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USE OF MINERAL RESOURCES IN THE FERGANA VALLEY AND RELATED ECOLOGICAL PROBLEMS

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ABSTRACT

This article examines the mineral resources of the Fergana Valley, the current status of their utilization, and the environmental problems associated with their exploitation. It also provides a comprehensive analysis of the scale of these environmental challenges and presents detailed information on the measures being implemented at both the international and national levels to mitigate their impacts and promote the sustainable use of mineral resources.

Keywords

Fergana Valley, mineral resources, mineral deposits, environmental problems, land reclamation, environmental monitoring, sustainable development.

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INTRODUCTION

The Fergana Valley is one of the most significant natural, economic, and geopolitical regions in Central Asia. A comprehensive assessment of its geographical location from the perspectives of physical, economic, political, and mathematical geography is of considerable scientific importance. From the standpoint of physical geography, the Fergana Valley is situated in the easternmost part of Uzbekistan, within an intermontane depression between the Tian Shan and Alay mountain systems, and is almost entirely surrounded by mountain ranges. The valley is bordered by the Turkestan and Alay ranges to the south, the Fergana and Otoynoq ranges to the east, the Chatkal Range to the north, and the Qurama and Qoramazor ranges to the northwest. The only western outlet of the valley is the narrow (8–9 km wide) Fergana Gate, also known as the Khujand Gate, which connects the valley with the Dalvarzin and Mirzacho'l plains (Figure 1.1).

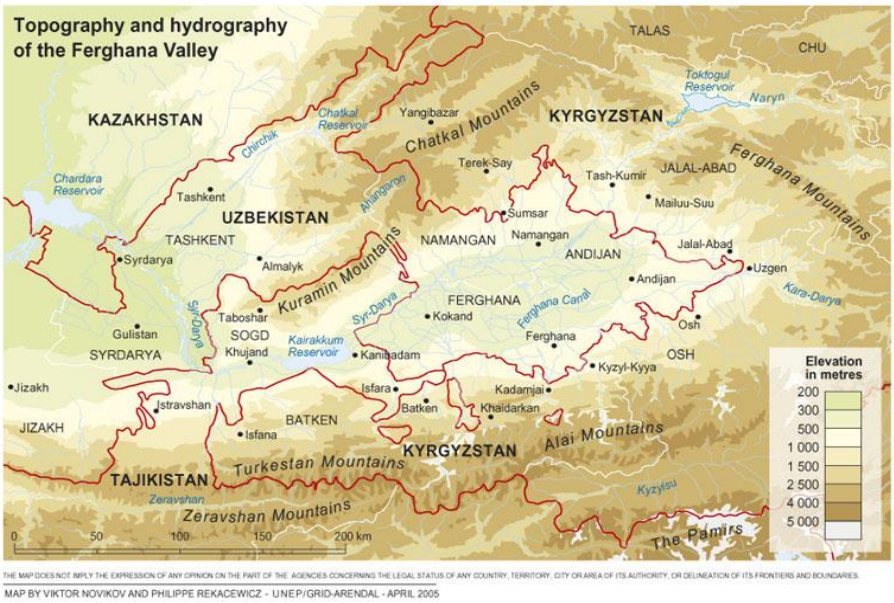


Figure 1.1. Physical Map of the Fergana Valley

The central part of the Fergana Valley lies at an elevation of approximately 200–300 m above sea level, while the terrain gradually rises toward the surrounding margins. The increase in elevation is particularly pronounced in the northern and northwestern parts, where absolute elevations reach approximately 2,200 m.

From a geomorphological perspective, the Fergana Valley constitutes a single artesian basin. Numerous rivers and streams originating in the surrounding mountain ranges flow toward the central part of the valley and ultimately discharge into the Syr Darya River. The Syr Darya is the only transit river that flows out of the valley. Owing to this distinctive geomorphological feature, the region is also referred to as the Fergana Depression.

The Fergana Valley is located approximately between 40°00′–41°20′ N latitude and 70°00′–73°40′ E longitude. In terms of latitude, it lies within the same climatic belt as the subtropical regions of Southern Europe, including Spain and southern Italy, as well as parts of East Asia, such as Beijing.

According to the scientific literature (e.g., A. Soliyev and G. Asanov), the economic-geographical position of the Fergana Valley is characterized by the concepts of a regional enclave and a transboundary crossroads.

First, the valley is shared by three sovereign states—Uzbekistan, Kyrgyzstan, and Tajikistan—and encompasses seven administrative regions: Andijan, Namangan, and Fergana in Uzbekistan; Osh, Jalal-Abad, and Batken in Kyrgyzstan; and Sughd in Tajikistan. This complex administrative and territorial structure not only creates various cross-border challenges but also provides significant opportunities for the development of cross-border economic cooperation.

