Практикалық маңызы. Зерттеу нәтижелерін монополияға қарсы саясаттың неғұрлым тиімді құралдарын әзірлеу, ӘМТ үшін бағаны реттеуді оңтайландыру, сыртқы экономикалық бәсекелестік жағдайында отандық өндірушілерді қолдау шараларын тұжырымдау үшін пайдалануға болады.

Түйін сөздер: бәсеке, трансшекаралық нарықтар, әлеуметтік маңызы бар тауарлар, импортқа тәуелділік, бағаны реттеу

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ANALYSIS OF CARBON STORAGE AND ECONOMIC VALUE OF DIFFERENT LAND USE TYPES IN KAZAKHSTAN (2001–2020)

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ABSTRACT

Research purpose. The research analyzes the causes and impacts of land degradation in Kazakhstan, focusing on its economic and environmental consequences. The study explores potential solutions for mitigating land degradation and promoting sustainable land use practices.

Methodology. The study utilizes a combination of comparative, systemic, and dialectical approaches. The comparative method examines land degradation trends across different regions. At the same time, the systemic approach provides a holistic view of the interdependencies between land use practices, climate change, and socio-economic factors. The dialectical method helps to understand the dynamic interactions and long-term consequences of land degradation.

Originality/Value of the Research. This research contributes to understanding land degradation in Kazakhstan by incorporating innovative approaches such as ecological branding as a driver of sustainable land management. The study also highlights the importance of transitioning to a green economy as a key strategy for mitigating land degradation and achieving sustainable development goals.

Findings. The study outlines the key stages of land degradation in Kazakhstan, identifying the main contributing factors and regions most affected. The findings emphasize the need for integrated land management practices and the adoption of sustainable solutions to combat land degradation. Recommendations are provided for policy interventions to restore degraded lands and promote sustainable agricultural practices.

Keywords: land degradation, carbon storage, total economic value, sustainable development, total benefit

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Introduction

Land degradation, often defined as the decline in a land's productive capacity and broader ecological functions, is widely recognized as a global threat. "So while the UNCCD COP called for the restoration of 1.5 billion hectares of land by 2030 to achieve a land-degradation neutral world, it was also essential to acknowledge land rights and inclusive land governance arrangements at the national and sub-national levels. " (UNCCD, as cited in [1]). Such deterioration compromises ecosystem stability and heightens food security risks, particularly in regions under intensive agriculture or livestock production. Without clear land rights and meaningful participation of local communities, restoration efforts risk being top-down and potentially unjust. "The land degradation hotspots are concentrated in the north of Kazakhstan, and stretch over Eastern Kazakhstan to the southern part of Central Asia…". This supports the fact that Kazakhstan the largest country in Central Asia, exemplifies the challenges of balancing economic activities with the conservation of soil fertility and carbon stocks. [2]. Its expansive steppes, deserts, and forested landscapes, while supporting a range of industrial and agricultural sectors, face mounting pressures from overgrazing, large-scale cropping, and industrial projects.

Over the past two decades, Kazakhstan's economy has reaped benefits from resource extraction, chiefly fossil fuels and mineral deposits, and also from cereal production and livestock-based agriculture. Yet these same activities intensify processes linked to land degradation. Issues such as soil erosion and loss of soil organic matter diminish carbon sequestration capacity and disrupt ecological processes essential to long-term agricultural productivity [7]; [9]. These concerns have risen to the forefront, notably as Kazakhstan strives to meet the global climate targets established under the Paris Agreement. Land-based mitigation strategies, including improved rangeland management, expansion of forested areas, and integrated carbon capture technologies, now factor into national policy debates [3].

In recent years, the nation's policymakers have introduced programs emphasizing a "Green Economy," which aims at reconciling the twin imperatives of economic development and environmental protection [3]. Such programs typically spotlight transitions to cleaner energy sources, sustainable resource management, and broader ecological services. Nevertheless, effective implementation calls for robust quantitative data: precisely, how different land use types—arable land, pastures, and mixed crop–vegetation mosaics—store carbon, and how these same uses rank in terms of economic returns. Without objective metrics on carbon storage and corresponding estimates of total economic value (TEV), policies might inadvertently promote short-term gains at the expense of ecosystem integrity.

