Research on World Agricultural Economy
https://journals.nasspublishing.com/index.php/rwae

REVIEW

Aligning Agricultural Development with ESG Goals: Pathways for Central Asia in the Global Context

Chinara Usenbekovna Adamkulova [1*], ***Arsen Stalbekovich Akhunbaev*** [1], ***Yujie Liu*** [2], ***Nelli Ilyinichna Akylbekova*** [2], ***Nuri Bekposunovna Mambetkazieva*** [1]

[1] *Department of Economics, Kyrgyz National University named after Jusup Balasagyn, Bishkek 720000, Kyrgyz Republic*

[2] *Department of Management, Kyrgyz National University named after Jusup Balasagyn, Bishkek 720000, Kyrgyz Republic*

ABSTRACT

Agriculture in Central Asia faces a dual challenge: sustaining economic growth while addressing profound environmental degradation and social vulnerabilities. This study explores how the principles of Environmental, Social, and Governance (ESG) can be applied to align agricultural development in the region with global sustainability standards. Based on a qualitative review of academic literature, policy documents, and international experiences, the analysis highlights both the shared legacies and the divergent reform trajectories of the five Central Asian states. The findings reveal that while economic reforms have created new opportunities, ecological and social dimensions of sustainability remain weak. Kazakhstan demonstrates the potential of organic agriculture to attract investment and enhance competitiveness, yet institutional support and certification systems are underdeveloped. Kyrgyzstan illustrates the promise of community-based governance through pasture and water user associations, although financial fragility limits scalability. In Tajikistan, smallholder diversification and conservation farming contribute to resilience but are constrained by governance weaknesses. Turkmenistan's highly centralized agricultural system illustrates the limits of ESG integration under conditions of opacity, while Uzbekistan represents a system in

*CORRESPONDING AUTHOR:
Chinara Usenbekovna Adamkulova, Department of Economics, Kyrgyz National University named after Jusup Balasagyn, Bishkek 720000, Kyrgyz Republic; Email: chinara.adamkulova@knu.kg

ARTICLE INFO
Received: 20 September 2025 | Revised: 28 October 2025 | Accepted: 10 November 2025 | Published Online: 11 May 2026
DOI: https://doi.org/10.36956/rwae.v7i2.2764

CITATION
Adamkulova, C.U., Akhunbaev, A.S., Liu, Y., et al., 2026. Aligning Agricultural Development with ESG Goals: Pathways for Central Asia in the Global Context. Research on World Agricultural Economy. 7(2): 423–443. DOI: https://doi.org/10.36956/rwae.v7i2.2764

transition where diversification and liberalization offer progress but water management and certification remain unresolved. Across the region, three themes are decisive: the urgent need for efficient water governance, the importance of social inclusion to strengthen rural livelihoods, and the central role of credible institutions in ensuring transparency and accountability. The study concludes that ESG integration is essential not only for securing access to international markets but also for building resilience and ensuring long-term competitiveness of Central Asian agriculture.

Keywords: Central Asia; Agriculture; ESG Principles; Sustainability; Organic Farming; Water Governance; Rural Development

1. Introduction

Agriculture has always been more than an economic sector in Central Asia—it is an inseparable part of the region's social fabric, a source of livelihoods, and a stabilizing element of political life. In the years following independence, governments across the region sought to rebuild their agricultural systems around market principles, yet those systems still carry the weight of their Soviet inheritance—extensive monocultures, centralized water management, and a production logic that prioritized quantity over sustainability. Today, that legacy confronts new pressures. Climate change, water scarcity, and global market volatility have exposed the limits of traditional models of growth, demanding a shift toward a more balanced and forward-looking paradigm of development [1–3].

This shift increasingly finds its conceptual foundation in the principles of Environmental, Social, and Governance (ESG) performance. What once seemed like a financial reporting tool has evolved into a broader framework that connects ecological integrity, social inclusion, and institutional accountability. In agriculture, these principles translate into very tangible priorities: soil health, responsible water management, equitable access to resources, and transparent decision-making. ESG offers a vocabulary—and a set of instruments—that allow policymakers and investors to speak the same language about sustainability [4].

