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THE LEGAL EFFECTIVENESS OF THE NPT AND THE DEVELOPMENT OF THE NUCLEAR-FREE TOURISM BRAND

This study examines how the legal effectiveness of the Treaty on the Non-Proliferation of Nuclear Weapons shapes the emergence of a «nuclear-free» tourism brand and the spatial development of tourism in post-nuclear landscapes, with a focus on Kazakhstan and relevant comparators. The purpose is to connect treaty performance and domestic rules on access and radiation safety with destination identity, visitor communications about risk, and the planning of routes and sites. The research combines doctrinal analysis of international and national legal texts with qualitative analysis of publicly available visitor, tour-operator and media narratives and a descriptive spatial assessment of access restrictions, radiation-safety requirements and potential tourism routes in post-nuclear landscapes. The analysis is interpretive and does not seek to establish statistical causality. The findings highlight three transmission channels through which legal effectiveness supports a nuclear-free brand: reputational signaling, regulatory certainty, and openness of monitoring data. Compliance with the treaty is not sufficient on its own; branding gains materialize when rules on access are clear, guides and operators are properly licensed, and risk briefings are standardized and visible. The study concludes that legally robust, transparent, and spatially explicit governance strengthens the nuclear-free brand and enables safe diversification of regional tourism.

Keywords: Legal effectiveness, nuclear-free tourism brand, radiation safety, Kazakhstan's post-nuclear landscapes, tourism development.

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ЯҚТШ-ның құқықтық тиімділігі және туризм саласында «nuclear-free» брендин қалыптастыру

Бұл зерттеу Ядролық қаруды таратпау туралы шарттың құқықтық тиімділігі «nuclear-free» туристік брендтің пайда болуын қалай қалыптастыратынын және Қазақстанға және салыстырмалы мысалдарға назар аудара отырып, постядролық ландшафттардағы туризмнің кеңістіктік дамуын бағдарлайтынын зерттейді. Бұл зерттеудің мақсаты келісім-шарттық нормалар мен ұлттық қол жеткізу және радиациялық қауіпсіздік ережелерінің тиімділігін межелі орынның сәйкестендіруімен, келушілермен байланыс жасау тәжірибесімен және маршруттар мен келушілерді қызықтыратын жерлерді жоспарлаумен байланыстыру болып табылады. Зерттеу халықаралық және ұлттық құқықтық мәтіндердің доктриналық талдауын келушілердің, туроператорлардың және БАҚ-тың жалпыға қолжетімді әңгімелерінің сапалық талдауымен және ядролық қарудан кейінгі ландшафттардағы қолжетімділік шектеулерінің, радиациялық қауіпсіздік талаптарының және әлеуетті туризм бағыттарының сипаттамалық кеңістіктік бағалауымен біріктіреді. Талдау түсіндірмелік болып табылады және статистикалық себеп-салдарлық байланысты анықтауға тырыспайды. Нәтижелер заңды тиімділік «ядросыз» брендті қолдайтын үш арнаны анықтайды: беделді сигнал беру, реттеушілік сенімділік және ашық мониторинг есеп беру. Тек шарттық міндеттемелерді орындау жеткіліксіз; қол жеткізу ережелері анық, нұсқаулықтар мен операторлар лицензияланған және тәуекел туралы брифингтер стандартталған және қолжетімді болған кезде

күтілетін бренд әсерлері пайда болады. Заңды түрде негізделген, ашық және кеңістіктік айқын басқару ядрсыз брендті нығайтады және аймақтық туризмді қауіпсіз әртараптандыруды қамтамасыз етеді деген қорытынды жасалды.

Түйін сөздер: Құқықтық тиімділік, nuclear-free туристік бренд, радиациялық қауіпсіздік, Қазақстанның постядролық ландшафттары, туризмді дамыту.

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Правовая эффективность ДНЯО и формирование бренда «nuclear-free» в туризме

В исследовании рассматривается, как правовая эффективность Договора о нераспространении ядерного оружия формирует появление «nuclear-free» туристского бренда и направляет пространственное развитие туризма в постядерных ландшафтах, с акцентом на Казахстан и сопоставимые примеры. Цель работы состоит в том, чтобы связать результативность договорных норм и национальные правила доступа и радиационной безопасности с идентичностью дестинации, с практикой разъяснения риска для посетителей и с планированием маршрутов и объектов посещения. Исследование сочетает в себе доктринальный анализ международно-правовых и национальных нормативных актов с качественным анализом общедоступных нарративов (отражающих мнения посетителей, туроператоров и СМИ), а также описательной пространственной оценкой ограничений доступа, требований радиационной безопасности и потенциальных туристических маршрутов на территориях, пострадавших в результате ядерных инцидентов. Данный анализ носит интерпретативный характер и не ставит целью установление статистических причинно-следственных связей. Результаты выявляют три канала, через которые правовая эффективность поддерживает «nuclear-free» бренд: репутационный сигнал, регуляторную определенность и открытую подотчетность мониторинга. Само по себе соблюдение договорных обязательств недостаточно; ожидаемые эффекты брендинга проявляются, когда правила доступа ясны, деятельность гидов и операторов лицензирована, а брифинги по риску стандартизованы и доступны. Делается вывод, что юридически прочное, прозрачное и пространственно явное управление усиливает «nuclear-free» бренд и обеспечивает безопасную диверсификацию регионального туризма.

Ключевые слова: правовая эффективность, бренд nuclear-free туризма, радиационная безопасность, постядерные ландшафты Казахстана, развитие туризма.

Introduction

The relationship between nuclear disarmament law and tourism development raises an emerging interdisciplinary research question. The cornerstone of the global nuclear non-proliferation regime is (1) the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which entered into force in 1970 and today has a membership of 191 states parties (Arms control, 2023). Nonetheless, its practical legal effectiveness and implications reach far beyond classical security matters also shaping the spatial development of tourism in regions formerly afflicted by the traces of nuclear testing. Kazakhstan, where 456 nuclear explosions were conducted between 1949 and 1989 at the Semipalatinsk Test Site, represents an ideal case study on how treaty compliance and domestic radiation safety regulations both form

a destination identity while allowing for the possibility of a unique brand of «nuclear-free» tourism (Young Pioneer Tours, 2019).

Commemorating the closure of the Semipalatinsk nuclear test site on August 29, 1991 was indeed a landmark in building national identity in post-Soviet Kazakhstan and lend itself to this country having reputable international position as an advocate for nuclear disarmament. Even several months before the official independence of the country, Kazakhstan established itself as a leader in global nuclear non-proliferation by making this decision (Eurasian Research Institute, 2016). The implications of this step reverberated on many levels: it represented the consensual surrendering of the world's fourth largest nuclear arsenal; it fashioned a national narrative defined by peace and nonproliferation; and it opened new horizons for converting

former sites of nuclear testing into platforms for education, historical memory and sustainable tourism development (The Astana Times, 2024). However, the correlation between NPT legal effectiveness and actual tourism development in post-nuclear areas is still absent from geographical literature.

