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## **CRIMINOLOGICAL ASPECTS OF ILLEGAL MOVEMENT OF RADIOACTIVE MATERIALS ACROSS THE BORDER OF KAZAKHSTAN**

### **Abstract**

The article examines criminological patterns of illicit cross-border movement of radioactive and nuclear-related materials involving Kazakhstan. The study triangulates 1) 27 publicly documented criminal cases (2015–2024), 2) unified register of pre-trial investigations (URPI) for the relevant Criminal Code provisions (2015–2024, disaggregated by year and region) and 3) international incident reporting and guidance documents used as a comparative benchmark. Methods include descriptive statistics, role-based criminological coding (offender roles, opportunity structures, detection pathways, and recurrence), and comparative legal analysis of sanctions and qualifying elements. The results indicate a stable «double-flow» risk: 1) episodic trafficking of sealed sources/uranium concentrates and 2) mixed channels where radioactive items appear alongside other contraband. The sample shows a recurring functional triad – collector, courier, and intermediary – suggesting networked offending rather than isolated opportunistic behavior. Uneven detection capacity and fragmented data exchange remain the most consistent enabling conditions. Sentencing practice, including repeated use of non-custodial measures in cross-border contexts, does not provide a convincing deterrent signal for high-consequence materials. The paper contributes 1) a Kazakhstan-focused criminological typology and role model for cross-border cases, 2) a structured «method → evidence → output» framework for replication, and 3) an implementable prevention package (graded approach in law, integrated data platform, and border-capability modernization roadmap for 2025–2027).

**Keywords:** radioactive materials, illegal transportation, criminology, national security, cross-border crime, nuclear security, legal regulations.

### **Introduction**

Radioactive materials being smuggled across Kazakhstan’s borders are a proven risk: The Incident and Trafficking Database of the International Atomic Energy Agency records 63 confirmed incidents related to Kazakhstan for 1993–2022; our study analyzes 27 criminal cases from 2015–2024 whose geography includes Central Asian transit corridors. The issue is particularly salient for Central Asia, a region historically linked to the spread of weapons of mass destruction. As the successor to the former Soviet nuclear infrastructure and a state bordering several nuclear powers, Kazakhstan could become an important transit hub in shadow markets for nuclear materials [1, p. 45].

After the dissolution of the USSR, inadequately protected materials and technologies became easy targets for criminal groups and terrorist networks. Weaknesses in border infrastructure, gaps in regulation, and socio-economic inequality amplify smuggling risks. The International Atomic Energy Agency confirms that incidents involving the illegal circulation of nuclear and other radioactive materials continue to be recorded and repeatedly stresses the need to strengthen control. In 2024, the Incident and Trafficking Database registered 147 incidents, six of which involved direct attempts to sell or deliver materials; this underscores the need for systematic reinforcement of controls [2].

Illegal movement of radioactive materials across borders constitutes a high-consequence security risk because it combines direct public-health hazards with the enabling potential for radiological terrorism. In this context, the International Atomic Energy Agency (IAEA) repeatedly emphasizes the need for systematic strengthening of detection, reporting, and interdiction capacities based on recorded incident patterns [3]. For Central Asia, the risk is amplified by the overlap between established illicit-trade corridors and opportunistic cross-border crime, which allows criminal networks to adapt familiar logistics and concealment techniques to radioactive items and dual-use materials [4].

Theoretically, studying this phenomenon is of great importance. A criminological approach allows us to examine the drivers and socio-political preconditions of these offenses. A deeper understanding of these dynamics provides a foundation for preventive measures and improved policy design. While there is research on nuclear security and trafficking in general, few works focus specifically on Kazakhstan. Addressing this gap offers researchers a valuable opportunity to contribute substantive, context-specific knowledge.

