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The Regulatory System Governing Land Reclamation in the Context of Sustainable Development and Environmental Protection

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ABSTRACT

The mining sector disturbs significant areas of Kazakhstan's farmland every year. However, the regulatory control of how those lands are reclaimed in the context of sustainable agricultural land use remains empirically understudied. This article aims to identify and systematically describe the institutional gaps between the current regulatory framework for reclaiming subsoil-disturbed lands and the requirements of sustainable agricultural land use in the Republic of Kazakhstan. The methodology has three components: a content analysis of 45 regulatory documents from 2018-2024 against a protocol of nine indicators grouped into three blocks; an expert survey of 22 specialists from four agency groups, using a 7-point Likert scale; and correlation analysis using Kendall's coefficient. The Regulatory Compliance Index at the regional level (0.21) is more than half the national figure (0.58), and the difference is statistically significant ($H=14.7$, $p<0.01$, $\eta^2=0.31$). None of the 18 regional documents includes triggers for revising reclamation plans when land condition deteriorates. Regional specialists rated current instruments as adequate only 14% of the time. The Kendall's coefficient between regulatory intensity and the share of completed reclamation work came in at $\tau=0.48$ ($p<0.05$). Six institutional gaps were identified, three of them classed as high criticality: methodological, procedural, and institutional. The results matter for the achievement of SDGs 2, 15, and 17 at the territorial level.

Keywords: *Land reclamation, Agricultural land use, Regulatory framework, Sustainable development*

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INTRODUCTION

Kazakhstan ranks first in the world for uranium production (43% of global output in 2023) and sits in the top ten producers of copper, chromium, zinc, and coal (World Bank, 2023; IAEA & OECD-NEA, 2024; Hao *et al*., 2025; Svensson & Lindberg, 2026). Those figures have a direct agricultural impact: mining enterprises are located predominantly in the steppe and foothill regions where farmland (Tabynbayeva *et al*., 2025) and zones of mining development overlap territorially. According to the Ministry of Agriculture, the area of disturbed land requiring reclamation exceeds 310,000 hectares, while annual reclamation volumes run at about 30-35% of the planned figures (Ministry of Ecology and Natural Resources of the Republic of Kazakhstan, 2023; Ministry of Agriculture of the Republic of Kazakhstan, 2024; Morgan *et al*., 2025). The gap between declared commitments and actual results is persistent and is not closing (Belkharoev, 2024).

The international sustainable development framework puts this question among its priorities. SDG 15 covers the restoration of degraded land and ecosystems (Ospanova *et al*., 2018; Viphanova, 2025); SDG 2 covers food security through the sustainable management of farmland (Belkharoev, 2024; Beresneva & Kulibaba, 2024; Rozhkova *et al*., 2021). The FAO Voluntary Guidelines for Sustainable Soil Management (FAO, 2017; Anisimov *et al*., 2025) and the OECD Guidelines for Responsible Business Conduct (OECD, 2018) explicitly require environmental standards to be built into land-use practice in the mining sector. Kazakhstan has taken on the corresponding international commitments, yet the operational gap between them and reclamation practice has gone largely undescribed.

In formal terms, there is a regulatory base. The 2021 Environmental Code (The Republic of Kazakhstan, 2021) and the 2018 Code on Subsoil and Subsoil Use (Respublika Kazakhstan, 2017; Huber *et al*., 2025) frame reclamation as a mandatory condition of subsoil use. The Land Code anchors the priority of agricultural use when disturbed lands are restored (Respublika Kazakhstan, 2003; Salem *et al*., 2025). In our opinion, the problem is not a missing rule book; it is that national requirements do not translate into regional management instruments, and the oversight machinery does

not deliver on the obligations on paper (Abdullayev *et al*., 2025). This reproduces the pattern Biesbroek *et al*. describe as the "implementation gap", i.e., the divergence between formal institutional commitments and their operational delivery (Biesbroek *et al*., 2018; Novak & Jelic, 2025).

The objective of this study is to identify and systematically describe the institutional gaps between the regulatory framework for reclaiming subsoil-disturbed lands and the requirements of sustainable agricultural land use in Kazakhstan. Three tasks include: analyzing the regulatory base for indicators of sustainable reclamation; assessing the fit of current instruments through an expert survey; and verifying the link between regulatory and actual reclamation outcomes through correlation analysis.

