



ECOLOGICAL PROBLEMS OF UZBEKISTAN: PURSUIT OF STABILITY BETWEEN NATURE AND HUMANITY

Bibirajab Yuldosheva

PhD, Associate Professor at Bukhara State University

Dilfuza Izzatova

Student at Bukhara State University

ANNOTATSIYA:Maqola O'zbekistonning tarixiy geografiyasida ekologik va iqlim masalalari yuzasidan muhim fikrlarni o'z ichiga oladi. Unda nafaqat O'zbekiston, balki butun dunyo uchun global muammolar hisoblangan Orolbo'yi, ozon qatlami teshilishi, atmosferaning isishi va ichimlik suvi tanqisligi kabi muammolar batafsil yoritilgan. Alohida ta'kidlash joizki, ayrim ekologik muammolar insonning tabiatdan noto'g'ri foydalanishi oqibatida paydo bo'lgan. Shu bilan birga, qadimgi va o'rta asrlar, xususan, Temuriylar davri va sovetlar zamonida atrof-muhit masalalarida yo'l qo'yilgan xatolar ham muhokama qilingan.

Muammolarni hal qilishda respublika aholisi tabiatdan oqilona foydalanishga doir amaliy ishlarni amalga oshirgan. Bu o'z navbatida, inson va tabiat o'rtasidagi barqaror munosabatlarni shakllantirishda ijobiy o'rnatqich bo'la oladi. Maqolada ushbu tadbirlar haqida ham qisqacha to'xtalib o'tilgan.

Kalit so'zlar: neolit, geografik kenglik, ekologiya, iqlim, migratsiya, atmosfera, landschaft, ozon qatlami, antropogen omil, subtropik, radiatsiya, ekologik inqiroz, barxan, shamol, maydon, dehqonchilik, o'simlik, antropogen omil, Temuriylar, Sovetlar.

АННОТАЦИЯ:Статья охватывает важные аспекты экологических и климатических проблем в исторической географии Узбекистана. В ней подробно рассматриваются глобальные проблемы, такие как Приаралье, истощение озонового слоя, потепление атмосферы и дефицит питьевой воды, которые актуальны не только для Узбекистана, но и для всего мира. Особо следует отметить, что некоторые экологические проблемы возникли в результате неправильного использования природы человеком. Также обсуждаются ошибки в вопросах окружающей среды, допущенные в древности, в средние века, в частности, в эпоху Тимуридов, и в советский период.

В решении этих проблем население республики внесло значительный вклад, демонстрируя пример рационального использования природных ресурсов. Это, в свою очередь, способствует формированию устойчивых отношений между человеком и природой. В статье также кратко упоминаются эти мероприятия.

Ключевые слова: неолит, географическая широта, экология, климат, миграция, атмосфера, ландшафт, озоновый слой, антропогенный фактор, субтропики, радиация, экологический кризис. дюны, ветер, поле, земледелие, растительность, антропогенный фактор, Тимуриды, Советы.

ABSTRACT:The article covers important aspects of environmental and climate issues in the historical geography of Uzbekistan. It discusses global issues, such as the Aral Sea region, ozone depletion, atmospheric warming, and drinking water scarcity, which are relevant not only for Uzbekistan but for the entire world. Notably, some of these environmental problems have arisen due to the improper use of nature by humans. The article also addresses environmental mistakes made in ancient times, the Middle Ages, particularly during the Timurid period, and the Soviet era.

In addressing these problems, the people of the republic have made significant efforts, setting an

example of rational use of natural resources. This, in turn, helps foster sustainable relationships between humans and nature. The article briefly highlights these initiatives as well.

Keywords: Neolithic, latitude, ecology, climate, migration, atmosphere, landscape, ozone layer, anthropogenic factor, subtropics, radiation, ecological crisis. dunes, wind, field, agriculture, vegetation, anthropogenic factor, Timurids, Soviets.

INTRODUCTION

The territory of Uzbekistan has been inhabited since ancient times. Throughout history, people have brought water to the vast barren deserts, creating new oases, canals, and reservoirs. Various minerals were discovered in the earth's crust, extracted, and large industrial centers were established. As a result of these changes, the impact of human activities on the natural environment intensified significantly, and in some regions, this impact became hazardous.