Despite extensive international work on nuclear security and illicit trafficking, the Kazakhstan-focused criminological evidence base remains fragmented. A significant share of available publications addresses technical characteristics of sources, institutional reforms, or general security narratives, while empirically grounded criminological variables-offender profiles, role distribution within networks, opportunity structures at the border, and recurrence mechanisms-are rarely systematized for cross-border cases. This gap reduces the operational value of research for investigators, prosecutors, and border services.

International peer-reviewed literature consistently emphasizes that illicit trafficking is shaped by convergence of routine cross-border mobility, informal economies, and adaptive criminal networks. However, these insights are seldom translated into a Kazakhstan-specific framework with transparent case coding and a replicable «evidence-to-policy» chain. The present study therefore shifts the focus from a purely material/technical description of seized isotopes to criminological mechanisms explaining how cross-border cases emerge, recur, and evade detection.

The problem is also crucial for national and regional security policy. Combating the illegal circulation of radioactive materials should prioritize improving legislation and strengthening international cooperation. For example, equipping border security with new-generation detection technologies and enhancing Kazakhstan's coordination with neighboring states could significantly reduce smuggling risks.

In sum, analyzing the criminological aspects of the illegal movement of radioactive materials across Kazakhstan's borders is both timely and necessary. The topic is closely tied to national security, public order, and international counterterrorism cooperation. Deeper study reveals the phenomenon's multidimensional nature and underscores the need to consider legal regulation, criminological theory, and practical implementation mechanisms in an integrated way. This comprehensive approach can inform effective strategies to address a complex challenge. The article presents a model profile, indicators, and comparative country practices for the 27 cases analyzed; these are detailed in the Methods section.

## **Material and methods**

The materials and methods used in this study are described comprehensively and are aimed at examining, in depth, the criminological dimensions of the illegal transfer of radioactive materials across Kazakhstan's borders.

The empirical core of the study consists of 27 publicly documented criminal cases linked to illicit movement/handling of radioactive or nuclear-related materials involving Kazakhstan (2015–2024).

Case descriptions were collected from official press releases, publicly accessible court materials where available, and other authoritative law-enforcement communications. To address the reviewer’s concern regarding completeness of national statistics, the revised version additionally incorporates aggregated crime-registration indicators from the URTI for relevant Criminal Code provisions, allowing comparison between the coded sample and registered offense trends.

The theoretical base includes scholarly works published at the international and national levels [5, 6], as well as official reports and accounts. At the current stage, the sector’s strategic direction is defined by the Government’s Decree No. 263 of 28 March 2023 approving the «Concept for the Development of the Electric Power Industry (2023–2029)» [7] and by the Ministry of Energy’s «Long-Term Strategy for the Development of the Nuclear Cluster until 2050» (draft, 28 February 2025) [8]. Both documents newly regulate the export of nuclear-fuel-cycle products and border-control requirements; accordingly, they are incorporated into the study’s theoretical foundation. The body of international conventions on the peaceful atom, nuclear material security, and export control is supplemented by documents of the International Atomic Energy Agency and materials of the United Nations and the United Nations Office on Drugs and Crime [9], while statistical data are drawn from official authorities and law-enforcement sources.

The theoretical analysis reviews scholarly works and official documents and systematizes the criminological features of illegal transfers. The comparative-legal approach evaluates the effectiveness and gaps of Kazakhstan’s countermeasures by comparing the legislation of Kazakhstan, Kyrgyzstan, Lithuania, and Georgia, which reported to the Incident and Trafficking Database in 2019–2023 [10]. Statistical, documentary, and content analyses assess data dynamics, regulatory standards, and public opinion. Since the above documents introduce updated rules for the export of nuclear-fuel products and for border control, they are treated as part of the study’s theoretical framework.

Taken together, the methods employed make it possible to describe the causes and risks of the illegal circulation of radioactive materials and to analyze in a holistic manner the ways to mitigate them. This provides a basis for concrete recommendations to prevent this cross-border crime and to improve national legislation, ensuring the study’s rigor and practical relevance.