Additionally, empirical research indicates that land-use policies often miss non-market benefits like climate regulation and cultural services [4]. Traditional market mechanisms usually favor immediate returns, leading to undervaluation of biodiversity, soil carbon, and resilience to climate extremes. Efforts to correct these distortions have given rise to advanced modeling frameworks—such as the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST)—capable of quantifying carbon sequestration potential across diverse ecosystems [4],[8]. The application of such frameworks in Kazakhstan remains an evolving field. This study thus seeks to fill the gap by examining the historical changes (2001–2020) in Kazakhstan's land use and their ecological and economic implications.

This paper consolidates two main components of inquiry. First, it quantifies and compares carbon storage across significant land use categories—cropland, pasture, and mosaics of crop–vegetation. Second, it translates carbon storage findings into monetary terms to uncover the total economic value (TEV) associated with each land use arrangement. The data span from 2001 through 2020, incorporating satellite-based assessments of vegetation density, region-specific metrics of carbon content, and a net present value analysis to measure how changes in land cover affect overall economic performance. In doing so, the paper adds an empirical layer to the evolving scholarship on sustainable land use in Central Asia, offering aa snapshot of current conditions and insights for future policy interventions around climate and land management.

The remainder of the paper is structured as follows. First, a short literature review addresses global and local perspectives on land degradation, carbon storage, and ecosystem valuation. Second, the main body explains the methodology, including the study's reliance on cost-benefit analyses, Normalized Difference Vegetation Index (NDVI) data, and scenario-based simulations. Third, the results convey which land use categories appear especially beneficial from both a carbon sequestration and economic perspective, and they analyze how total economic value has shifted across regions of Kazakhstan. Finally, a discussion contextualizes the findings relative to other studies and evaluates the complex trade-offs between short-term profitability and long-term ecological stewardship.

Literature review. The intensification of agriculture, deforestation, and reliance on chemical inputs are cited consistently as primary drivers of land degradation worldwide [4],[5]. Academic analyses underscore that degraded lands frequently yield diminished crop outputs, less stable water cycles, and lower ecosystem resilience [6]. The United Nations Convention to Combat Desertification draws attention to the social ramifications, revealing that resource-poor communities in arid and semi-arid zones are particularly susceptible to climate extremes once the land's capacity to buffer shocks has been compromised [1]. Scholars agree that terrestrial ecosystems can mitigate climate change by acting as carbon sinks, absorbing CO_2 from the atmosphere through vegetation growth and soil organic matter. Forests generally excel in carbon storage, yet grasslands, wetlands, and peatlands are essential reservoirs [2],[4]. In Kazakhstan, rangelands cover expansive areas, and research into their sequestration potential is ongoing [9]. While past studies underscore that industrial-scale agricultural conversions diminish soil carbon by intensifying tillage and removing vegetative cover, data from certain managed pastures suggest that strategic grazing practices can stabilize or even enhance carbon retention [7]. Tools like InVEST facilitate robust modeling of changes in carbon stocks, making it possible to track the impacts of land use shifts over time [8].

An important branch of sustainability research examines how best to assign economic value to ecosystem services. Traditional markets rarely capture intangible services such as climate regulation, flood mitigation, or cultural significance, so adopting economic valuation techniques clarifies the broader socio-economic stakes [10]. Pioneering work by Costanza and peers in 2014 (as cited in [9]), calculates the global value of ecosystem services in the trillions of dollars, setting a precedent for subsequent evaluations that attempt to quantify local or regional services. In Kazakhstan, the application of cost-benefit analysis for land management has been sporadic, though a growing body of research explores integrating ecosystem valuation into local policy.

Kazakhstan's unique blend of steppe, desert, and forested zones underlies a distinct set of ecological and economic priorities. The expansion of monoculture cereal production, combined with large livestock herds in semi-arid rangelands, has magnified soil erosion and desertification hazards [2],[7]. Rapid industrialization contributes to the depletion of soil organic matter, a key driver reducing carbon storage capacity [9]. While government programs referencing a "Green Economy" have sought to limit harmful practices, implementation obstacles remain [3], [10]. Payment for ecosystem services, carbon trading schemes, and stricter grazing regulations are among the recommendations advanced by some scholars to realign incentives and bolster carbon sequestration [1], [6].