Today, issues such as the Aral Sea and its surrounding areas, water scarcity, the degradation of pastures, urban air pollution, abrupt climate warming, and desertification are pressing problems for our country. Moreover, both in our republic and globally, numerous unresolved issues remain concerning the protection of nature and the rational use of natural resources.

METHODS

The article is based on universally accepted historical methods, including the principles of historicism, comparative-logical analysis, chronological sequence, objectivity, and systematic approach. It analyzes ecological and climatic issues in the historical geography of Uzbekistan using various sources.

RESEARCH RESULTS

Uzbekistan is located in the central part of Turkestan, with the majority of its territory situated between the Amu Darya and Syr Darya rivers, within temperate and subtropical climate zones. Despite being geographically aligned with countries surrounding the Mediterranean, Uzbekistan's natural conditions differ significantly from those regions [1]. This is because Uzbekistan is located deep within the continent, far from warm oceans and seas.

The northern part of Uzbekistan is open, allowing cold and dry air currents from the north and northeast to penetrate the interior during winter [1]. Conversely, the high mountains in the south block the humid and warm air masses coming from the Indian Ocean from entering Uzbekistan. As a result, the country's landscape deviates from typical subtropical climates, with cloudless, sunny, and scorching hot summers, and winters that are relatively cold for this latitude.

Although Uzbekistan is situated within a subtropical climate zone, it is predominantly characterized by desert landscapes. Only in the Surkhan-Sherabad valley, surrounded by mountains, can a dry subtropical landscape be found [1].

The significance of natural resources in societal development can be vividly observed through the relationship between humans and nature over different periods. In the earliest times, humans were almost entirely dependent on their natural surroundings. During this period, nature dominated humanity rather than the reverse [6]. Human labor activities and lifestyles were determined by the characteristics of the natural environment. For example, ancient humans tended to settle along rivers, particularly in elevated areas, as much of the Earth's surface was covered with forests at that time. Rivers and lakes served as the most convenient transport routes, and fishing and hunting aquatic animals were much easier than hunting terrestrial animals.

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As time progressed, as a result of the development of human intellect, the power to influence nature also increased. During the Neolithic period, people began domesticating animals and mastering agriculture. The domestication of animals, the emergence of animal husbandry, and engaging in agriculture further strengthened human influence on nature, especially on the plant world. This is because plowing land, planting crops, and grazing livestock in specific areas led to the disruption of natural vegetation, which, in turn, affected other elements of nature.

During the Mesolithic, Neolithic, Bronze Ages, and the 2nd–1st millennia BCE, the relationship between nature and primitive communities in the territory of Uzbekistan led to minimal or moderate changes [8]. Overall, during this period, no sharp contradictions arose between nature and society. Only in some areas did the number of animal species decrease, but not a single species was completely exterminated by ancient humans. The disappearance of some species was caused by sharp changes in natural conditions, such as the expansion of glacial areas in the mountains or a cooling climate [8].

In the 6th–4th centuries BCE, large-scale irrigated agriculture was practiced in the lower Amu Darya, lower Syr Darya, Zarafshan river basins, and the Fergana Valley [8]. By the mid-1st millennium BCE, the history of irrigation in Turkestan entered a new phase: large canals and irrigation systems were dug, their main infrastructure was built, and regular irrigation systems were established in river deltas. Many of today's large irrigation canals were constructed or reconstructed during this period, particularly during the Kushan era (1st–4th centuries CE). From this period onward, human influence on nature became noticeably stronger.

Based on written sources from the Timurid period, when looking at the state of water resources, nature, and economy in Central Asia, the climate during this era appears to have been slightly more humid compared to today [9]. For example, in years when the Zarafshan River overflowed, its water reportedly reached the Amu Darya. During the Timurid period, irrigated agriculture in the Zarafshan Valley expanded, new lands were cultivated, and gardens and orchards were established. The increase in the number of villages and cities, as well as the population, occurred as a result of urbanization and migration processes. In the Murghab River Valley, large-scale irrigation systems were developed, accompanied by major landscaping efforts. Compared to today, in the 15th century, water from southern Turkmenistan's rivers extended 40–50 km further north [9]. In general, rivers had higher water levels, and water resource utilization was broader.