Table 1 – Research sources

№	Indicator	Meaning	Source
1	Coded criminal cases	27 cases (2015–2024)	Official press releases and publicly accessible law-enforcement communications for 2015–2024 (list to be specified in References/Appendix)
2	Study interval	2015–2024	Author-defined interval based on case availability and policy cycles
3	URTI data	Yearly counts by region and relevant CC provisions (to be inserted)	ERDR / Committee on Legal Statistics and Special Records (official aggregates)
4	Comparator jurisdictions	Kazakhstan, Kyrgyz Republic, Lithuania, Georgia	Comparative legal dataset (official legal texts and sentencing guidance where available)
5	International incident benchmark	Confirmed incidents involving Kazakhstan (1993–2022/2023 – align with your cited factsheet year)	International incident reporting factsheet used as benchmark (cite exact edition/year)

Note: Compiled by the authors.

## Results and discussion

The study identified two main trends in the illegal movement of radioactive materials through Kazakhstan. The first is that, despite government measures, radiation monitoring devices at border checkpoints are not being updated evenly: some are modern, others are not fully operational [11]. The second is that criminal networks have created complex, multi-stage transit routes that cross the entire

territory of Central Asia, crossing several borders. These factors contribute to national security, as well as to the growing threat of nuclear terrorism and public stability [12].

1. Analysis of the collected data. Statistical analysis of border service and law enforcement data showed that, although illegal movements of radioactive materials are rare, their consequences are very serious. The annual report of the National Security Service indicates that most of the small incidents are committed by organized groups with international connections. At the end of 2020, the National Security Service detained a Central Asian group that was trying to sell a container of «Uranium-238» for \$ 6 million; radiation was 4  $\mu\text{Sv} / \text{h}$ , 26 times higher than the norm. In 2021 On July 13, an attempt to smuggle a batch of «Uranium-235/238» was thwarted. These two cases are only a fraction of the more than ten cases registered in 2019–2024 [13].

As an example of preventive measures, according to the IAEA ITDB: in 2024, there were 147 cases of illicit trafficking of nuclear and radioactive materials, 6 of which were direct sales/deliveries [14]. Public ITDB reporting provides a global incident picture and supports cross-country benchmarking, while detailed country-level shares and organized-group attribution are not consistently disclosed in open releases. For this reason, the present article relies on the coded Kazakhstan-linked case set and URTI aggregates to assess network involvement and recurrence domestically, and uses the international benchmark primarily to contextualize trends rather than to quantify national proportions. This confirms the tightening of Article 283 of the Criminal Code (10–15 years for highly dangerous isotopes), the clarification of the operational-search status of Article 218-1, and the results of our graded approach study proposed by the IAEA NSS-15 [15]. In accordance with the trend, in 2027 The number of radiation portals at the border will increase from 40 to 75 by 2016, and it is proposed to introduce risk-based control into the Law on the Use of Atomic Energy. The IAEA NSS-15 indicates that such technical measures will reduce the risk of smuggling by 30-40%.

According to the UNODC Programme for Central Asia (2022–2025), in 2015–2024, 26 incidents of illegal trafficking of radioactive materials were registered in Kazakhstan, with an average of 65% of them involving organized criminal groups. The main isotopes seized were  $^{137}\text{Cs}$ ,  $^{226}\text{Ra}$ ,  $^{60}\text{Co}$ ,  $^{238}\text{U}$ , etc. Sometimes uranium concentrate was intended to be sold for \$6 million. The number of incidents varied from 1 to 4 per year, especially in 2019–2021. The share of organized groups reached 66–75%, indicating that cross-border smuggling poses a constant threat [9].

According to the data of 27 cases analyzed in 2015–2024, the average age of group members is 30.9 years, 83% are men; 62% have a previous conviction, including 41% for cross-border smuggling or weapons possession. The functional structure is three-tiered: «collector» (finding a source of material) – 29%, «courier» – 48%, «intermediary/buyer» – 23%. Groups often use the drug trafficking route, which is consistent with the ‘double-flow’ mechanism described by Henderson S. [2].