Kazakhstan's interest in carbon capture and storage (CCS) technology complements broader ambitions to meet emission targets under global climate accords [7]. This approach often involves trapping CO_2 from major industrial sources and injecting it into underground formations, sometimes coupled with Enhanced Oil Recovery (EOR). Although CCS can address emissions from fossil fuel combustion, large-scale success depends on policy frameworks, high capital investment, and acceptance by local stakeholders. CCS also does not eliminate the need for improved land management, given that a major share of terrestrial carbon already resides in soils and vegetation, and preventing further losses is typically cheaper than trying to recapture carbon artificially later on.

MAIN BODY

Methodology

This investigation merges cost-benefit analysis with a net present value (NPV) approach to illuminate how land degradation influences the economic viability of various land uses from 2001 to 2020. By comparing no-restoration baselines against restored scenarios, the study tests whether rehabilitated lands yield benefits commensurate with their costs. NDVI measures were used to identify degraded areas, while land cover data aided classification into three key land use types—cropland, pasture, and crop–vegetation mosaics.

Researchers such as Costanza et al. (as cited in [9]) and Trucost (as cited in [10]) found that land degradation results in both direct (e.g., productivity losses) and indirect (e.g., diminished carbon sequestration) economic costs. Following their methodology, the present study's cost-benefit framework includes:

1. Baseline scenario (no restoration)

– Productivity: projected yields of food and livestock under degraded conditions.

– Foregone benefits: value of unaccounted carbon sequestration.

– Costs: minimal or no additional investment.

2. Restoration scenario

– Enhanced productivity: estimated gains in cereals, fodder, or other resources through improved soil health.

– Ecosystem services: monetary valuation of regained carbon sequestration, water balance, and biodiversity.

Restoration costs: one-time and recurring expenses (e.g., planting trees, adopting agroecological practices, and better management).

Net present value (NPV) was computed for each scenario over the observation period. Negative NPVs suggest land users may be reluctant to adopt restoration, indicating the need for policy incentives or technology support.

Data sources and approaches

1. NDVI analysis

NDVI time-series data, from Landsat and MODIS (with cross-checking from Sentinel-2 images), helped classify land condition status. Threshold definitions varied by vegetation and climate zone, yet the guiding logic was that consistently low NDVI signals significant degradation. Tracking NDVI also provided insights into changes triggered by drought or overgrazing ([15]).

2. MODIS global land cover change

The primary land cover dataset, MCD12Q1, has a 500 m spatial resolution. It enabled the identification of how forested areas, steppes, or croplands evolved throughout 2001–2020. The study also flagged transformations from woodland to farmland, though these were relatively minor in Kazakhstan.

3. Carbon storage calculations

The central indicators for carbon stocks were above- and below-ground carbon pools. Soil organic carbon (SOC) was integrated using region-specific factors and IPCC guidelines (see also Table 1). The Equation 1:

$$\text{Carbon Storage} = \text{Aboveground Carbon} + \text{Belowground Carbon} + \\ + \text{Soil Organic Carbon} + \text{Dead Organic Matter} \qquad \text{Eq (1)}$$

accounted for different carbon pools. Values came from a combination of local sampling and previously published coefficients. Field measurements validated the theoretical carbon density for distinct land use categories.

4. Calculating Total Economic Value (TEV)

The TEV for each land use encompassed direct market returns (e.g., grain harvest revenues, livestock output) and non-market benefits (carbon sequestration, water regulation). Market values were derived from relevant local databases, while carbon's monetary worth was pegged to standard proxies for global carbon prices.

5. Regression and scenario simulations

A standard linear regression in Stata tested how TEV in 2020 correlated with the economic value of 2001 land use. Although the final model's R^2 was small, indicating unobserved variables, the analysis still shed light on the negative association between initial and final TEV. Additional simulations introduced ±10% and ±20% hypothetical modifications to TEV, thereby gauging the prospective range of net benefits or losses under shifting economic conditions.

Results

Three prevalent land use types—arable land, pastures, and crop–vegetation mosaics—were examined. Table 1 summarizes the average aboveground and belowground carbon (43.43 and 31.77 t/ha, respectively), revealing a consistent capacity across all categories. Despite uniform carbon density figures in broad terms, measured peak values in specific localized sites might top 611.00 t/ha aboveground or 204.97 t/ha belowground. Meanwhile, apparent differences appear in economic returns: cropland stands at US$625.84/ha, pastures at US$1,338.65/ha, and mosaics at US$1,023.84/ha.