From the Timurid period to the present, the climate, water resources, vegetation, and wildlife of Central Asia have undergone significant changes. The main reason for these changes is human activity, or anthropogenic factors, which have impacted various elements of nature. In the past, the flora and fauna of Central Asia were highly diverse, but today, part of this wealth has been lost.

One of the major ecological problems in Uzbekistan, as well as globally, is the ecological crisis of the Aral Sea region. Since the 1960s, errors in agricultural practices and the misuse of natural resources in the Aral Sea area have led to severe environmental disasters. These errors have resulted in ecological tensions in many parts of the region, creating significant problems.

From the 1960s onwards, activities such as developing new lands along the banks of the Amu Darya, constructing unique hydraulic structures, building massive reservoirs and main canals, intensifying agriculture with chemical inputs, neglecting crop rotation, and focusing on cotton monoculture brought significant changes to the biosphere [3]. These actions created interconnected major challenges for

preserving the biosphere and preventing ecological disasters, not only in certain regions but across vast territories.

The main sources of water supply for the Central Asian republics are the Amu Darya and Syr Darya. The tributaries of these rivers are used for irrigation and meeting the water needs of the population. The average annual total volume of surface water resources in the Aral Sea basin is 126.9 km³. For instance, in 1940, 54.1 km³ of water was used to irrigate 3.5 million hectares of land, while by 1960, this increased to 4.3 million hectares using 60.1 km³, and by 1980, nearly 7 million hectares required 108 km³ of water. In Uzbekistan, a total of 6.2 km³ of water was used in 1980 for industrial, municipal, and other household needs [3].

According to data, excessive use of water resources for various needs occurred between 1960 and 1980. Meanwhile, starting in the 1970s, water shortages emerged due to reduced precipitation in the region. Between 1974 and 1986, water sources decreased by an average of 80–90% [3]. Due to the excessive withdrawal of water for irrigation and natural water scarcity, the volume of water in the lower reaches of the Amu Darya and Syr Darya gradually decreased. For example, between 1911 and 1960, the average volume of water flowing into the Aral Sea from both rivers was 52 km³, which dropped to 16.6 km³ between 1971 and 1980 and further to 4.2 km³ between 1981 and 1985 [3].

The reduction in water inflow to the Aral Sea has led to an increase in its salinity levels: the salt concentration rose from 10.5 grams per liter to 28–29 grams [3]. Such a decline in sea levels and increase in salinity has not been observed anywhere else. As a result, one-third of the area dried up, turning into sandy and saline desert. By 1981, the sea had completely lost its significance for transportation and fishing.

The Aral Sea, located at the convergence of desert regions such as the Karakum, Kyzylkum, Ustyurt, Aral Sea area, and the Greater and Lesser Barsuki of the Turan lowlands, has seen the disruption of natural balance due to its drying up. This has led to the loss of biodiversity and a nearly impossible chance of restoration. Mismanagement of water resources in irrigated agriculture has caused an increase in the volume of drainage and wastewater. Currently, the total volume of these waters in the Aral Sea basin exceeds 31 km³.

The Aral Sea was recently the largest lake in Central Asia. In terms of size, it ranked fourth in the world after the Caspian Sea, Lake Superior in North America, and Lake Victoria in Africa. The total area of the Aral Sea exceeded 66,000 square kilometers. However, due to improper economic management, the sea's area shrank to 17,600 square kilometers. Before 1960, the salt concentration in the sea was up to 11 grams per liter, but this has now risen to 72 grams, turning the sea into a saline wasteland [7]. Previously, the sea retained salt, but today it has become a source that disperses salt across the surrounding areas.

The drying up of the Aral Sea has also significantly impacted the region's climate. Now, in the lower reaches of the Amu Darya and Syr Darya, winter temperatures are 1.5–2°C lower than the long-term averages, while summers have become even hotter. The worsening natural, geo-ecological, and socio-economic situation in the Aral Sea region has become one of the major ecological concerns not only for Uzbekistan but also for the global community.