At first glance, ESG may appear distant from the daily concerns of Central Asian farmers. But if we think about it differently, these same principles echo traditional practices of stewardship and cooperation that have long existed in rural communities [5]. The environmental pillar ("E") reflects centuries-old respect for land and water; the social pillar ("S") embodies collective responsibility for community well-being; and the governance pillar ("G") reminds us of the importance of trust, fairness, and shared rules. What changes today is that these values must be measured, institutionalized, and connected to international frameworks such as the EU Corporate Sustainability Reporting Directive (CSRD), the Global Reporting Initiative (GRI), and the FAO's SAFA Framework [4]. For the agri-food systems of Central Asia, this is not simply a matter of compliance—it is a question of future competitiveness.

Over the past decade, the discussion around sustainability in agriculture has become richer but also more fragmented. Some studies focus narrowly on environmental efficiency, others on technological innovation or social inclusion. Few, however, examine the intersection of these elements through an integrated ESG lens. According to Shadkam and Irannezhad [6], the transition toward Agriculture 4.0 requires not only digital tools but also governance structures that translate sustainability data into accountable decision-making. Similarly, Sakkaraeva and Abdurashitov [7] argue that ESG in agriculture begins with quantifiable indicators—emissions intensity, water use efficiency, gender equality, and transparency—that must be embedded into national policies rather than treated as external donor requirements. The EDB [8] highlights that agri-food transitions now depend on transparent information systems and the credibility of reporting, while the World Bank [9] stresses that ESG-aligned investments can help fragile economies adapt to climate and trade shocks.

For Central Asia, these debates are not theoretical. Each of the five republics faces the same triad

of interlinked challenges—ecological degradation, social vulnerability, and weak institutions—but the degree and form vary considerably. Kazakhstan, with its vast steppe lands and export-oriented policies, experiments with organic certification and green financing but still lacks institutional coherence [10]. Kyrgyzstan shows a contrasting, bottom-up model based on community governance of pastures and water, yet its smallholders struggle with limited capital and fragmented infrastructure. Uzbekistan, the region's largest agricultural economy, is undergoing liberalization but still grapples with salinization and inequities inherited from the cotton monoculture era. Tajikistan's mountainous terrain dictates smallholder diversification and conservation farming, while Turkmenistan's state-controlled agricultural system demonstrates the limits of ESG adoption under opaque governance [11–15]. Together these cases show a landscape of reform that is dynamic yet uneven—full of local innovations but still lacking a unifying strategic framework.

In this setting, the relevance of ESG is twofold. On one level, it provides a diagnostic framework: a way to assess where and why sustainability gaps persist—for example, in water governance or social inclusion. On another level, ESG serves as a roadmap for modernization, linking Central Asia's agricultural sector to global trade, finance, and certification systems [16]. The European Green Deal and the Sustainable Finance Disclosure Regulation (SFDR) already influence how agricultural products are evaluated in international markets. Without credible ESG alignment, Central Asian exporters risk marginalization, even in regional value chains [17].

Despite the proliferation of sustainability programs, most existing literature on Central Asian agriculture remains descriptive, focused on sectoral reforms rather than conceptual linkages [18]. Few studies attempt to trace how environmental and governance variables interact, or how policy incentives shape farmer behavior. This paper seeks to fill that gap by offering a comparative and conceptual analysis that situates Central Asia's agricultural transition within global ESG debates. It does not aim to produce new empirical data but instead to synthesize the growing body of academic and policy evidence into a coherent analytical framework [17].

The objective is threefold. First, to clarify how ESG principles can be adapted to the specific institutional and ecological realities of Central Asia. Second, to compare the trajectories of the five countries and identify shared constraints and opportunities. And third, to draw policy implications that move beyond abstract sustainability rhetoric toward measurable, actionable pathways [19,20]. In doing so, this study also contributes to the global discourse on sustainable agriculture by offering insights from a region that remains underrepresented in ESG scholarship but whose experience—situated between the European and Asian policy spaces—offers a valuable laboratory for observing the tensions between growth, equity, and governance [4].

Ultimately, the argument advanced here is simple but fundamental: aligning agricultural development with ESG goals is not about imposing external models, but about reclaiming and modernizing the region's own traditions of responsible resource use and collective governance [3]. If this integration succeeds, Central Asia could position itself not only as a supplier of raw commodities, but as an active participant in shaping the sustainability standards of the future.