Table 1 – Carbon storage and the economic value of different land use types

Type of the land use	Average carbon storage above ground (tonnes/ha)	Average underground carbon storage (tonnes/ha)	Average economic value (US$/ha)
Arable land	43,43	31,77	625,84
Pastures	43,43	31,77	1338,65
Mosaics of agricultural crops and vegetation	43,43	31,77	1023,84
Source: compiled by the author based on [13;14]			

This outcome implies that certain rangelands not only effectively sequester carbon but also surpass monoculture farmland in terms of TEV once ecosystem services are factored in. Confirming these results, earlier findings in semi-arid Central Asia demonstrate that rangelands can be economically competitive when properly managed ([2], [9]).

Below, in table 2, the data on changes in total economic value (TEV) is represented for different regions of Kazakhstan, including the country as a whole and individual provinces. Data are presented as average and total change in TEV, expressed in millions of US dollars. The average change in TEV reflects the change in the economic value of a territory per unit of time or event. For Kazakhstan, the average change in TEV was 0.0012213 million US dollars, indicating a slight positive trend in economic value at the national level. However, for some regions, the changes in TEV vary significantly. For example, in the Kyzylorda region, a larger positive change is observed with a value of 0.0157 million US dollars, which may indicate an increase in economic activity or environmental value.

On the other hand, some regions show an adverse change in TEV. In the Mangistau region, the average change was -0.0158 million US dollars, indicating a decrease in economic importance. Similar negative changes are also recorded in Atyrau (-0.0091 million US dollars) and East Kazakhstan (-0.0056 million US dollars) regions, which may be due to certain economic or environmental problems in these regions.

The total change in TEV shows the overall change over a longer time or across the entire territory. Kazakhstan recorded a total change in TEV of USD 1,565.01 million, reflecting the overall improvement in the economic situation at the country level. While Kyzylorda showed a positive result of USD 2,651.07 million, other regions such as Mangystau and Atyrau regions showed a significant decrease in total TEV (-USD 3,278.03 million and -USD 305.68 million, respectively). These data highlight the differences in economic and environmental development of different regions of Kazakhstan, which may be useful for further research and development of regional development strategies and sustainable management of natural resources.

Table 2 – Change in Total Economic Value (2001–2020)

Country/Region	Average Change in TEV (US$ million)	Total TEV Change (US$ Million)
Kazakhstan	0,0012213	1565,01
Kyzylorda region	0,0157	2651,07
Mangystau region	-0,0158	-3278,03
Almaty region	0,0083	861,33
Atyrau region	-0,0091	-305,68
East-Kazakhstan region	-0,0056	-731,35
Source: compiled by the author based on [13;14]		

The regression analysis results for the economic value of land use in 2001 and 2020 show a negative relationship between these two indicators. The coefficient of the variable reflecting the economic value of land use in 2001 is -0.0419684, indicating a moderate negative change in the economic value in 2020 relative to the level of 2001. This means that with an increase in the economic value in 2001, there is a decrease in the value in 2020, which may be due to various economic, social or environmental changes that occurred during this period.

This coefficient also has high statistical significance, as confirmed by the p value < 0.001. This indicates that the observed dependence is statistically significant, and we can confidently state that the negative relationship between economic value in 2001 and 2020 is not random. It is also important to note that the confidence interval for the coefficient (-0.04375; -0.04018) does not include zero, further confirming the significance of the result.

However, despite the statistical significance, the model explains only 0.16% of the variation in total economic value (TEV), which is reflected in the low value of the coefficient of determination $R^2 = 0.0016$. This suggests that the model has limited explanatory power and cannot fully explain the changes in the total economic value of land use over this period. Such a low coefficient of determination may indicate the presence of other factors not taken into account in the model that significantly impact the change in economic value. The use of simple linear regression was a deliberate choice to establish a baseline understanding of the relationship between our chosen variables. While acknowledging its limitations, this method offers transparency and interpretability, which are valuable in early-stage empirical assessments. In future studies, multivariate regression would allow the inclusion of multiple explanatory variables simultaneously, helping to control interdependencies among them. Table 3 reports a negative coefficient of –0.0419684 for the 2001–2020 relationship. The statistical significance suggests that areas initially having higher economic value might have experienced moderate erosion of TEV over time, possibly reflecting overexploitation or vulnerability to resource depletion. On the other hand, the low R^2 of 0.0016 underscores the presence of multiple unmodeled factors, such as policy shifts, climate anomalies, or macroeconomic disruptions, that shape TEV.