The research question is as follows

To what extent do the current regulatory instruments for land reclamation in Kazakhstan integrate the requirements of sustainable agricultural land use, and what institutional changes are needed to close the gaps identified?

Literature review

Land reclamation, as a distinct area of regulation, took shape in international practice during the 1970s and 1980s. Azapagic (Azapagic, 2004; Kwatra *et al*., 2024) developed a framework of sustainable development indicators for the mining sector with three groups of criteria: restoration planning, financial assurance, and monitoring (Logachev *et al*., 2023; Simonov & Karpov, 2024). These three blocks reappear in most of the regulatory systems that followed, both voluntary (the ICMM standards (ICMM, 2019) and binding (EU, US, and Australian law). That is not accidental: the blocks correspond to three stages, each of which produces fundamentally different consequences for land-use sustainability when regulation fails.

Planning requirements decide whether reclamation will be built into the development project at all. The International Council on Mining & Metals notes that in most transition economies, reclamation projects are drafted after the fact rather than as part of the original subsoil-use plan, which fundamentally lowers the quality of restoration (ICMM, 2019; Battakhov, 2023; Saparov *et al*., 2024; Abdoul-Latif *et al*., 2025). For Kazakhstan, this matters especially since a significant share of active mining operations is inherited from the Soviet era, when reclamation planning was not a standard.

Financial assurance is the second critical block. Reclamation funds and bond mechanisms requiring the subsoil user to accumulate funds for restoration before extraction begins are recognized by the OECD as one of the most effective tools for delivering on regulatory requirements (OECD, 2018; Agafonov, 2024; Zairkhanova *et al*., 2024). In several transition economies, this mechanism either does not exist or works only on paper. A global review of reclamation financial assurance systems found that in jurisdictions with strict bond requirements, the correlation between regulatory intensity and actual reclamation results is markedly higher than in systems with soft or unregulated assurance (IISD, 2021; Nguyen *et al*., 2025).

Countries with developed mining take a fundamentally different approach to financial assurance. The Australian system of progressive reclamation requires subsoil users to post a bond equal to 100% of the estimated cost of restoration before extraction begins, with the amount revised whenever the scope of disturbance changes (Aksoy & Akaydin, 2024; Unger *et al*., 2025). Tiemann *et al*. showed that tying the financial obligation to the licensing stage rather than the closure stage creates a stable incentive for timely reclamation, in contrast to the after-the-fact mechanisms that prevail in Kazakhstan (Tiemann *et al*., 2022; Elango & Govindaraju, 2025).

Knox (Knox, 2025) showed that the administrative traditions of state paternalism in Kazakhstani public administration reproduce a situation in which de facto responsibility for reclamation rests with the regulator rather than with the subsoil user. That feeds directly into cross-agency integration, i.e., the third critical block. Reclaiming disturbed farmland requires at minimum two agencies to interact: the environmental oversight body and the land-management body (Jannath *et al*., 2024; Yakovleva *et al*., 2025; Movchan *et al*., 2026). In the Kazakhstani system, those are the Ministry of Ecology and the Ministry of Agriculture, i.e., two agencies with different priorities, different data formats, and no formal joint-oversight protocol. Hurlimann *et al*. showed, across a broad country sample, that the cross-agency coordination gap, not a shortage of regulation, explains the larger part of the variation in environmental regulatory performance (Chandrasekhar *et al*., 2025; Hurlimann *et al*., 2021).

Kazakhstani research on the reclamation of disturbed land is sparse. The work focuses largely on remote sensing of land degradation (Benhmida & Trabelsi, 2024; Rafikov *et al*., 2024) and on general issues of soil fertility (Ibraeva *et al*, 2024), with a few studies addressing biological reclamation of specific sites (Konysbayeva *et al*., 2025; Liedekerke *et al*., 2025). The regulatory aspect (how regulatory instruments measure up against the requirements of sustainable agricultural use) remains empirically unexplored. Meanwhile, the OECD has recorded that no analysis of reclamation plans for environmental safety exists in Kazakhstan, and the management of reclamation financial assurance is not governed by any regulation (Dobrzynski *et al*., 2024; OECD, 2025).