Second, the hydrogeographical location of the region is highly advantageous. The Syr Darya River and its major upper tributaries, including the Naryn, Kara Darya, Sokh, Isfara, Shahimardan, Isfayram, Ak-Buura, and Quvasay rivers, provide the valley with a stable supply of water resources. Historically, this favorable hydrological setting has supported the development of intensive irrigated agriculture, including cotton cultivation, rice farming, horticulture, vegetable production, and sericulture.

Third, from the perspective of industrial geography, the Chimyon and Mingbulak oil and gas fields, the Sho‘rsuv sulfur deposit, and the local mineral raw material resources around Quvasay and Olmos have formed the basis of the region’s industrial production system. These mineral resources contribute significantly to the economic self-sufficiency of the valley, although the largest mineral deposits are primarily located in the mountainous areas of neighboring countries.

Fourth, demographic potential is another key factor defining the economic-geographical significance of the Fergana Valley. With a population of approximately 16 million, the valley is the most densely populated region in Central Asia. This demographic advantage provides a substantial labor force for labor-intensive industries, including textiles, machinery manufacturing, electronics, and food processing.

The Fergana Depression possesses a unique geological structure characterized by thick sedimentary rock sequences containing major hydrocarbon resources, while metallic ore deposits occur along the foothills of the surrounding mountain ranges. National sources report the presence of oil, coal, natural gas, gypsum, iron and copper ores, mercury, limestone, zinc, sulfur, ozokerite, rock salt, polymetallic ores, antimony, and mineral water deposits. These natural resources have historically constituted the foundation of the regional economy, and today the Fergana Economic Region remains one of Uzbekistan's leading centers for the oil and gas industry as well as mining and chemical production.

The Fergana Valley is widely recognized as the birthplace of the petroleum industry in Central Asia. At the Chimyon oil field, production of approximately 130 tons of crude oil per day was recorded from a depth of 278 meters. Subsequently, the Yarkutan and Selrokhs oil fields were discovered, the Chimyon–Vannovsk oil pipeline was constructed, and regional oil refining facilities were expanded. By 1913, annual oil production in the region had reached approximately 13,000 tons. Natural gas utilization also originated in the valley: in 1944, a gas pipeline was constructed from the Andijan gas field to the city of Andijan, and commercial gas production began at the Polvontosh field in 1951.

At present, the Fergana and Altariq oil refineries are the major petroleum processing enterprises in the valley, producing gasoline, diesel fuel, kerosene, and lubricating oils. The Fergana Oil Refinery is one of the largest industrial enterprises in the region, employing nearly 7,000 workers. In the Kyrgyz sector of the valley, the Tash-Kömür, Kök-Jaŋgak, Kyzyl-Kiya, and Sulukta coal deposits have historically played an important role in regional energy production.

The southern and northern foothill zones of the valley contain significant non-ferrous metallurgical deposits. Among the most prominent are the Khaidarkan (Aydarken) mercury–antimony deposit and the Kadamzhai Antimony Combine in Batken Region, Kyrgyzstan. According to the United Nations Environment Programme (UNEP), the Khaidarkan deposit has been the world's last primary producer of mercury for export, supplying approximately 10% of the global mercury market.

A separate category of environmental concern is represented by the legacy of uranium mining. Central Asia served as one of the principal uranium-producing regions of the former Soviet Union. Although most uranium mines and processing facilities were closed by 1995, little attention was paid for many years to mitigating the environmental and public health risks associated with the remaining radioactive and toxic waste. In 2017, the International Atomic Energy Agency (IAEA) identified seven priority uranium legacy sites in the region, all of which are located within or adjacent to the Fergana Valley.

Table 1. Major Mineral Resources of the Fergana Valley

Resource Group	Main Types	Location and Remarks
Fuel and Energy Resources	Oil, natural gas, coal, ozokerite	Chimyon, Polvontosh, Mingbulak (Uzbekistan); Tash-Kömür, Kyzyl-Kiya, Sulukta (Kyrgyzstan)
Non-Ferrous Metals	Mercury, antimony, polymetallic ores, zinc, copper	Khaidarkan (Aydarken), Kadamzhai, Sumsar, Kan (Kyrgyzstan)
Non-Metallic Raw Materials	Limestone, gypsum, sulfur, rock salt	Used primarily for the construction materials and chemical industries
Water Resources	Mineral and thermal waters	Chimyon, Shahimardan, and other locations

The Khaidarkan and Kadamzhai industrial complexes represent one of the most significant environmental challenges in the Fergana Valley. Since the 2010s, international organizations have supported the Government of Kyrgyzstan in facilitating the transition from primary mercury mining to alternative economic activities. The initiative has focused on three strategic objectives: reducing the most urgent environmental and public health risks associated with the mining area, attracting investment in alternative industries, and creating sustainable employment opportunities for local communities.