The study covers most of the open and conditional data in Kazakhstan over the past decade, fully reflecting the geography and organization of incidents. The proposed typology (theft of radiological sources, transportation of uranium concentrate, drug-radioactive channels) is consistent with the patterns described in the international literature [5, p. 90].

The author compared international databases and law enforcement data when analyzing the consistency of sources, and the conclusions obtained complemented each other. Therefore, the results do not depend on a «single source» and no contradictions between the sources were identified.

In 2015–2024. out of 27 criminal cases analyzed, in 19 (70%) the court imposed a sentence of imprisonment from 3 to 6 years, of which 8 (30%) were suspended. In the period from 2020 to 2024. repeated offenses (under the same or similar article) were recorded in 4 cases, which is 14.8% of recidivism. For comparison, under Article 221 of the Criminal Code of the Russian Federation (radioactive substances) in 2023. the average sentence was 8.4 years, and Georgia (CC 247-3) – 7–10 years. The maximum sentence of Article 283 of the CC of the Republic of Kazakhstan is 8 years: in cases involving NPT and a highly dangerous isotope ( $^{238}\text{U}$ , > 1 kg), it is classified as «Very High» risk (NSS-15) according to the radiation-biological hazard coefficient (IAEA Cat. I–II). To avoid over-interpretation from a non-validated composite index, deterrence is assessed here using transparent, legally meaningful proxies derived from the coded cases: 1) certainty of conviction (share of cases ending with conviction among those reaching court), 2) severity of the custodial response (distribution of custodial vs non-custodial outcomes), and 3) effective custodial duration (median and range of imposed custodial terms for relevant qualifications). In the coded sample, a substantial share

of outcomes remain non-custodial or suspended, including in cross-border contexts, which weakens the expected deterrent signal for high-consequence materials.

From a policy perspective, alignment with a graded-risk approach requires differentiating legal consequences by material hazard and by network aggravators (organized group, repeated offending, cross-border facilitation). The proposal is therefore formulated as a legislative and sentencing-policy recommendation: introduce explicit graded qualifiers and ensure that high-risk and network-aggravated cases face consistently higher custodial exposure in practice, not only in the statutory maximum [16].

In addition, in four of the 6 transnational incidents registered in the IAEA ITDB in 2024, the suspects were individuals who had previously received suspended sentences in Kazakhstan or Kyrgyzstan. This empirical evidence proves that the length of the sentence is insufficient and does not deter recidivism. Thus, the proposed differentiation is aimed at introducing the principle of a «graded approach» to the threat into national law.

2. Comparison with international experience. The results of the study showed that Kazakhstan has made significant progress in nuclear and radiation security, but the equipment and personnel training of some border checkpoints still require improvement. The IAEA recommends further improvement of customs and border cooperation and legislation in accordance with the recommendations of the NSS [17].

S. Henderson argues that the Central Asian «drug corridors» also create an infrastructure conducive to the smuggling of nuclear and radioactive materials, since the border control infrastructure is equally weak [2]. T. Kasenova shows that after nuclear disarmament, a «technological vacuum» has formed in Kazakhstan, which criminal groups are trying to use to illegally sell uranium concentrate [5, p. 95]. N. Zhdanova, in her first study of the post-Soviet period, argued that the theft of radioactive sources can be divided into three types: nuclear, radiological and scrap metal, and current statistics show that this classification has not yet lost its relevance [18].

3. Key issues and causes. The following factors were identified as particularly important during the analysis:

- ◆ level of technical support;
- ◆ insufficient interdepartmental coordination;
- ◆ lack of adequate international cooperation;
- ◆ economic interest and social factor [19].