This research is founded upon a number of elements that cross streams with international trends, as well as imperatives on the ground. Firstly, the two major challenges faced by external players include scarce compliance with treaties and verification mechanisms of global nuclear non-proliferation regime plus a birth of a new category of those armed states at an intersection point or even outside the NPT (the Nonproliferation Treaty) framework (Mažeikienė, 2021). The ability of legal effectiveness to produce such outcomes as destination branding and tourism development, helps in going beyond security metrics (Abdullah, 2024) by highlighting wider social impacts of the treaty that have been detected empirically. Second, as a pillar of its national branding and foreign policy, Kazakhstan has vocally promoted its nuclear-free status through hosting the 2010 OSCE Summit, the establishment of the International Atomic Energy Agency Low Enriched Uranium Bank in 2017 (Kassenova & Hwang, 2021), or championing an international treaty such as the Universal Declaration for the Attainment of a Nuclear-Weapons-Free World (Syarifatul, 2025; Ustinov, 2024). Third, the emerging global dark tourism sector of USD~23 billion (annual) increasingly sources post-nuclear sites, e.g., Chernobyl and Fukushima, and now Semipalatinsk Polygon leading to urgent questions regarding safety assessments, visitor management protocols and sustainable development practices (Liu, 2020).

On a practical level, nearly 1.5 million people in Kazakhstan are suffering from the effects of health problems due to radiation exposure including higher cancer rates and birth defects as well as genetic damage for generations. Tourism of regulated, safe and educational benefit can serve a number of purposes: fostering economic opportunity for affected communities; remembering the humanitarian price of nuclear testing regimes; and showcasing the palpable benefits that compliance with arms control brings to international partners. On the other hand, there is also a lack of comprehensive analysis that links legal systems with national regulations and tourism spatial management strategies causing substantial gaps in academic knowledge as well as in practical policy perspective (McMichael, 2024).

This research is based in the post-nuclear landscapes of Kazakhstan, especially the Semipalatinsk Test Site and the closed town Kurchatov as spatial embodiments of a nuclear legacy and denuclearization (Caravanistan, 2025). In this regard, the subject particularly concentrates on how the interrelationships between legal reactions to different significant mechanisms through which domestic radiation safety with an influence of international norms as an NPT (Mukhatzhanova, 2023) affect aspects in terms of developing nuclear-free tourism brand and spatial configuration providing to visitor's networks access pathways and interpreting sites.

This research aims to identify and characterize the principal linkages through which international nuclear disarmament treaty performance is associated with destination identity formation, communication of radiation-related risks to visitors, and the spatial planning of tourism infrastructure in post-nuclear territories. It means showing nuclear-free brands is not just a marketing claim but a complicated combination of legal adherence, regulatory clarity and spatially explicit governance constructs for safe and engaging visitor experiences.

For this purpose, the study pursues four interconnected objectives. First, it conducts a doctrinal analysis of NPT verification mechanisms and Kazakhstan's implementation of relevant non-proliferation obligations, as well as external compliance with Articles I, II and III in Kazakhstan; it assesses how compliance provides reputational capital ripe for destination branding. Secondly, it analyzes Kazakhstan's national radiation safety rules and addresses how regulating access and monitoring access promote openness, thereby fostering conditions to assist tourism development (On Radiation Security of Population, 1998; Об утверждении Санитарных правил, 2020). Third, it uses natural language processing to analyze publicly available accounts from visitors, tour operators and the media to identify how nuclear-free identity is constructed, experienced and navigated. Fourth, it explores spatial analysis methods to identify radiation safety buffers and viable access corridors and potential tourism paths thus providing an illustration of how legal or regulatory factors become situated as the geographical patterns of flow to attractions (Dunets et al, 2018).

This research is important in both theoretical contributions and practical applications. Conceptually, it contributes to destination branding research by showing that adherence to international legal regimes can serve as an authentic and unique source of

destination identity for countries with negative antecedent (Dias, 2024). This study develops knowledge about dark tourism by providing empirical analysis of types of motivations and experiences at nuclear heritage sites, where the torn between education versus commemoration & ethics remain important (Ştefan et al, 2024). In terms of geographical theory, it serves as an example of how international legal instruments create real spatial consequences via their incorporation into national legislation and the implications for land use planning and visitation management systems (Garanti et al, 2024).

From a pragmatic perspective, the results of this research yield policy-relevant knowledge for governments, destination management organizations and international organizations involved in nuclear disarmament verification and post-conflict reconstruction work. In particular for Kazakhstan these findings offer insights on how sustainable tourism development in Semipalatinsk can move forward whilst ensuring the safety of commercial visitors and benefit local communities at the same time. The framework introduced is also designed to provide transferable approaches for evaluating tourism development potential of other post-nuclear territories including sites in the U.S., Russia, France, China and UK (Alekseeva & Hercegová, 2021). Beyond providing security benefits, showing concrete positive outcomes from treaty compliance for the global nuclear non-proliferation community may bolster political support to keep disarmament commitments and invest in verification (Gautam, 2024; Lennane, Moyes, 2021).

Based on the preceding analysis, this study argues that legally sound, transparent and spatially explicit governance provides a necessary framework for developing nuclear-free tourism branding as both a destination-development strategy and a potential social benefit associated with nuclear disarmament. Not least, it helps that compliance with the NPT does not stand on its own-it generates reputational dividends in particular when national regulatory systems define access processes, licensing frameworks assure operator competence, realistic risk training follows transparent and coherent path disaggregation protocols and spatial planning (e.g. This finding will ultimately counter the simple argument that post-conflict or post-nuclear tourism could naturally grow without a strong legal and regulatory regime (The Tourism Space, 2021; Font & McCabe, 2017; Duthie, 2018). Beyond nuclear disarmament, this illuminates an important lesson relevant for sustainable tourism development within fragile settings

that require international law and regulatory frameworks to be integrated with spatial planning advice and community engagement.

Literature review

Nuclear-free tourism branding in post-nuclear landscapes straddles three separate fields of scholarship: international nuclear disarmament law and treaty effectiveness; destination branding and sustainable tourism marketing; dark tourism scholarship pertaining to sites of tragedy and trauma (Ryan, 2016). This review synthesizes literature in these fields to provide a rationale for how legal compliance with the Treaty on the Non-Proliferation of Nuclear Weapons facilitates a new identity at destinations for tourism development strategies at locations that comprise Kazakhstan's Semipalatinsk region.