The health impacts of mining activities have been confirmed through field-based investigations. Within the framework of an international assessment program conducted in Batken Region, environmental and medical surveys were carried out in Aydarken, neighboring settlements, and the Chauvay area. The studies identified three major environmental contaminants—arsenic, antimony, and mercury. Elevated concentrations of antimony and arsenic were detected in the

blood and urine of vulnerable population groups, particularly children and women of reproductive age. These findings provide direct medical evidence of the long-term environmental legacy of mining activities.

The Uzbek section of the Fergana Valley is characterized by a high concentration of industrial enterprises. More than 80 industrial facilities operate in Fergana Region, including the Fergana Azot Production Association, the Kokand Superphosphate Plant, and the Fergana Oil Refinery. Such a concentration of heavy industry substantially increases atmospheric emissions and industrial wastewater discharges.

Environmental conditions are further aggravated by the valley's enclosed topography. Surrounded by mountain ranges, the basin frequently experiences winter temperature inversions, during which cold air becomes trapped near the surface, preventing the dispersion of atmospheric pollutants. Consequently, international environmental assessments classify the central part of the Fergana Valley as an area with a high potential for air pollution caused by persistent temperature inversions. National studies likewise emphasize that the region's distinctive medical and environmental conditions are largely attributable to the high concentration of industrial enterprises.

Mercury-related environmental issues are regulated under the Minamata Convention on Mercury. The Convention addresses the entire life cycle of mercury, from primary extraction to the final disposal of mercury-containing waste. It prohibits the development of new primary mercury mines and requires the gradual closure of existing operations. Consequently, the future of the Khaidarkan mercury mine has become an important issue on the international environmental policy agenda.

Progress has also been made in the field of environmental information and public participation. Public Environmental Information Centers have been established in the cities of Mailuu-Suu and Shekaftar in Jalal-Abad Region, as well as in Min-Kush, Naryn Region, Kyrgyzstan. These centers provide local communities with reliable information on actual environmental risks, thereby improving public awareness and preventing unnecessary public concern and misinformation.

In international practice, disaster risk management is generally regarded as a four-stage process comprising: (1) risk identification and assessment through hazard mapping and environmental monitoring; (2) risk prevention and mitigation by means of land-use planning, engineering protection measures, and population relocation; (3) preparedness through early warning systems, emergency drills, and resource stockpiling; and (4) emergency response and post-disaster recoveryUnder the conditions of the Fergana Valley, the second and third stages—prevention and preparedness—remain the most vulnerable components of the disaster risk management system. Although hazard assessment has been carried out extensively through seismic zoning maps, landslide inventories, and debris-flow basin cadastres, and emergency response mechanisms have been established, preventive measures and preparedness activities continue to suffer from insufficient financial support. Statistical evidence indicates that a considerable proportion of households located in high-risk zones have not been relocated, while construction activities are frequently undertaken without adequate consideration of hazard maps and land-use restrictions. Consequently, contemporary disaster risk reduction strategies emphasize a transition from a reactive “post-disaster response” approach to a proactive “pre-disaster investment” model. International assessments demonstrate that every unit of investment allocated to disaster prevention can save several times that amount in post-disaster recovery and reconstruction costs. In Uzbekistan, recent initiatives aimed at the digitalization of seismic monitoring systems and the implementation of early warning projects supported by the United Nations Development Programme (UNDP) represent important steps toward strengthening disaster resilience and sustainable risk management.

CONCLUSION

The analysis conducted demonstrates that mineral resource exploitation and natural hazards in the Fergana Valley are closely interconnected. The legacy of mining activities represents a static environmental risk, as mining waste and contaminated sites remain hazardous over long periods without natural attenuation. In contrast, natural disasters constitute a dynamic triggering factor, capable of mobilizing these existing hazards through processes such as landslides, floods, earthquakes, and debris flows. The interaction between these two factors has made the Fergana Valley one of the most environmentally complex and vulnerable regions in Central Asia.

A positive development is that, over the past decade, an effective international cooperation mechanism has been established to address these challenges. The strategic initiatives of the International Atomic Energy Agency (IAEA), the European Bank for Reconstruction and Development (EBRD) Environmental Remediation Account (ERA), and the Commonwealth of Independent States (CIS) programme have jointly completed remediation works at four of the seven priority uranium legacy sites and initiated activities at a fifth site. This represents one of the most successful examples of regional environmental cooperation in Central Asia.

In conclusion, environmental security in the Fergana Valley should not be viewed as a collection of isolated technical projects but rather as an integrated system that combines geology, seismology, hydrometeorology, public health, and regional diplomacy. Although the fundamental components of this system have been established in recent years, the primary challenge now lies in strengthening their integration and ensuring their coordinated and sustainable operation.

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