Table 3 – Results of Regression Analysis of Economic Value (2001–2020)

Variable	Coefficient	Standard error	t-value	p-value	Interval
Constant	14502,79	20,37598	711,76	0,000	14462,85-14542,72
Total economic value of the land use/cover in 2001, USD	-0,0419684	0,0009124	-46,00	0,000	-0,04375--0,04018
Source: compiled by the author based on [13;14]					

Table 4 demonstrates how the TEV might change under hypothetical ±10% or ±20% shifts. These shock scenarios were selected to reflect plausible short to medium term fluctuations in our variables due to climate variability and policy shifts. The baseline scenario shows a marginal gain of around US$1.2213 million, accompanied by minimal standard deviation. By contrast, the 10% TEV boost scenario yields about US$2,618.08 million on average, with extremely large variation (over US$28,000 million in standard deviation). The 20% TEV increase scenario produces even higher shifts, though with correspondingly wide uncertainty. The negative scenarios of –10% or –20% TEV re-emphasize the inherent fragility of land-based economies.

Table 4 – TEV change simulation results

Scenario	Average Change in TEV (USD Million)	Standard Deviation of TEV (USD Million)	Minimum Change in TEV (USD million)	Maximum TEV Change (US$ million)
Basic Scenario	1,2213	0,0269041	-0,0710094	0,0710094
Increase TEV by 10%	2618,08	28 321,55	-70872,38	78247,43
Increase TEV by 20%	4014,86	29792,19	-70735,31	85485,43
TEV decrease by 10%	-175,49	25548,80	-71146,48	63771,43
TEV decrease by 20%	-1572,27	24265,93	-71283,55	56533,43
Source: compiled by the author based on [13;14]				

Finally, Table 5 offers an aggregated view of net benefits from the studied projects or changes, covering 1,281,430 observations. The average is –US$2,988,325 million, with a standard deviation of US$1,832.65 million. Even the least negative maximum remains substantially below zero, confirming a general downward pressure on economic returns across many land uses or proposed interventions. This pattern highlights that land degradation might impose higher economic losses than previously anticipated and that restoration efforts can be quite expensive if engaged late in the degradation process.

Table 5 – Statistical analysis of Net Benefit

Variable	Observations	Average (USD million)	Standard deviation	Minimum	Maximum
Total benefit	1281430	-2988325	1832,65	-6169,919	-1070,854
Source: compiled by the author based on [13;14]					

Discussion.

The differences in average carbon storage across Kazakhstan's primary land use types appear less pronounced than anticipated, 43.43 t/ha aboveground in all three categories, and 31.77 t/ha belowground. However, potential outliers, especially in grassland or mosaic patches that experience minimal disturbance, could hold larger carbon pools. From an economic perspective, the higher TEV for pastures (US$1,338.65/ha) and mosaic systems (US$1,023.84/ha) highlights that well-managed rangelands and mixed systems might deliver synergy between carbon and financial returns, consistent with earlier findings from Central Asia ([2],[9]). By contrast, cropland's TEV of US$625.84/ha underscores possible vulnerability to soil erosion or cost-intensive inputs if farmland is intensively exploited.

Regional disparities reinforce the argument that local policies and environmental conditions matter greatly. Kyzylorda's net gain might reflect improvements in irrigation networks or expansion of higher-value crops. Mangystau's steep negative shift (–US$3,278.03 million) suggests resource depletion or desertification is driving down both carbon storage and TEV, illustrating the immediate need for land rehabilitation ([1]). The negative coefficient in the time-based regression implies that land with a high initial value could face an overuse effect, resulting in an erosion of TEV—a phenomenon also found in regions with heavy reliance on single commodities or unsustainable intensification ([6]).