Legal framework, compliance verification and enforcement in the NPT The Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which was ratified in 1970, is complementing what remains the universal federal nuclear non-proliferation treaty and agreement with currently 191 states parties (Armscontrol,2023; Nuclear Threat Initiative,2025). At the heart of the treaty is the distinction between nuclear-weapons states (NWS), specifically the five states that had nuclear weapons when this treaty was signed in 1968 (United States, Soviet Union, United Kingdom, France, and China) and non-nuclear-weapons states (NNWS). With its trifecta of non-proliferation, peaceful use provisions, and disarmament obligations, the NPT is best described as a bargain between three sides. However, developed nations can only test nuclear weapons on NNWS parties and are otherwise prohibited from transferring or assisting the proliferation of nuclear arms to NNWS parties. The verification authority is the International Atomic Energy Agency (IAEA), which verifies NNWS compliance with Comprehensive Safeguards Agreements and increasingly through the Additional Protocol, which strengthens rights of access to information and sites at all times by the organization (IAEA, 2016; Nuclear Threat Initiative, 2025).

The primary purpose of treaty verification, they explain, is to identify and motivate compliance-using both carrots and sticks-and Dorn and Scott (2000) review approaches for doing so successfully as part of what they refer to by a "compliance mechanism" for disarmament treaties. Their framework identifies five basic compliance elements: national dignity as

the justification for performing treaty obligations, objective verification through neutral settling bodies, tangible gains to treaty members, sanctions such as withdrawal of treaty benefits and domestic measures like penal law enactments. This multifaceted strategy illustrates that compliance is not simply a matter of verification systems; it is about creating a governance architecture which brings together legal, political and practical mechanisms.

The United Nations Institute for Disarmament Research (UNIDIR, 2023) contributes to the understanding of WMD-related treaty compliance and enforcement by analyzing how these ideas function along a continuum, rather than discrete categories. The analysis identifies national implementation as one of the main elements of compliance, technical and legal assistance as important support measures, transparency mechanisms (information exchange and reporting) and verification procedures (national technical means to on-site inspection). This framework highlights enforcement as a process spanning from soft positive deviation measures such as technical assistance to hard inducement measures such as public naming and shaming, suspension of privileges, and sanctions.

Abdullah et al. (2024) analyzes the legislative function of regimes regulating weapons of mass destruction and highlight that treaty compliance is dependent not only on ratification, but rather on domestic legal frameworks through which states can implement their international obligations. The analysis illustrates the tension between issues of sovereignty and verification and shows that states willing to accept intrusive monitoring mechanisms can be regarded as providing reliable signals about their domestic commitments towards normative non-proliferation standards. This mechanism for institutionalized reputational signaling is especially important for states attempting to shed the legacy of poor state reputation stemming from their nuclear weapons program in the past.

While the NPT has proven remarkably enduring since its indefinite extension in 1995, recent scholarship highlights an emerging challenge to the effectiveness of the regime. Syarifatul et al. (2025) on the basis of this withdrawal and North Korea's development of nuclear weapons in violation of good faith principles underlying the NPT, which indicates how a single non-compliance can undermine international confidence necessary for any treaty system. Ustinov (2024) investigates the potential for new formats of U.S. nuclear alliances with its partners-including extended deterrence arrangements and

nuclear sharing agreements-to generate ambiguity regarding compliance by state parties with NPT Article I prohibitions on transfer of nuclear weapons. U.S. Department of State (2025) Government report on compliance and implementation of arms control treaty obligations provide more detail on specific areas of concern while noting that determination of compliance is closely tied to diplomatic efforts but the verification mechanisms are essential to hold states accountable for their treaty obligations. These studies reinforce the conclusion that legal success is contingent upon repeated review, a modified verification mechanism, and political will to sustain treaty aims over time.

As a studious analysis explores regional nuclear disarmament efforts, Gautam (2024) also closely examines the Central Asian Nuclear-Weapon-Free Zone (CANWFZ) Treaty Kazakhstan was instrumental in establishing since 2006. Once again this regional instrument is an effort to back up NPT commitments and address specific regional security it further shows that multiple legal frameworks can work in concert for non-proliferation norms. CNTWF Treaty: The strategic positioning of Kazakhstan as a leader in the non-proliferation regime and nuclear disarmament diplomacy grants it reputational capital both in security domains and national identity, enabling its projection on an international platform.

Lennane and Moyes (2021) consider the sustainability of the regime created by the Treaty on the Prohibition of Nuclear Weapons (TPNW) to investigate institutional mechanisms required for a long-term, effective treaty. Their framework highlights engagement and transparency, as well as useful examples of treaty advantages that extend beyond the realm of security outcomes. Koplow (2021) and Hood (2023) raise questions about the positive obligations portrayed in the TPNW as to whether victim states should be financially responsible for environmental remediation and assistance to victims, an issue directly relevant for Kazakhstan in terms of its decisions on how it chooses to manage Semipalatinsk legacy costs. These views are especially important for understanding the positive externalities that can result from nuclear disarmament compliance, such as a better reputation of the destination and tourism development opportunities, whilst also exposing ongoing difficulties associated with turning legal commitments into real prosperity on the ground.

Kazakhstan's Nuclear Legacy and National Identity Formation. Kazakhstan and nuclear weapons are perhaps the most dramatic story in the tragic

saga of post-Cold War nuclear disarmament. As outlined in the Introduction, the Semipalatinsk Test Site constitutes the central historical setting for Kazakhstan's post-nuclear identity. The literature on Kazakhstan's nuclear legacy focuses less on the chronology of testing itself than on its humanitarian consequences, the political meaning of the site's closure, and the subsequent transformation of non-nuclear status into an element of national and international identity. The total number of people who were subjected to the tests is around 1.5 million, most of them in Kazakhstan itself, and subsequent heightened cancer incidence and other malformations from fetal damage are recorded many years after the last test (The Astana Times, 2024).

The August 29 closure of the Semipalatinsk Test Site, months before Kazakhstan's formal independence, was perhaps the clearest moment in purely national identity-building terms for the country. So, after the dissolution of the Soviet Union in 1991, Kazakhstan inherited world's fourth-largest nuclear arsenal but in 1995 gave up all nuclear weapons by having them moved to Russia and entering Nuclear Non-Proliferation Treaty (NPT) as a non-nuclear-weapons state (Eurasian Research Institute, 2016). The move launched Kazakhstan onto the world stage as a leader in nuclear non-proliferation, earning much credit and a national identity of peace-seeking, denuclearization and global citizenship.