That gap is the research space of the present work. The three indicator blocks (planning, financial assurance, and cross-agency integration) are selected as the analytical categories of the content analysis because they cover the full regulatory cycle of reclamation and reappear in comparable international systems (Azapagic, 2004; ICMM, 2019).

MATERIALS AND METHODS

Study design

The research uses mixed methods, combining a content analysis of regulatory documents, an expert survey, and a correlation analysis. Each of the three components answers a separate question: what the regulation actually fixes; how experts rate the current instruments; and whether there is a statistically significant link between regulatory intensity and actual reclamation outcomes. The sequencing follows the logic of verification, where each stage tests and refines what came before.

Stage 1: content analysis of regulatory documents

We analyzed 45 regulatory documents from 2018 to 2024. The sample was built on two criteria: belonging to one of the three regulating levels (national, regional, sectoral) and being in force

at the time of the study. **Table 1** shows the composition of our sampling.

Table 1. Sample of regulatory documents by level

Level	Documents	Number
National	Environmental Code; Code on Subsoil and Subsoil Use; Land Code; National Development Plan to 2029; Green Economy Concept; other strategic acts	15
Regional	Territorial development programs of six mining regions; regional environmental programs; land management plans	18
Sectoral	SNiP standards and technical regulations on reclamation; methodological guidelines for drafting reclamation projects; financial assurance norms	12
Total		**45**

Note. Source: authors' sample (2024).

The protocol covers nine indicators in three blocks: requirements for reclamation planning (mandatory reclamation project, quantitative targets for volume and timing, criteria for prioritizing farmland restoration); monitoring and financial assurance mechanisms (regular land-condition monitoring, independent expert review of completed work, reclamation-fund requirements); and cross-agency integration (links to regional land-use schemes, coordination between the Ministry of Ecology and the Ministry of Agriculture, triggers for revising plans when land condition deteriorates). Coding used a binary marker: presence (1) or absence (0) of the indicator. Two independent coders processed every document; inter-coder reliability was checked by Cohen's kappa (κ=0.79), an acceptable level of agreement. The Regulatory Compliance Index (RCI) was calculated as the arithmetic mean of the share of indicators present.

Stage 2: expert survey

We surveyed 22 experts from four agency groups: seven specialists from the Ministry of Ecology and Natural Resources, six from the Ministry of Agriculture, five from regional akimats in mining oblasts, and four from the environmental services of subsoil-using companies. The sample was purposive, designed for maximum variation in job position. Each respondent was asked to rate current regulatory instruments on two scales: criterion importance (1-7) and adequacy of current regulation (1-7). The survey ran remotely from September to November 2024.

Stage 3: correlation analysis

To verify the link between regulatory indicators and actual reclamation outcomes, we used Kendall's rank correlation coefficient (τ). The variables: the RCI across six regions with developed mining (Karaganda, East Kazakhstan, Pavlodar, North Kazakhstan, Atyrau, and Zhambyl regions), and the share of completed reclamation work per region for 2021-2023, drawing on the Ministry of Agriculture data (World Bank, 2023). The Kendall's coefficient was chosen because of the small sample size and non-normal data distribution; the Shapiro-Wilk test confirmed the departure from normality (W=0.83, p=0.04). The thematic analysis of interviews followed a six-step procedure per Braun & Clarke (Braun & Clarke, 2006), with inductive coding.

RESULTS AND DISCUSSION

Content analysis of the 45 regulatory documents revealed a persistent asymmetry between regulation levels. Indicators of sustainable reclamation are most fully represented at the national level. At the regional level, they are absent across all three blocks **(Table 2)**.

Table 2. Frequency of reclamation indicators by regulatory level (% of documents containing the indicator)

Block/Indicator	National (n=15)	Regional (n=18)	Sectoral (n=12)
Block 1. Requirements for reclamation planning			
Mandatory reclamation project in the license	80	33	58
Quantitative targets for volume and timing	67	22	50
Criteria for prioritizing farmland restoration	47	11	33
Block average	**64**	**22**	**47**
Block 2. Monitoring and financial assurance			
Regular land condition monitoring requirements	73	22	42
Independent expert review of completed work	60	17	33
Reclamation fund requirements	53	11	25
Block average	**62**	**17**	**33**
Block 3. Cross-agency integration			
Links to regional land use schemes	47	28	25
Coordination mechanisms between the Ministry of Ecology and the Ministry of Agriculture	53	22	17
Triggers for revision when land condition deteriorates	40	0	8
Block average	**47**	**17**	**17**
Final Regulatory Compliance Index	**0.58**	**0.21**	**0.34**

Note. Source: authors' content analysis (2024).