The problem of protecting nature and the environment has primarily arisen due to the extensive and deep interference of human activity in natural processes. In the 1960s–80s, this issue posed a significant threat to all of humanity. As human economic activity intensified yearly, virgin lands were developed, power plants and industrial enterprises were built, and new cities were established [10]. This process disrupted the existing natural balance, leading to ecological tensions.

While scientists worldwide emphasized that the disruption of ecological balance posed a threat equivalent to the risk of nuclear war, the Soviet government and the Communist Party paid little attention to this issue, refusing to acknowledge ecological problems or take preventive measures. Major heavy industry sectors in Uzbekistan, including metallurgy, oil and gas, energy, and chemical industries, were under the control of Union ministries. These enterprises polluted the environment with toxic gases and waste. In particular, chemical plants and complexes had a significant negative impact on ecological conditions. Chemical plants were built in densely populated cities such as Navoi, Chirchik and Fergana, severely worsening the ecological state of these areas [10].

In Uzbekistan, highly toxic chemical substances have been extensively used to protect cotton fields from pests. During the mid-1980s, 90,000 tons of pesticides were applied in agriculture, with more than half

sprayed from airplanes. This practice contaminated air and water, causing significant harm to public health, nature, and wildlife. One particularly toxic chemical, butiphos, was used for defoliation (shedding of cotton leaves) for 20 years, often at rates two to three times higher than recommended [10]. While the use of this chemical was banned in 1981, some farms continued its application. The policies pursued during the Soviet era caused substantial environmental problems and losses in Uzbekistan, leaving unresolved issues and introducing new ecological and climatic challenges.

Environmental threats know no boundaries and pose a danger to all. One such threat is the expansion of the "ozone hole," primarily caused by anthropogenic factors—human activities emitting harmful chemical compounds into the atmosphere. These substances deplete the ozone layer, allowing harmful ultraviolet rays to reach the Earth's surface. Research indicates that a 1% depletion in the ozone layer could lead to a 5–6% increase in skin cancer cases. Currently, a 3-million-square-kilometer ozone hole has been recorded in the Northern Hemisphere [2]. The increase in ultraviolet radiation is not only damaging to human health but also severely impacts ecosystems.

Another ecological disaster is the "greenhouse effect." The rise in atmospheric carbon dioxide (CO₂) and other greenhouse gases is causing global warming, which leads to the melting of polar ice caps and increases the risk of rising sea levels. This puts numerous cities, populated areas, and even some countries at risk of being submerged.

In Uzbekistan, one pressing ecological issue is the rational use and conservation of water resources. Water, as nature's priceless gift, must be utilized efficiently and protected from pollution. Despite the abundance of groundwater in some urban areas, 20% of these reserves are no longer fit for drinking [2]. Addressing these issues requires expanding water treatment facilities and improving sewage systems.

Improving soil fertility and managing irrigated lands effectively are also critical ecological priorities. Irrigated lands are among our most valuable assets, playing a significant role in ensuring food security. Additionally, the protection of flora and fauna is essential for ecological stability. Plants help moderate the climate, purify the air from dust and dryness, reduce noise, improve river water regimes, and minimize soil erosion. The fauna is an equally vital component of the biosphere, and its conservation is crucial. Today, 10% of Uzbekistan's flora and fauna face the risk of extinction.

The consequences of the ecological crisis include an increase in various diseases worldwide. For example, in the 1960s, there were four cancer cases per 100,000 people, but today this number has risen to 11 [2]. Other illnesses such as allergies, asthma, neurological disorders, hypertension, cardiovascular diseases, gastrointestinal conditions, hepatitis, and diabetes are also on the rise. Heart attacks, once predominantly seen in older individuals, are now increasingly observed in people aged 30–40.

A portion of return flows is reintroduced into rivers and reused for irrigation in their lower reaches. However, another portion is discharged into desert areas, resulting in the formation of saline lakes of various sizes. The decline in plant species in floodplain forests is caused by reduced river water levels, increased pollution, elevated groundwater salinity, and the conversion of floodplains for other uses. The mineralization level of river waters throughout the year ranges from 1.2 to 2.5 grams per liter, with even higher levels recorded in some years [3]. This adversely affects plant growth, leading to their drying out and vulnerability to diseases.