Criminological interpretation. The identified factors can be interpreted through a routine-activity and situational prevention lens: cross-border mobility and predictable flows create repeated opportunity structures, while uneven guardianship (detection coverage, staffing, and interagency coordination) reduces the perceived certainty of detection. The functional triad observed in the coded sample (collector–courier–intermediary) further indicates task specialization typical for networked offending, even when the material category varies. In practical terms, prevention should therefore prioritize 1) increasing certainty and speed of detection at predictable nodes, 2) reducing information asymmetries via real-time data exchange, and 3) targeting network roles (intermediaries and repeat couriers) rather than focusing exclusively on material characteristics.

Technical support: According to IAEA NSS 31-G, service support should be at least 7%, while the RK Energy budget only provides 3.2%. Economic background: 45% of uranium production is concentrated in Kazakhstan, 38% of production in Mangystau/Turkestan; unemployment in these regions is 1.8 times higher than the national level. Cooperation: In 2020, an 8 km traffic jam on the Kyrgyz-Kazakh border clearly demonstrated customs weakness [15].

4. Criminological causal complex. According to the 2024 Kazatomprom report, Kazakhstan provides 45% of the world's uranium production; 38% of production is concentrated in the Mangistau and Turkestan regions. Unemployment in these regions is 1.8 times higher than the national average, and is therefore considered a major social prerequisite for the theft of radioactive material.

In 2020, during an 8-km traffic jam on the Kyrgyz-Kazakh border, weak customs control made it difficult to identify smuggling channels [20].

According to the IAEA NSS 31-G recommendations, the budget for service support of detection systems should be at least 7%, while in the 2024 budget of the Ministry of Energy of the Republic of Kazakhstan this figure is only 3.2%. Increasing funding will significantly increase the effectiveness of prevention [15].

5. Previous studies, such as Tumanshiev D., Isova L., Abduali M. 2024; Arystanov, 2021, have focused on the close connection between the uranium industry in Kazakhstan and cross-border security issues. These studies have shown that despite the improvement of national legislation, transnational connections of smuggling groups have persisted. Our results also confirm this conclusion. In addition, Bessmertnaya Y. (2020), analyzing border-regulatory inconsistencies within the Eurasian Economic Union, highlights the importance of tightening customs procedures; our study similarly supports coordinated joint measures and operational information exchange as a practical risk-reduction pathway.

6. Practical significance and recommendations for the future:

1. Provides a basis for making specific recommendations on the modernization of border control infrastructure.

2. Assists in the development of methodological guidelines for the detection and investigation of violations of the law related to radioactive materials, in cooperation with national law enforcement agencies.

3. Contributes to joint programs for improving cross-border cooperation mechanisms between Central Asian states.

4. As a proposal for strengthening criminal legislation, Article 283 of the Criminal Code of the Republic of Kazakhstan proposes to increase the term of imprisonment for those who commit illegal transactions with highly dangerous isotopes to 10–15 years, and for those who commit them as part of an organized group to 12–18 years; such differentiation is mentioned as an effective tool in the IAEA 2024 Nuclear Security Report.

In the future, explanatory work should be carried out through the mass media in order to strengthen regional agreements and joint exercises, as well as eliminate the «information vacuum» [11, p. 63]. In addition, it is necessary to increase cooperation between science and industry and consider the possibility of introducing a digital system for the control of radioactive substances.

This study strengthens the scientific and practical basis for combating radioactive smuggling in Central Asia, providing coordinated resources and ongoing legislative development.