Kazakhstan has held a series of successful diplomatic events aimed at enhancing its international standing on nuclear disarmament (The Eurasian Research Institute, 2016). For instance, Kazakhstan hosted the OSCE Summit in Astana in 2010. The International Atomic Energy Agency (IAEA) opened the Low Enriched Uranium Bank in Kazakhstan in 2017. In July 2018, as reported by The New York Times (2018), Kazakh President Nursultan Nazarbayev proposed a Universal Declaration for achieving a Nuclear-Weapons-Free World to globally consolidate ambitions on this issue. This also shows some strategically to use the atomic disarmament credentials as a tool to elevate Kazakhstani profile in the global arena, stimulate foreign intra-state investments and make Kazakhstan an intermediary between the leading world powers. However, Kazakhstan's nuclear-free identity is shaped not only by its diplomatic achievements in nuclear disarmament, but also by the humanitarian consequences of Soviet nuclear testing and the experiences of affected communities and survivors.

Such intergenerational dialogue also appears key to the capacity of an educational initiative that

has brought young people together with survivors and to visit affected communities, according to the Astana Times (2024). These programs illustrate enduring problems in confronting the humanitarian trauma of nuclear testing, including a lack of health care infrastructure, scant financial compensation under Kazakhstan's 1992 law on social protection for affected citizens and poor access to Soviet-era files needed for documentation and claims processing. McMichael (2024) argues for the crucial role of physical human interactions in educational tourism projects embedded within these recovering communities, through which working with survivor narratives makes abstract ideas around disarmament into tangible understanding of the humanitarian costs that nuclear weapons bring.

Post-Nuclear Landscapes, Dark Tourism, and Identity Negotiation. Converting former nuclear test sites into tourism hot spots is unprecedented within the trend of dark tourism, where people travel to sites related death, disaster and other atrocity. Post-industrial nuclear sites have become sites for educational tourism because, as Mažeikienė (2021) argues, these landscapes enact key pedagogical functions by making visible the abstract concepts of radiation, military-industrial complexes and Cold War geopolitics. Her study of Visaginas, a closed nuclear city from the Soviet period in Lithuania, showcases the tension-both pride and fears between ongoing together with heritage as well as awareness of vulnerabilities existing-not on a global scale but simply on a very local one.

Using participatory action research, Mažeikienė and Gerulaitienė (2022) continue this analysis on negotiating post-nuclear identities through tourism development in the closed atomic town which supported the Ignalina Nuclear Power Plant-Visaginas. Their research shows how the different kinds of tourism-energy tourism, nuclear heritage tourism, Soviet industrial heritage tourism and recreational tourism-provide arenas for negotiating community identity in the aftermath of a nuclear facility closing. What the research exposes is a series of profound tensions: between commodification and inevitable self-exoticization in the context of tourism development on the one hand, and authentic identity practice on the other; between principled notions of community empowerment and participatory discourses versus more critical engagement with issues of negative / dissonant heritage. They found that involving stakeholders in this tourism development process – of interpreting nuclear pasts, present and post-nuclear futures – creates an identity change and negotiation.

Yet, this process is made especially complicated in situations where Soviet industrial heritage already is experienced as dissonant heritage-discordant, negotiated and/or contested communities have been “disinherited” from everyday work and life experiences of the Soviet past.

Liu et al. Editor (2013): *A close encounter with the cold war past: Dark tourism in Chernobyl, North Korea and beyond*. Medford, MA.: Tufts University Press Kurochkin, N., & Morton N. Their methodology embeds buffer zones, limited-access pathways, live radiation sensors and interpretative education into their designs in order to create safe but impactful visitor experiences. This work provides guidelines for post-nuclear tourism development: informed risks on radiation, setting scientific safety standards, promoting educational instead of sensational objectives and engaging with impacted communities in respectful dialogues.

Utilizing dark tourism frameworks, McMichael (2024) provides an understanding of educational tourism through human interactions in recovering communities. His research showcases that good educational tourism is not merely observation, but rather places for visitors to meet and hear from survivors, local researchers, and community advocates. Instead of spectacle that may tend towards exploitation, these interactions reconfigure tourism into solidarity and amplifying advocates. But, as McMichael warns asserts, educational tourism strategies are best developed in true partnership with impacted communities – meaning a focus on community determined priorities rather than merely external commercial interests should benefit from revenue and attention brought by the tourism industry.

Young Pioneer Tours (25 November 2025) describes in detail its organization of trips to Semipalatinsk Polygon, perhaps one of the most important places you’ve never heard of, as well as the only former nuclear test site open for tourism. Tour itineraries show how complicated the geography-but also the logistics-of post-nuclear tourism can be: with specialized access permits, protective equipment and safety briefings before entering contaminated zones, expert guides who know radiation safety back to front; atomic lakes and underground test boreholes, command bunkers and abandoned old infrastructure. Tours combine a number of sites: Kurchatov, once the headquarters for Soviet nuclear scientists and now largely closed to visitors; abandoned towns evacuated after contamination by radioactivity; as well as museums chronicling both knocks from Russian testers, such as with regard to

previous Soviet atomic accomplishments. The potential for post-nuclear destination branding is being exemplified here, with the Polygon as a place that might uniquely enable visitors to appreciate Cold War history, nuclear technology and disarmament imperatives.

Kurchatov, which is “still a testimonial to Kazakhstan’s nuclear past as it moves toward non-military research,” is described as a city built in Soviet-era buildings, KGB offices and guest homes for senior officials (Mukhatzhanova (2023). A new urbanism, it captures the tension of memorialization and mutation by maintaining material traces of nuclear testing-while reassigning its infrastructure for contemporary scientific and pedagogical purposes. Caravanistan (2025) is a travel guide for the intrepid and independent traveler, touching on safety issues, visa regulations and the tussle between historical value and radioactivity.

Duthie (2018) examines the ethical issues relating to dark tourism including whether visiting sites of tragedy is proper commemoration or an inappropriate consumption of the pain and suffering of others. Her three principles of dark tourism ethics are 1) respect the wishes and needs of communities/people affected by events, 2) these sites must be primarily educational (not sensationalized), focusing on contextualizing the history as well as addressing issues in modern society and 3) direct material benefits to affected communities in terms of jobs, monetary remuneration and amplified voices advocating for those whose rights have been violated. These principles provide normative criteria to assess if tourism development in the Semipalatinsk region is a responsible educational one or an exploitative one.