Low explanatory power ($R^2 = 0.0016$) underlines the multifaceted character of land-based economic outcomes. Variables ranging from climate shocks to policy regimes can influence how land is exploited or conserved, a conclusion paralleled by studies in other semi-arid contexts ([9]). The scenario simulations reveal that external changes in market factors, climate extremes, or policy frameworks can produce large swings in TEV, pointing toward the importance of building robust safety nets and risk management tools for land users.

One central takeaway is that conventional market signals do not capture the full cost of land degradation or the full value of carbon sequestration. To offer monetary incentives for sustainable practices, stakeholders and policymakers might consider implementing payment for ecosystem services (PES), carbon offset schemes, or ecological branding ([3],[6],[9]). Without these incentives, the negative average net benefit (Table 5) suggests that land users might default to short-term exploitation.

The results also raise another aspect: the relationship between restoration costs and potential upside. If net benefits remain negative on average, many restoration efforts may be unprofitable unless governments intervene (subsidies, carbon payments, or credit support). Similarly, for provinces like Kyzylorda that show robust positive changes in TEV, closer examination is warranted to ascertain which local interventions are replicable in Atyrau or East Kazakhstan.

A final implication is that although average carbon storage levels do not drastically differ across land uses, the synergy between carbon-rich grasslands and livestock-based revenue could be harnessed for policy. This resonates with recent arguments that grassland restoration offers a relatively cost-effective route to rebuild soil organic matter while sustaining livelihoods. Meanwhile, mosaic landscapes might complement the linear expanses of crops, buffering biodiversity and securing ecosystem stability.

Moreover, the empirical linkage between carbon sequestration and TEV across land use types offers a more localized and policy relevant valuation than previous studies.

Limitations of the study. The main limitation of this study is the data it is based on. In particular, the use of available data may not take into account all aspects of land use and economic activity, which limits the completeness of the analysis. In addition, the results of the regression analysis, with a low coefficient of determination, show that the chosen methodology requires revision. The need to use more complex models emphasizes the importance of taking into account additional factors for more accurate forecasting. Another limitation is the time period of the study, which covers the period up to 2020. Changes that occurred after this year were not taken into account, which may also affect the relevance of the findings in the context of a changing economic and environmental situation.

Conclusion

This study combined cost-benefit analysis, NDVI-based assessment, and net present value calculations to evaluate Kazakhstan's land use shifts (2001–2020) and discern how they affect carbon storage and total economic value. The findings show that although arable land, pastures, and crop–vegetation mosaics register broadly similar average carbon storage levels in above- and belowground pools, their respective economic values differ substantially. Pastures and mosaics tend to deliver higher TEV, underscoring that protecting or enhancing these systems could bolster carbon stocks while generating more substantial financial returns.

Despite overall positive TEV changes at the national level, several provinces, most notably Mangystau, recorded significant losses, exposing regional vulnerabilities tied to land mismanagement or ecological fragility. The regression analysis further revealed a negative correlation between economic value in 2001 and 2020, although the low R^2 points to omitted variables shaping long-term outcomes. Scenario-based simulations showed that small changes in TEV assumptions can produce significant variations, highlighting inherent uncertainties in land-based investments. The policy takeaway involves dedicating further resources to restoration, adopting advanced monitoring, and crafting incentives that properly reward carbon sequestration and ecological resilience.

The findings offer relevant insights for future climate finance mechanisms, particularly in identifying land types with high ecosystem value and carbon storage potential. This approach aligns well with global funding programs, the GCF (Green Climate Fund), and GEF (Global Environmental Facility). In economic terms, the study supports business cases for ecosystem adaptation and land restoration investments in Kazakhstan.

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ҚАЗАҚСТАНДАҒЫ КӨМІРТЕКТІ САҚТАУДЫ ЖӘНЕ ЖЕРДІ ПАЙДАЛАНУДЫҢ ТҮРЛЕРІНІҢ ЭКОНОМИКАЛЫҚ ҚҰНДЫЛЫҒЫН ТАЛДАУ (2001-2020 жж.)

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АҢДАТПА

Зерттеу мақсаты. Қазақстандағы жердің деградациясының себептері мен салдарын талдау, оның экономикалық және экологиялық зардаптарына ерекше назар аудару. Зерттеу жердің деградациясын азайтудың әлеуетті шешімдерін зерттеуге және жерді тұрақты пайдалану тәжірибесін ілгерілетуге бағытталған.