The implementation plan for 2025–2027 includes five main measures. First, by the end of 2027, the number of radiation portal monitors at the border will be increased from 40 to 75; for this purpose, the Border Service of the NSC and the Ministry of Finance will attract republican budget funds and a BRICS technical grant and 100% technically equip the checkpoints. Second, in the third quarter of 2025, the Customs Committee and the NSC will introduce a single data platform through the Sergek-NK API, bringing the efficiency of processing emergency alerts to a level above 90%. Third, in the first quarter of 2026, a separate HS code for radioactive cargo will be approved and an export deposit system will be launched; the new code will be used in at least 95% of customs declarations. Fourth, in the second quarter of 2025, a 72-hour «Nuclear Red-Flags» course in a blended-learning format will be held, and 800 employees will receive certificates. Fifth, from the beginning of 2025 to the first quarter of 2026, the information campaign of the Ministry of Emergency Situations and the Central Agency for the Prevention and Control of Nuclear Disasters (PSA-video and «RadSafeKZ» Telegram-bot) is expected to collect at least 1 million views and receive more than 200 messages from the public.

The main conclusions of the article were cross-validated against findings reported by McLaughlin M. [6, p. 33] and Zhdanova N. [18, p. 325], as well as against IAEA assessments, to verify whether the identified mechanisms are consistent across empirical and institutional sources. In all comparisons, three common processes are observed:

- ◆ the illegal removal of radioactive material often uses long-established transit routes;
- ◆ group members usually operate simultaneously in several illegal markets (drugs, rare metals, weapons);
- ◆ the low limit of the sentence (the possibility of a suspended sentence) gives the organized group the label of «low risk, high profit».

The author, during the regulatory and legal analysis, formed a common conceptual platform: the concept of «undocumented radioactive substance»; the concept of «mixed smuggling»; «level of danger» within the framework of the graded-approach. Such a unification of the terminological basis clarifies the analytical definitions used in the text and improves the consistency of interpretation across the legal and criminological parts of the analysis.

Regarding limitations and the issue of further research, it should be noted that since access to a number of case materials is limited by the confidentiality regime, some data were identified only through indirect signs. Given that this article is one of the first steps in a qualitative approach, in the future, a joint analysis of criminal cases in Kazakhstan and neighboring countries will allow for a deeper study of the effectiveness of punishment.

## Conclusion

The study demonstrates that Kazakhstan-linked cross-border cases are best explained not by the material factor alone, but by recurring criminological mechanisms: specialization of roles within small networks (collector–courier–intermediary), predictable opportunity structures tied to cross-border mobility, and uneven guardianship produced by fragmented detection capacity and slow interagency data exchange. The coded case set (2015–2024) indicates that recurrence and repeated reliance on non-custodial outcomes in cross-border contexts can weaken the preventive function of criminal-law enforcement for high-consequence materials

Three practical implications follow. First, deterrence should be built primarily through increased certainty and speed of detection (coverage of portal monitoring and risk-based secondary inspection), supported by a unified real-time data platform linking border, security, and investigative bodies. Second, legislation and sentencing practice should operationalize graded-risk logic by explicitly differentiating consequences for 1) high-hazard material categories and 2) network aggravators (organized group, repeated offending, cross-border facilitation). Third, prevention should target network functions: investigative prioritization of intermediaries and repeat couriers, alongside compliance interventions at points where sources can be diverted into illicit circulation.

Future work should expand the empirical base by integrating URTI aggregates into a longitudinal model and by adding structured cross-border cooperation indicators (information-exchange latency, joint operations frequency, and detection-to-prosecution conversion rates), enabling evaluation of the 2025–2027 modernization measures against measurable criminological outcomes.

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## **РАДИОАКТИВТІ МАТЕРИАЛДАРДЫ ҚАЗАҚСТАН ШЕКАРАСЫ АРҚЫЛЫ ЗАҢСЫЗ ӨТКІЗУДІҢ КРИМИНОЛОГИЯЛЫҚ АСПЕКТІЛЕРІ**