Destination Branding, Sustainability Marketing, Environmental Image, and Place Identity. Garanti et al. conducts systematic literature review and synthesized the existing knowledge on sustainable place brand and visitors’ response, identified authentication, differentiation and stakeholder involvement as significant success factors for destination branding. Their review shows that genuine brands based on a real sense of place and authentic community have much greater visitor loyalty and word-of-mouth than simulated marketing stories. This indicates that nuclear-free branding delivers genuine, as opposed to rhetorical, impact in the context of nuclear-free zones only through concrete examples of lawful compliance with state and local regulations along with transparent governance on safety issues and accountability to those communities affected by past or present operations.

Bilynets et al. (2021) demonstrate that publicly visible pro-environmental initiatives can strengthen a destination's organic environmental image when such initiatives are credible, consistent and clearly communicated to visitors. Their findings are directly applicable to nuclear-free tourism branding, with the research concluding that if Kazakhstan's transparency in regard to radiation monitoring and environmental remediation, as well as its compliance with international safety standards, is visible to visitors and communicated effectively, they would serve to bolster the destination environmental image. In contrast, they warn, delivering what observers perceive as greenwashing-influential environmental claims devoid of actual backing-can hurt destination reputation more than absence of thrown-out-the-blue environmental messaging.

Dias (2024): A Bibliometric Analysis of New Directions in Destination Branding: Destination Evolution through Digital Media Dias, V. These analyses show increasing focus on sustainability narratives, heritage preservation and community-based tourism as elements to set their brands apart. Public diplomacy tourism branding corresponds with such trend as nuclear-free, where the Semipalatinsk of Kazakhstan serves as a destination that visitors can learn about nuclear disarmament at peaceful places and communities and promote regional development at the same time through proper tourist investment.

Ştefan et al. (2024) establish a tourism branding model for Romania, focusing on real cultural heritage that also follows the principles of sustainable development. Their model identifies five core areas of branding that include a clear organizational identity informed by authentic place characteristics, consistent messaging across multiple channels, alignment between stakeholder expectations and community support for the brand role within the marketplace, visitor experience design with consistency in brand promise execution, and continual assessment of brand performance and stakeholder satisfaction. Taken together, this application of the framework to nuclear-free tourism branding means that relevant Kazakhstan institutions should ensure that its destination identity mechanisms substantiate their legal compliance verification processes, manage the transparency of radiation safety governance mechanisms and engage local communities if they are ever going to become credible brands which can be sustainably defended by international stakeholders or vested authority groups.

Font and McCabe (2017) examine the sustainability marketing paradoxes, approaches and chal-

lenges in tourism. This is where they say sustainability marketing grapples with a 'structural paradox' between encouraging consumption (travel) while promoting conservation, among other things like conflicting differentiation strategies that can commodify suffering / environmental degradation as well saying that short-term commercial imperatives conflict with long-term sustainability goals. These tensions take the form of how to effectively brand a destination that is synonymous with humanitarian tragedy, as well as steering tourism development towards recovery for affected communities and away from commodifying suffering.

According to The Tourism Space (2021), there is elevated interest in sustainable and destination marketing strategies, showing bottom-up groundswells where destinations continue to highlight environmental stewardship, social responsibility, & cultural preservation as defining brand assets. The trend is also indicative of changing visitor values, particularly amongst younger generations who are increasingly driven by a desire for genuine experiences and responsible consumption. Branding tourism as nuclear-free is consistent with these values, including educational sites for peace, solidarity with affected communities, and support of the nuclear disarmament movement.

In a particular niche focused on energy and industrial tourism Alekseeva & Heccegová (2021) characterize features distinguishing this segment: visitor interest in technological processes and infrastructure, educational motivation as opposed to leisure or recreation, tolerance for unusual or utilitarian destination environments, inclination toward unique experiences only accessible behind closed doors of sites not commonly open for public access. Nuclear test site tourism would fall into this category, catering to visitors for whom the allure of Cold War history tinged with nuclear content, whether writ large in the form of a testing facility tour or through a lens of disarmament politics, takes precedence over. Knowing the attributes of this niche market helps to advise marketing approaches, site interpretation methods and infrastructure development priorities.

Spatial, tourism development, and regulatory organizations. Dunets et al. (2018): This paper proposes a structural model of spatial development of tourism using territorial tourist complex theory. The framework consists of five components: core attractions, which are the primary reasons for visiting; supporting infrastructure, which allows access and services; spatial organization, determining how visitors move and interact with sites; regulatory frame-

works that establish what activities can take place in various settings and under what conditions those activities can occur; and community integration – a design regime that ensures local involvement in decision making and benefit distribution. The application of this model to post-nuclear tourism development indicates that legally robust regulatory frameworks regarding radiation safety, access permissions, and operator licensing are essential.

Especially the spatial problems of post-nuclear tourism development are relatively heavy. Radiation contamination provides spatially explicit constraints, with hotspots requiring permanent exclusion but other areas allowing controlled access. Kazakhstan has its legal foundation regarding radiation protection through the Law on Radiation Security of Population (1998) describing exposure limits and monitoring as well as regulatory authorities for radiation. The 2020 Sanitary Rules outline the dosimetry, protective equipment standards and access control measures to ensure that radiation safety is guaranteed. The regulations deliver the legal basis to enable tourism in Semipalatinsk by defining safety limits with which tour operators must operate.

But regulatory frameworks are only effective when they are clear to implement and enforce. As a minimum, tourism development in sensitive post-nuclear contexts requires public access to radiation monitoring data, rigorously designed briefings for visitors and restricts access through licensed tour operators with demonstrated safety competence and emergency response capacity. Differentiating responsible development of a nuclear tourism sector from activities that would be inappropriate or exploitive relies on legal compliance, spatial planning and operational safety management.

Research Gaps and Theoretical Contributions. Literature has addressed aspects of nuclear-free tourism branding in isolation-nuclear treaty compliance verification, destination branding strategies, dark tourism ethics, and spatial planning-but the literature still lacks an integrated analysis of the linkages among these mutually reinforcing dimensions. Research Question How does international legal compliance affect the formation of a destination identity? Research Questions How does domestic radiation safety regulation promote the generation of tourism development? Specifically, how do visitors interpret and assess nuclear-free labels? What patterns of access, movement and sense-making result from the interactions between legal stipulations, public safety imperatives and visitor expectations?

To help fill these gaps, this study develops an international (legal effectiveness)–personal (national regulatory transparency)–destination (brand authenticity)–spatial tourism development analytical framework. Through a case study of Semipalatinsk, Kazakhstan, this research illustrates how legally sound and transparent, spatially explicit governance enables nuclear-free tourism branding as both a development strategy for destinations and as an empirical peace dividend derived from compliance with historical nuclear disarmament treaties.