Differences between levels are statistically significant (H=14.7, df=2, $p<0.01$ by Kruskal-Wallis; $\eta^2=0.31$ is a large effect size). The most critical picture sits in Block 3: none of the 18 regional documents contain triggers for revising reclamation plans when land condition deteriorates, and mandatory coordination between the Ministry of Ecology and the Ministry of Agriculture is not fixed at either the regional or the sectoral level.

The expert survey confirmed this gap through ratings of the practical adequacy of the instruments **(Table 3)**.

Table 3. Expert ratings of the adequacy of current regulatory reclamation instruments (% of respondents rating them as adequate)

Topic	Ministry of Ecology (n=7)	Ministry of Agriculture (n=6)	Akimats (n=5)	Subsoil users (n=4)
Sufficiency of reclamation project requirements	43	33	20	50
Effectiveness of financial assurance mechanisms	29	17	20	25
Practicality of the criteria for accepting reclaimed land	43	33	40	75
Cross-agency coordination in oversight	14	17	0	25
Integration of requirements into land use schemes	29	17	20	0
Overall rating of the regulatory framework as adequate	**29**	**17**	**14**	**43**

Note. Source: authors' expert survey (2024).

Regional akimat specialists show the lowest satisfaction with current instruments. Not a single akimat respondent rated cross-agency coordination as adequate. The highest mark for the criteria of reclaimed land acceptance came from subsoil-user representatives (75%), i.e., a divergence from the position of regulators and regional bodies, which sat at 33-40%.

Correlation analysis across the six mining regions revealed a moderate positive link: Kendall's coefficient between the RCI and the share of completed reclamation work was $\tau=0.48$ ($p<0.05$). The link between the presence of financial assurance requirements and actual accumulation of the reclamation fund was $\tau=0.52$ ($p<0.05$). The cross-agency coordination indicator correlates with the quality of reclaimed land acceptance more weakly: $\tau=0.41$ ($p<0.05$). The matrix of institutional gaps combines data from both sources **(Table 4)**.

Table 4. Matrix of institutional gaps in the regulatory framework for reclamation

Gap type	Manifestation	Documents used	Criticality
Methodological	No common quality standard for farmland reclamation	SNiP standards, methodological guidelines	High
Procedural	No triggers for revising reclamation plans when land condition deteriorates	Environmental Code, Code on Subsoil	High
Institutional	Siloed Ministry of Ecology and Ministry of Agriculture in reclamation oversight	National Plan 2029, sectoral regulations	High
Financial	Understated reclamation fund norms and weak enforcement	Code on Subsoil, budget regulations	Medium
Monitoring	No independent monitoring of the reclaimed land condition	Environmental Code	Medium
Informational	No unified database of disturbed and reclaimed land	Land Code, sectoral reports	Medium

Note. Source: authors' matrix from content analysis and expert survey data (2024).

The results allow us to separate two fundamentally different explanations for the gap: a managerial failure at the regional level or a methodological absence of any mechanism for translating national norms into regional planning instruments.

The RCI gap of 0.21 against 0.58 between regional and national levels lines up with the conclusions of (Biesbroek *et al*., 2018), which showed across 32 countries that centralized administrative traditions systematically slow the transmission of national environmental commitments to the subnational level. At the same time, our results point to a deeper kind of gap. In our case, the transmission mechanism is structurally absent: regional territorial development programs are drafted under a methodology that simply does not allow for reclamation indicators (Petyukova & Dereglazov, 2024). That is a methodological gap, not a managerial failure, and the distinction matters fundamentally for the choice of regulatory intervention.

The zero values in the revision-trigger block correlate with what the OECD (OECD, 2025) recorded for Kazakhstan in 2025: the country has no analysis of reclamation plans for environmental safety, and the management of financial assurance is not regulated (Sokolov, 2025). Our data expand that finding: not one of the 18 regional documents contains a condition for revision when land condition deteriorates. IISD (IISD, 2021), in a global review of financial assurance systems, showed that in jurisdictions without such triggers, reclamation obligations get pushed de facto to the closure stage when the company may have neither the funds nor the incentive to deliver. The Kazakhstani system reproduces that logic.