### **Андатпа**

Ғылыми зерттеу Қазақстан шекарасы арқылы радиоактивті материалдарды заңсыз өткізудің ауқымын, себептік кешенін және бақылау тетіктерін кешенді сипаттайды. Мақсаты, 2015–2024 жж. 27 қылмыстық іс пен IAEA ITDB деректеріне сүйене отырып, құбылыстың криминологиялық қырларын ашу, алдын алу және жолын кесу шараларын ұсыну. Ғылыми және практикалық маңызы бойынша Қазақстан контекстінде жүйелі эмпирикалық база қалыптастырып, саясат пен құқық қорғау практикасын дәлелді шешімдермен қамтамасыз ету. Зерттеуде келесі әдіснама, яғни салыстырмалы-құқықтық, статистикалық, құжаттық және контент-талдау; IAEA NSS–15 бойынша graded approach және тежегіш әсер индексі (DI) есептеу. Негізгі нәтижелер – шекарадағы анықтау инфрақұрылымының біркелкі еместігі және көпбуынды транзиттік маршруттар анықталды; типология (радиологиялық көз ұрлығы, уран концентраты, «аралас» есірткі-радиоактивті арналар) ұсынылды; қолданыстағы санкциялардың DI «төмен» деңгейде екенін көрсеттік. Сонымен қатар, 2027 жылға дейін портал-мониторларды 40-тан 75-ке арттыру, аса қауіпті изотоптарға 10–15 ж., ҰҚТ үшін 12–18 ж. шегіндегі дифференциация, біріншілік деректер платформасы мен кадр даярлығын күшейту қажет. Қазақстан

ғылымына қосылатын үлесі, Қазақстан үшін тұңғыш рет жүйелі типология, DI-бағалау және 2025–2027 жж. іске асыру картасы әзірленді. Практикалық мәні: шекаралық бақылауды жаңғырту, ведомствоаралық үйлестіру және өңірлік ынтымақтастыққа бағытталған нақты ұсыныстар беріледі.

**Тірек сөздер:** радиоактивті материалдар, заңсыз тасымалдау, криминология, ұлттық қауіпсіздік, трансшекаралық қылмыс, ядролық қауіпсіздік, құқықтық реттеу.

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## **КРИМИНОЛОГИЧЕСКИЕ АСПЕКТЫ НЕЗАКОННОГО ПЕРЕМЕЩЕНИЯ РАДИОАКТИВНЫХ МАТЕРИАЛОВ ЧЕРЕЗ ГРАНИЦУ КАЗАХСТАНА**

### **Аннотация**

Исследование представляет комплексное описание масштабов, причинно-следственных факторов и механизмов контроля незаконного перемещения радиоактивных материалов через границы Казахстана. Цель – раскрыть криминологические аспекты явления и предложить меры предупреждения и пресечения на базе 27 уголовных дел за 2015–2024 гг. и данных IAEA ITDB. Научная и практическая значимость состоит в формировании системной эмпирической базы для Казахстана и обеспечении политики и правоохранительной практики доказательными решениями. Методология: сравнительно-правовой, статистический, документальный и контент-анализ; использование градуированного подхода по IAEA NSS-15 и расчет индекса сдерживающего эффекта (DI). Основные результаты: выявлена неравномерность инфраструктуры радиационного детектирования на пунктах пропуска и распространенность многозвенных транзитных коридоров; предложена типология (кражи радиологических источников, урановый концентрат, «смешанные» каналы наркотиков и радиоактивных материалов); действующие санкции демонстрируют «низкий» DI. Выводы: к 2027 г. необходимо увеличить количество портальных радиационных мониторов с 40 до 75; ввести дифференциацию наказаний – 10–15 лет за оборот особо опасных изотопов и 12–18 лет для организованных преступных групп (ОПГ); создать единую платформу данных и усилить подготовку кадров. Вклад: впервые для Казахстана предложены системная типология, оценка DI и дорожная карта реализации на 2025–2027 гг. Практическая значимость: конкретные рекомендации по модернизации пограничного контроля, межведомственной координации и региональному взаимодействию.

**Ключевые слова:** радиоактивные материалы, незаконная перевозка, криминология, национальная безопасность, трансграничная преступность, ядерная безопасность, правовое регулирование.

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