Methodology

The methodological framework combines doctrinal legal analysis, qualitative textual analysis and descriptive spatial assessment. Doctrinal legal analysis was used to examine the NPT compliance and verification framework together with Kazakhstan's domestic legal instruments regulating radiation safety, social protection and the Semipalatinsk Nuclear Safety Zone. The analysis focused on provisions governing access, monitoring, safety requirements, institutional competence and liability.

The qualitative textual component examined publicly available materials cited in the study, including visitor and tour-operator narratives, media publications, official institutional materials and policy documents. These materials were reviewed thematically to identify recurring representations of safety, peace, nuclear legacy, transparency and educational value. The textual analysis was interpretive rather than statistically representative; therefore, no causal or population-level inference is made from the frequency of particular themes.

The spatial component was used descriptively to examine how legal restrictions, radiation-safety rules and access requirements shape the organization of potential tourism routes and visitor access in the Semipalatinsk region. Rather than estimating causal spatial effects, the study uses publicly available regulatory and cartographic information to identify the relationship between legally defined access conditions and tourism planning. The purpose of this component is to illustrate legal-spatial constraints and opportunities, not to provide an independent radiological or GIS-based safety certification.

The empirical material consists exclusively of publicly accessible sources referenced in the manuscript: international and national legal instruments, official institutional documents, tourism-operator materials, media publications and secondary academic literature concerning Semipalatinsk and com-

parable post-nuclear destinations. The textual material was selected purposively on the basis of its direct relevance to nuclear-free identity, visitor safety, tourism access and post-nuclear destination representation. Because the corpus was not constructed as a statistically representative sample, the findings are interpreted qualitatively. Similarly, the spatial analysis relies on publicly available regulatory and descriptive spatial information and does not claim to reproduce an independent radiological survey or comprehensive GIS model.

The main analytical proposition of the study is that the legal effectiveness of the NPT is associated with nuclear-free tourism branding through three interrelated transmission channels: reputational signalling, regulatory certainty and monitoring transparency. First, reputational signaling: if a state claims to have fulfilled its NPT obligations and receives international recognition, then that state has definitively dispensed with any nuclear weapons capabilities and such compliance provides the basis for credibility in branding themselves as nuclear-free. Second, regulatory certainty: The NPT cannot be effectively implemented without robust domestic legal frameworks governing nuclear materials, facilities and radiation safety – both the foundation necessary for authorizing and administering visitors to former test sites. Third, transparency of monitoring: effective compliance verification relies on the scope and transparency of radiation monitoring systems which provide each necessary safety data required to formulate safe visitor routes, duration limits and protection protocols.

Results and discussion

The findings of the study indicate that the role of NPT as a legal influence is one such multidimensional driver towards post-nuclear destination identity formation within Kazakhstan. The analysis effectively supports the argument that parties to the NPT, along with national radiation-safety regulations, are indeed producing real-world benefits in three related areas – reputational signalling at an international level; regulatory certainty for domestic tourism governance; and improved monitoring and access management routinization. These springboards in tandem have helped carefully tie together the loose ends in making a credible and timely move toward a nuclear-free tourism brand through Semipalatinsk.

1. Reputational Signalling and Global Image Transformation. Kazakhstan continues to define it-

self globally on the basis of its early and voluntary renunciation of nuclear weapons. The Semipalatinsk Test Site The closure of the Semipalatinsk test site in 1991-prior to independence served more as a symbolic act rather than constructive compliance with NPT's spirit while showcasing political will towards disarmament (Eurasian Research Institute, 2016). Such an act provided Kazakhstan as a state with reputational capital, which has continued to be used by Kazakhstan in its diplomatic activities like the 2010 OSCE summit or the IAEA Low Enriched Uranium Bank establishment (IAEA, 2016). The active participation of the country in the Central Asian Nuclear-Weapon-Free Zone (CANWFZ) has suitably solidified its status as a «model non-nuclear state» (Gautam, 2024).

The textual and spatial analyses uncover how this reputation-based identity has increasingly become concretized in space-as articulated through the medium of tourism narratives, guiding services, and representation locations. Qualitative analysis of tour operators' promotional materials suggests that «nuclear free», «peace», and «education» are commonly used framing terms – appearing far more often than the terms, such as «radiation» or «danger». This finding is consistent with Abdullah et al. (2024), who argue that compliance with international legal obligations may generate normative visibility and strengthen international legitimacy and trust.

Finally, a comparative fieldwork example contrasts Kazakhstan's Semipalatinsk Polygon with Ukraine's Chernobyl Exclusion Zone, showing that reputational signalling based on NPT creates an ethical distinction between types of dark-heritage tourism. In contrast to the fallout from Chernobyl, which continues to be focused on catastrophe, the story of Semipalatinsk falls into a paradigm of moral authority and human endurance (Liu et al., 2020). This volatility illustrates why what is integrated within the narratives around destinations; compliance with international legal standards), which along the lines of Garanti et al. (2024), who demonstrate that brand trust builds only over time for authentically grounded brands, and safter being visible through governance transparency.

2. Regulatory Certainty and Domestic Legal Infrastructure. We can say that the doctrinal approach of Kazakhstan's legal context confirms the regulatory clarity as the second pillar supporting nuclear free tourism brand. The Law «On Radiation Security of Population» (1998) and 2020 Sanitary Rules established the system including radiation-protection standards, licensing procedures, and ex-

posure limits permissible (On Radiation Security of Population, 1998; Об утверждении Санитарных правил, 2020). The national legislation compares well against approved or proposed international safety recommendations (IAEA, 2016) indicating a strong relationship where the domestic regulatory framework internalizes international verification standards.

Available regulatory and descriptive spatial materials indicate that access across the former test-site territory remains highly differentiated: some areas remain subject to strict restrictions, while others may be accessible for scientific, educational or other controlled purposes under state supervision. This differentiated access regime demonstrates how radiation-safety regulation directly shapes potential visitor routes and the spatial organization of tourism activities. This spatial distribution is the same as that of Dunets et al. propose a model of territorial tourism complexes (2018) that leads through regulatory frameworks and access zones to define visitor flows allowed by the authorities: since these types of tourist activities are located relatively close to urban environments. The model illustrates that safety and predictability, two fundamental factors for tourism investors and operators, are guaranteed when spatial planning is guided by legal certainty.

The reviewed materials further indicate that radiation zoning maps have been incorporated into local urban-development plans, a unique case of legal-spatial alignment in post-nuclear governance (the Kurchatov and Abai Region). Such alignment is in direct support of Font and McCabe's (2017) assertion that sustainable tourism marketing, obviate the commodification of environmental risk, requires sound regulatory foundations. The regulatory framework thus serves not only as a safety mechanism but also as a branding tool, giving visitors and foreign partners the confidence to know that tourism development in Kazakhstan is consistent with international best practice.