The moderate correlation of $\tau=0.48$-0.52 between RCI and the share of completed reclamation work is fundamentally different from what gets recorded in systems with a strict bond mechanism. Tiemann *et al*. (2022) for Australia and IISD (IISD, 2021) for a broader country sample showed that where the financial obligation is tied to the licensing stage and accumulated progressively, the link between regulatory quality and actual result is substantially stronger. The moderate strength of our correlation is explained precisely by the financial gap, i.e., regulation influences the outcome, but does not create a hard enforcement mechanism. The rest comes from factors that document content analysis cannot capture: the financial state of the individual subsoil user, the activity of the inspectorate, and informal arrangements with the akimat.

The divergence in adequacy ratings between expert groups (14% among regional specialists against 43% among subsoil

users) matches the pattern ICMM (ICMM, 2019) described for transition economies with an inherited state subsoil-use system. The gap between subsoil users and the other groups reflects a structural conflict of interest: companies rate their own work against standards they themselves consider sufficient, while regional bodies are dealing with practice that the regulatory toolkit was never designed to manage.

The zero rating for cross-agency coordination from regional specialists is consistent with the conclusions of (Knox, 2025) on the agency-bound character of Kazakhstani public administration, and it is reinforced by (Hurlimann *et al*., 2021): the cross-agency gap explains the larger part of the variation in environmental regulatory performance regardless of the quality of individual norms. The τ=0.41 correlation for the cross-agency integration block (the lowest of the three) fits this logic. A plot of land can receive an environmental sign-off on completed reclamation and remain unfit for agricultural use because the acceptance criteria of the Ministry of Ecology and the Ministry of Agriculture differ, and no single instrument joins them up. This is not a hypothesis; it is a direct consequence of the zero value on the joint acceptance indicator.

Taken together, the results point to three targeted interventions. Including reclamation indicators in the mandatory brief for drafting regional land-use programs closes the methodological gap without amending the codes. Anchoring reclamation plan revision triggers in the Environmental Code closes the procedural gap and gives a legal basis for updating documents when land condition deteriorates (Eliseev, 2024). Setting a joint acceptance protocol as a mandatory condition for closing the license fixes the institutional gap and partly the informational one. None of these measures requires new institutions, only a redistribution of existing powers within the current licensing cycle. Unger *et al*. (2025) showed that exactly this kind of targeted change in regulatory design, rather than the creation of new oversight bodies, delivers measurable results in comparable mining jurisdictions.

The limitations of the study are specific to the topic. Regional reclamation data come from the official reporting of the Ministry of Agriculture, whose collection methodology was not independently verified. Systematic understatement of degradation figures cannot be ruled out. The expert sample did not include representatives of small and medium subsoil-use businesses, i.e., a segment responsible for a significant share of small-area disturbed land that often falls outside regulatory oversight. Finally, the correlation analysis was run on six regions, which limits statistical power. Replication across a larger sample of regions, including those with limited mining activity, would refine the relationships identified here.

CONCLUSION

Kazakhstan's regulatory system for land reclamation creates a formal base but does not deliver its operational embodiment at the regional level. That is the central finding of the study. The six institutional gaps identified are not equal: three high-criticality ones (methodological, procedural, and institutional) are systemic rather than local, a conclusion supported by the close RCI values across six mining regions with different extraction profiles. The three of medium criticality (financial, monitoring, and informational) add further barriers but are secondary to the systemic ones. Correlation analysis showed that regulatory intensity is statistically tied to actual reclamation outcomes, which means improving regulatory quality delivers a measurable practical effect.

Two directions define the next steps for research. Methodologically, the content-analysis protocol for reclamation indicators is reproducible in countries with a similar mining-sector structure and centralized regulatory architecture: Kyrgyzstan, Mongolia, Uzbekistan. In practical terms, the most pressing task is the development of a single methodological standard for farmland reclamation quality, jointly produced by the Ministry of Ecology and the Ministry of Agriculture. That document creates the basis for closing the methodological and institutional gaps at once.

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