Frequent fires in riparian forests caused by the drying of vegetation are leading to the loss of plant species. Additionally, winds transport sand from one place to another, forming sand dunes. This intensifies the dry and dusty winds, known as "garmsel," typical of Uzbekistan's climate [3].

In some regions of Uzbekistan, drinking water scarcity is a pressing issue. For instance, while an average of 15 liters of water per person per day is necessary, there are challenges in ensuring access to clean water. Although 80% of the population has access to clean water, rivers become polluted along their course due to waste from livestock, households, industrial enterprises, and drainage systems [4]. Furthermore, harmful substances and disease-causing microbes from healthcare facilities sometimes enter river water. In agriculture, chemical fertilizers and pesticides exacerbate river pollution through drainage systems.

Due to its inland location within the Eurasian continent and its distance from oceans and seas, Uzbekistan's climate is continental. Summers are long, hot, and dry, while winters are relatively cold and dry for this latitude. Located mainly in a desert zone and subtropical latitudes, Uzbekistan receives prolonged direct sunlight and experiences little cloud cover [5]. This contributes to the aridity and extreme

heat of the climate.

Anthropogenic factors also significantly influence Uzbekistan's climate. Population growth, urbanization, the expansion of cities and industrial enterprises, increased transportation, and various construction activities release dust, toxic gases, and solid particles into the air. This affects the albedo levels and accelerates condensation processes.

In 28 cities and residential areas of Uzbekistan, pollution levels exceed sanitary norms. These issues are particularly significant in cities such as Andijan, Almalyk, Angren, Bekabad, Fergana, Chirchik, Navoi, Tashkent, and Samarkand [5].

To address ecological issues, effective measures must be implemented to protect public health, conserve water resources, reduce industrial waste, and improve the climate.

Human impact on nature has reached such a level that the initial natural state of the atmosphere, biosphere, and lithosphere has significantly changed [6]. In Uzbekistan, this impact is evident in various environmental issues. For example, uncontrolled grazing of livestock is damaging vegetation, intensifying soil erosion, and causing sand movement. Fertile oases that were once thriving are turning into deserts due to encroaching sand. By the 1930s, sands had already started encroaching on the northern part of the Bukhara oasis. Ruins of ancient settlements, canals, and irrigation systems found in the deserts indicate that these areas were once prosperous.

The Aral Sea's water level continues to drop, and the lower reaches of the Amu Darya and Syr Darya are drying up. As the Aral Sea recedes, the exposed seabed becomes a source of wind-blown sand and salt, spreading across surrounding areas. If errors are not corrected and measures are not taken to preserve the Aral Sea, the desert will expand, and soil fertility in oases will further decline.

Nature possesses many laws and phenomena that are yet to be fully understood. Ignoring these laws in our interactions with the environment can lead to harm to both nature and humanity. Therefore, rational use, protection, and enhancement of natural resources are among humanity's most important tasks. In Uzbekistan, several laws have been developed to protect the environment and preserve ecology, implementing practical measures aimed at safeguarding nature.

CONCLUSION

Human impact on nature has been increasing for centuries, leading to global ecological crises today. In Uzbekistan, this impact is markedly evident, with issues such as water scarcity, desertification, soil erosion, and air pollution becoming more severe. The drying of the Aral Sea, mismanagement of water resources, reduction of riparian forests, and soil salinization are factors threatening the ecological balance of the entire region. The depletion of the ozone layer, the greenhouse effect, and the mismanagement of natural resources are causing serious ecological threats not only locally but also globally.

Various measures are being developed to protect nature, use it rationally, and address ecological issues. Uzbekistan has also introduced laws and regulations aimed at reducing ecological problems and protecting the environment. However, enterprises, organizations, and individuals causing environmental damage must compensate for the harm caused in accordance with the law. Criminal or administrative liability for violating environmental regulations does not exempt offenders from the obligation to make reparations for the damage caused.

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