3. Monitoring Transparency and Data-Driven Governance. The third dimension of analysis-monitoring transparency-points to an association between open data practices and the level of destination credibility attributed by visitors. The public availability of dose rate maps and IAEA monitoring results was found to increase visitor trust and bolster portrayals of Kazakhstan as a scientifically sound nation. The results support Hood (2021), who has argued that transparency mechanisms (such as aerial and satellite verification) are integral to generating public trust in arms-control regimes.

In 2023, Kazakhstan had already integrated the use of open-access radiation data into national law in its Law «On the Semipalatinsk Nuclear Safety Zone», creating a digital portal that displays real-time environmental readings. The reviewed visitor, tourism and media narratives repeatedly associate references to safety, monitoring and publicly available data with expressions of trust in the destination. While the qualitative material does not permit a statistically representative estimate of changes in visitor trust, it suggests that transparency functions not only as a compliance mechanism but also as an important component of destination communication. These results indicate that transparency is not just a compliance mechanism but also a means of communication, as supported by Bilynets et al. (2021), who found that visible environmental actions can considerably augment destinations organic environmental image.

In addition, such transparency in monitoring makes it possible to develop participatory citizen science to incorporate local knowledge into tourism governance. Tourists, with handheld dosimeters, provide data for publicly available radiation databases – this is compatible with UNIDIR (2023) by ways of «soft enforcement», where transparency and participation become alternative objectives to punitive mechanisms. These practices bolster the experiential aspect of nuclear free branding by recruiting visitors as co-monitors of safety and care.

4. Comparative Insights and International Relevance. Third, the results suggest that Kazakhstan's case displays both alignment and misalignment with other post-nuclear sites. Industrial-heritage interpretation driven negotiation of identity: Case of Visaginas, Lithuania Mažeikienė and Gerulaitienė (2022) By contrast, Kazakhstan's transformation and historical narrative is fundamentally based on the normative legitimacy and pride of its voluntary denuclearization discussion; it does not invoke any moralistic narrative as with European cases. In a similar vein, McMichael (2024) argues when educational tourism creates opportunities for visitors to contemplate light and shadow via direct interaction with living witnesses of disarmament it is transformative, as seen in Kazakhstan's use of survivor testimonies in museum curation.

Compared what has been written about the legal governance of Chernobyl tourism. Inconsistencies in visitor management have occurred as a result of Ukraine's fragmented licensing and overlapping authorities (Liu et al. 2020). Kazakhstan has a more unified radiation-safety system, including ministe-

rial decrees and local regulations organized within the frame of a centralized legal hierarchy. This congruence in terms of regulation is important for

compliance visibility – as one of the key elements ostensible «objective verification through neutral tribunals» (Dorn and Scott 2000).

Table 1

The comparison can be systematized across several dimensions relevant to post-nuclear tourism governance

Dimension	Semipalatinsk case	Chernobyl case in the literature reviewed	Analytical implication
Dominant destination narrative	Denuclearization, peace, memory and education	Disaster, exclusion and dark heritage	Different historical narratives produce different branding opportunities
Access governance	Controlled access shaped by radiation-safety regulation and national legal requirements	Restricted and controlled access shaped by exclusion-zone governance	Both cases demonstrate that tourism depends on regulated rather than unrestricted access
Safety communication	Emphasis on legal regulation, monitoring and controlled access	Emphasis on radiation risk, exclusion and visitor-management procedures	Risk communication is a central component of destination legitimacy
Role of nuclear legacy	Linked to voluntary denuclearization and international anti-nuclear identity	Linked primarily to technological disaster and its consequences	Semipalatinsk permits a stronger peace/disarmament identity
Tourism orientation	Educational, memorial and specialized heritage tourism	Dark, educational and disaster-related tourism	Ethical interpretation should differ according to the origin of the nuclear legacy

The comparison should not be interpreted as a ranking of the two governance systems. Rather, it demonstrates that similar radiation-related access constraints operate within substantially different historical, legal and reputational contexts.

5. Challenges and Limitations. However, despite these successes some challenges remain. At first, the areas between tourism agencies and radiation-safety authorities lack connections. Interviews with municipal planners and NGO representatives (reported here from secondary sources) reveal sparse data-sharing activity between scientific institutions and destination-management organizations. This problem indicates a US Department of State (2025) caution that effective compliance becomes difficult when domestic enforcement mechanisms are not cross-agency integrated.

Second, although transparency will make most types of radiation data more accessible and for some, clearer, there are still coverage challenges through main stream media when it comes to accurate multi-faceted communication to non-specialists. Many existing visitor briefings are written in conventional technical terminology and seldom respond to or translate into more lay terms at the risk of misinterpretation. The Tourism Space (2021) argues that worthwhile sustainability communication must communicate the truth in a way that resonates emo-

tionally with potential visitors, thus engaging both ethically and intellectually. Solving this problem involves interdisciplinary communication between scientist, travel professionals and social scientists.

Third, these socioeconomic disparities are relentless between communities in the Polygon. Yet residents of the old testing area still suffer health and livelihood impacts, which raises ethical considerations as to whether the benefits from nuclear technologies – if any – are allocated equitably. Dark-tourism development needs to be done carefully, as it can easily exploit suffering if agencies do not retain ownership and return real benefits (Duthie 2018). It is therefore essential for ethical legitimacy and local support of tourism plans to ensure the inclusion of all relevant perspectives.

Several methodological limitations should also be acknowledged. First, the study relies primarily on publicly available legal, institutional, tourism and media materials rather than on original interviews or visitor surveys. Second, the qualitative textual material was selected purposively and is not statistically representative of all visitors to the Semipalatinsk region. Third, the spatial analysis is descriptive and based on publicly available regulatory and spatial information; it does not constitute an independent radiological assessment or comprehensive GIS survey. Fourth, the single-case focus on Kazakhstan

limits the direct generalizability of the findings to other post-nuclear destinations whose legal, political and environmental circumstances differ substantially. Finally, the interpretive design identifies associations and transmission channels but does not establish causal effects between treaty compliance and tourism outcomes.

6. Theoretical and Practical Implications. The combined results provide reaffirmation of the hypotheses of how NPT legal effectiveness acts in production through three supplementary transmission channels (reputation, regulation, and transparency) to further facilitate nuclear-free destination branding. In theory, this shows that the eventual compliance with an international treaty can deliver spatial and perceptual changes beyond just security, supporting evidence from Lennane and Moyes (2021) that visibility of social co-benefits confers sustainability on disarmament treaties. In practical terms, this indicates that the administrative spatial governance models relying on legal compliance and transparent monitoring can be transferred to different post-nuclear or post-industrial contexts.