Әдіснамасы. Зерттеу салыстырмалы, жүйелік және диалектикалық тәсілдердің жиынтығын қолданады. Салыстырмалы әдіс әртүрлі аймақтардағы жердің деградация тенденцияларын зерттеу үшін қолданылады, ал жүйелік тәсіл жерді пайдалану тәжірибесі, климаттың өзгеруі және әлеуметтік-экономикалық факторлар арасындағы өзара тәуелділіктер туралы тұтас көзқарасты қамтамасыз етеді. Диалектикалық әдіс динамикалық өзара әрекеттесуді және жердің деградациясының ұзақ мерзімді салдарын түсінуге көмектеседі.

Зерттеудің бірегейлігі / құндылығы. Экологиялық брендинг сияқты инновациялық тәсілдерді тұрақты жерге орналастырудың драйвері ретінде енгізу арқылы Қазақстандағы жердің деградациясын түсінуге ықпал етеді. Зерттеу сонымен қатар жердің деградациясын азайтудың және тұрақты даму мақсаттарына жетудің негізгі стратегиясы ретінде жасыл экономикаға көшудің маңыздылығын көрсетеді. Зерттеу *Зерттеу нәтижелері.* Негізгі ықпал етуші факторлар мен ең көп зардап шеккен аймақтарды анықтай отырып, Қазақстандағы жер деградациясының негізгі кезеңдері көрсетілген. Нәтижелер жерге орналастырудың кешенді тәжірибесінің қажеттілігін және жердің деградациясымен күресу үшін тұрақты шешімдерді қабылдауды көрсетеді. Тозған жерлерді қалпына келтіруге және тұрақты ауылшаруашылық тәжірибесін ілгерілетуге бағытталған саяси араласулар бойынша ұсыныстар берілген.

Түйін сөздер: жердің деградациясы, көміртекті сақтау, жалпы экономикалық құндылық, тұрақты даму, жалпы пайда

Алғыс сөз. Мақала **AP23488084: «Қазақстандағы жердің тозуы және экономикалық мүмкіндіктер мәселесін шешу: тұрақты эко-интенсивті трансформация үшін таңдау эксперименттерін біріктіру»** тақырыбы бойынша Қазақстан Республикасы Ғылым және жоғары білім министрлігінің Ғылым комитеті 2024–2026 жылдарға арналған гранттық қаржыландыруы шеңберінде жүзеге асырылатын жоба аясында жарияланды.

АНАЛИЗ НАКОПЛЕНИЯ УГЛЕРОДА И ЭКОНОМИЧЕСКОЙ ЦЕННОСТИ РАЗЛИЧНЫХ ТИПОВ ЗЕМЛЕПОЛЬЗОВАНИЯ В КАЗАХСТАНЕ (2001-2020 гг.)

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АННОТАЦИЯ

Цель исследования. Проанализировать ряд причин и последствий деградации земель в Казахстане, с особым акцентом на ее экономические и экологические последствия. Исследование направлено на поиск потенциальных решений для смягчения последствий деградации земель и продвижения практики устойчивого землепользования.

Методология. Сочетание сравнительного, системного и диалектического подходов. Сравнительный метод используется для изучения тенденций деградации земель в различных регионах, а системный подход позволяет получить целостное представление о взаимозависимости между практикой землепользования, изменением климата и социально-экономическими факторами. Диалектический метод помогает понять динамические взаимодействия и долгосрочные последствия деградации земель.

Оригинальность/ценность исследования. Вклад в понимание проблемы деградации земель в Казахстане путем применения инновационных подходов, таких как экологический брендинг в качестве движущей силы устойчивого управления земельными ресурсами. Исследование также подчеркивает важность перехода к «зеленой» экономике как ключевой стратегии для смягчения деградации земель и достижения целей устойчивого развития.

Результаты исследования. Описаны основные этапы деградации земель в Казахстане, определены основные способствующие факторы и наиболее пострадавшие регионы. Результаты исследования подчеркивают необходимость комплексного управления земельными ресурсами и принятия устойчивых решений для борьбы с деградацией земель. Даны рекомендации по политическим мерам, направленным на восстановление деградированных земель и продвижение устойчивых методов ведения сельского хозяйства.

Ключевые слова: деградация земель, накопление углерода, общая экономическая стоимость, устойчивое развитие, общая выгода

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