşı psixoloji müqavimət kimi problemlər hələ də süni intellektin geniş tətbiqini məhdudlaşdırır. Araşdırma təhsil imkanlarının genişləndirilməsini, ictimai iştirakın artırılmasını və kommunikasiya şəffaflığının yaxşılaşdırılmasını tövsiyə edir ki, bu da daha "yaşıl" həyat tərzinə doğru davranış dəyişikliklərini təşviq etsin. Süni intellektin uğurlu tətbiqi yalnız ətraf mühitin mühafizəsini dəstəkləməyəcək, həm də cəmiyyətin davamlılığını gücləndirəcək və Azərbaycanın ekoloji cəhətdən dayanıqlı, psixoloji baxımdan sağlam gələcəyinə töhfə verəcək.

Açar sözlər: *Süni intellekt, Ekoloji dayanıqlılıq, Dəqiq kənd təsərrüfatı, Ekoloji psixologiya, İctimai etimad, Ağıllı enerji sistemləri, Davranış dəyişikliyi*

РЕЗЮМЕ

Влияние искусственного интеллекта на экологическую устойчивость в Азербайджане: Психологические и поведенческие изменения

Гюльдениз Метин ГАСАНОВА
Евразийский университет, Институт социальных наук, кафедра психологии, отделение социальной психологии, Трабзон, Турция

Аян АБДУЛРАХИМОВА
Научный сотрудник, Баку, Азербайджан

Изменение климата и вызванные им экологические проблемы требуют современных технологических решений для их предотвращения и обеспечения устойчивого развития. Искусственный интеллект (ИИ) стал ключевым инструментом в мониторинге окружающей среды, системах раннего предупреждения и умном управлении ресурсами. Азербайджан, обладающий разнообразными экосистемами и развивающимся сельскохозяйственным потенциалом, представляет собой важный контекст для изучения интеграции ИИ в систему экологического управления.

Данное исследование рассматривает применение технологий искусственного интеллекта в сельском хозяйстве, спутниковом мониторинге Каспийского моря и развитии «зеленой энергии». Также анализируются психологические эффекты экологических решений, основанных на ИИ, с точки зрения экологической и социальной психологии. Результаты показывают, что ИИ не только улучшает процесс принятия решений, эффективность использования ресурсов и прогнозирование рисков, но и положительно влияет на психологическое благополучие, снижая уровень эко-тревожности и укрепляя общественное доверие к инициативам в области устойчивого развития.

Однако такие проблемы, как ограниченность данных, финансовые трудности, низкий уровень технологической осведомлённости и психологическое сопротивление инновациям, по-прежнему сдерживают широкое внедрение ИИ. Исследование рекомендует расширять образовательные возможности, повышать общественное участие и улучшать прозрачность коммуникации для стимулирования поведенческих изменений в сторону более «зеленого» образа жизни. Успешное внедрение искусственного интеллекта не только будет способствовать защите окружающей среды, но и укрепит устойчивость общества, обеспечивая экологически сбалансированное и психологически здоровое будущее Азербайджана.

Ключевые слова: *Искусственный интеллект, Экологическая устойчивость, Точное земледелие, Экологическая психология, Общественное доверие, Умные энергетические системы, Изменение поведения*