Kazakhstan illustrates how nuclear-free tourism branding may contribute of nuclear-free tourism branding into an economic diversification tool, as well as a place to show off peace dividends. The actual reinterpretation of the infrastructures installing test-sites, into museum, reception-center and research park expose the spatialization of legal norms. In this regard, Mažeikienė (2021) points out, educational tourism converts the nuclear heritage into a cognitive capital-something that Kazakhstan itself regularizes through the «Atomic Heritage Route» project incorporating memorials, laboratories and rustic settlements.

Lastly, this research adds an empirical example to the field of spatialized law by showing how international legal frameworks are spatially deployed through methods of land-use regulation and destination governance. The nuclear-free tourism brand therefore does not function simply as a marketing artifact, but rather more like an applied geography of the law: an achieved geography of treaty enactment.

Conclusion

This paper aims to examine the way in which the legal success of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) materialises in spatial and socio-economic terms through post-nuclear landscapes in Kazakhstan-specifically with

regard to Semipalatinsk Test Site (STS) and its associated «nuclear-free» tourism brand. In particular, this was achieved through identifying the principal transmission channels linking international treaty compliance and national governance structures with destination identity formation and tourism spatial planning. This study, using a multidisciplinary approach, integrating doctrinal legal analysis with computational text processing and descriptive spatial assessment, illustrated how NPT compliance works as both an instrument of international security and frame through which regional development and identity transformation can take place.

The results show that legal effectiveness acts through three connected transmission channels-reputational signalling, regulatory certainty and monitoring transparency-that together constitute stability and prosperity of Kazakhstan's nuclear-free tourism area. Kazakhstan has voluntarily renounced nuclear weapons and was a part of international disarmament diplomacy, this creates a moral and symbolic basis for building tourism branding that is founded on resilience and education, not risk or disaster. This nuclear split image helps to gain international recognition and allows you to distinguish the country from non-nuclear regions of post-responsibility (such as Chernobyl, where the narrative focuses on disaster history and crime).

From the regulatory perspective, this research ensured that the national legislation of Kazakhstan, such as The Law on Radiation Security of Population (1998), 2020 Sanitary Rules and recent 2023 Law on Semipalatinsk Nuclear Safety Zone establishes a necessary legal framework for tourism development in sensitive environments. Such deeds provide unambiguous safety standards, monitoring commitments, and licensing systems to translate abstract principles of verification and non-proliferation derived from the NPT into actionable national laws. A consensus of norms between international and national law is essential to safeguard visitors, spatially planning access corridors, ensuring the confidence that investments in tourism can generate.

The third channel of transparent monitoring turned out to be vital in regard the public relations of Kazakhstan with respect both to international domestic and foreign perception of its post-nuclear sites. The availability of open-access radiation data and the implementation of transparent communication practices help build public trust, revealing that these mechanisms for compliance verification can also act as instruments for tourism. The availability of monitoring information and the potential for

participatory citizen-science practices illustrate how transparency can contribute to trust-oriented post-nuclear tourism governance.

The results also emphasize that legal and spatial governance mechanisms can convert erstwhile restricted spaces into vehicles for education, memorialization and peace activism. This shift supports the analytical proposition of the study that visible international legal compliance can generate reputational signaling and comparative scrutiny among States, producing broader reputational and governance effects beyond conventional security outcomes. Kazakhstan experience in this respect provides an example that can be replicated by many post-nuclear or post-industrial areas having similar concern of transformation of legacy of technological hazard into a sustainable development path.

The research also highlights challenges that continue to be prevalent and requires attention. Despite benefits, we found various barriers to fully realizing nuclear-free tourism, including institutional fragmentation among agencies, lack of effective communication of scientific data with non-specialist audiences and insufficient socio-economic inclusion of local communities. To bridge these gaps, claims to ethical legitimacy and channels for social sustainability demand better inter-agency coordination, building capacity among those who work on the ground (local operators) and creating inclusive benefit-sharing mechanisms. As Duthie (2018) warns, without strong community involvement and ethical reflection, dark-heritage tourism threatens commodification of human pain.

The findings of this study provide evidence that Kazakhstan's nuclear-free tourism initiative is not only a tool for diversifying the economy; it also serves as an actual a potential social and symbolic benefit associated with disarmament of international legal obligations (peace accords) in both physical and symbolic spaces. These findings feed into wider theoretical debates within spatial law and sustainable tourism, indicating that the law is a space forming force itself shaping land use, infrastructure and perception. This indicates a new order of what we call 'legal geography' in post-nuclear development, in which treaty performance, national regulation and participatory transparency are integrated.

The research opens multiple avenues for further exploration and implementation moving forward. Future studies should explore:

Comparative policy analysis of Kazakhstan and other nuclear legacy sites (specified: Nevada, Novaya Zemlya, or Lop Nor) for regulatory harmonization best practices.

Longitudinal perspective: long term insight on visitors' values of nuclear heritage to track the changing influence of information and demystification;

- Digital and AI-Augmented Radiation Safety and Visitor Management Systems to Improve Real-Time Accountability;

the integration of the «Atomic Heritage Route» into regional and international tourism networks as an instrument of peace education and sustainable economic development.

In summary, the study suggests that the significance of the NPT and related non-proliferation commitments may extend beyond their immediate security functions when treaty compliance is reinforced by transparent national regulation and responsible spatial governance. In the Kazakhstan case, these elements contribute to the reinterpretation of a difficult nuclear legacy through education, memory, safety and peaceful engagement. Framed in this manner, Semipalatinsk is more than a site of traumatic nuclear heritage; it embodies what law can accomplish for mankind via transformation into something safer and more responsible.

Funding

This research is funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan grant number AP 25795633.

Conflict of interest

The authors declare no conflict of interest.

Authors' contributions

«*Conceptualization, A. Bolat and A. Kassymova; Methodology, A. Aktymbayeva; Software, N. Jangeldina; Validation, N. Yüzbaşıoğlu, A. Bolat.; Formal Analysis, Z. Akimov; Investigation, A.Kassymova; Resources, A. Bolat, A.Aktymbayeva; Data Curation, A.Kassymova; Writing – Original Draft Preparation, A.Bolat; Writing – Review & Editing, A.Bolat and A.Kassymova; Visualization, N. Yüzbaşıoğlu; Supervision, N. Yüzbaşıoğlu; Project Administration, A. Aktymbayeva; Funding Acquisition, A. Bolat*»

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