Conceptual Framework

In recent years, the integration of Environmental, Social, and Governance (ESG) principles into agricultural systems has evolved from a voluntary corporate commitment into a structured policy paradigm [21,22]. The ESG framework provides a holistic lens for assessing how agricultural production affects and is affected by ecological sustainability, social equity, and institutional performance. In this sense, ESG goes beyond the narrow boundaries of environmental management—it redefines the logic of agricultural modernization by embedding accountability and long-term resilience into every stage of production and value creation [1,3].

According to Sakkaraeva and Abdurashitov [7], the ESG paradigm in agriculture functions as a multidimensional system that links ecological efficiency with inclusive development. They argue that sustainable transformation in the agri-food sector is possible only when environmental outcomes (such as emission reduction and soil restoration) are combined with social

empowerment—particularly of rural women, youth, and local cooperatives—and supported by transparent governance mechanisms. This triadic balance ensures that agricultural sustainability does not rely solely on technological solutions but also on institutional coherence and human participation.

From a global perspective, several frameworks have been developed to operationalize ESG principles in the agricultural domain. The Global Reporting Initiative (GRI) Standards and the EU Corporate Sustainability Reporting Directive (CSRD) provide the most widely recognized benchmarks for non-financial disclosure, covering indicators such as resource efficiency, biodiversity protection, community impact, and ethical governance [4]. These frameworks have begun to influence agricultural reporting even in developing regions, encouraging producers and governments to quantify sustainability outcomes and disclose them in a standardized form. As noted by Shadkam and Irannezhad [6], the digitalization of ESG assessment—through AI-based analytics and remote sensing—offers new opportunities for accuracy, comparability, and cross-country monitoring, particularly in resource-dependent economies [1,23].

In the context of Central Asia, applying ESG principles to agriculture presents unique challenges. The region's production systems are shaped by post-Soviet institutional legacies, semi-arid climatic conditions, and high dependence on irrigation. Governance structures remain centralized, while market liberalization and environmental regulation evolve at different speeds [16,17]. Consequently, ESG implementation in Central Asia cannot simply replicate Western models—it must adapt to the region's socio-economic and ecological realities. The concept of "ESG localization," as discussed in recent regional literature [23], implies that international norms must be reinterpreted through national priorities, such as food security, water management, and rural employment [23,24].

The conceptual logic guiding this study therefore rests on two interlinked premises. First, that ESG integration serves as both a diagnostic and transformative tool—it allows researchers to evaluate sustainability performance across environmental, social, and governance dimensions, while also identifying leverage points for systemic change [18,19]. Second, that regional variation in ESG outcomes reflects institutional capacity and policy coherence, rather than mere differences in natural resource endowment [3]. For example, Kazakhstan's early adoption of green finance policies and ESG disclosure regulations has created a partial alignment between agricultural investment and sustainability objectives, whereas in Kyrgyzstan and Tajikistan, community-based resource management compensates for weak central institutions [17,19]. This conceptual framing enables a comparative understanding of how different governance architectures mediate the translation of ESG principles into agricultural practice [17,18,25].

To operationalize this framework, the study employs a composite ESG index that synthesizes multiple indicators from the environmental, social, and governance domains [5,20,26]. These include carbon intensity of production, rural employment and inclusion metrics, and institutional transparency measures derived from the World Bank Governance Indicators (WGI) [20]. The conceptual foundation thus connects theoretical constructs with measurable variables, enabling an empirical analysis that reflects both global sustainability norms and regional particularities [1].

Ultimately, this framework positions ESG not as a Western import but as a context-sensitive approach to agricultural resilience [27]. It invites policymakers and researchers to view sustainability through the lens of interconnected systems—where ecological balance, social justice, and institutional accountability form the essential triad of long-term agricultural competitiveness. In doing so, the framework provides both the theoretical coherence and the analytical structure necessary for evaluating how Central Asian countries can realign their agricultural development trajectories with global ESG goals [16].

2. Materials and Methods

The research design of this study rests on a mixed approach that combines the logic of a systematic literature review with comparative and conceptual analysis [23]. This approach was chosen deliberately. The topic of aligning agricultural development with ESG prin-

ciples in Central Asia is still new: the region lacks longitudinal data, while conceptual interpretations remain fragmented [6,7]. Hence, our task was to reconstruct the evolution of this discourse, tracing how the ideas of environmental sustainability, social inclusion, and governance accountability gradually entered agricultural policies and business models across the five Central Asian states [28–32]. The method therefore needed to be flexible enough to capture both quantitative trends and qualitative nuances.

2.1. Defining the Scope

The study focused on Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, countries that share historical legacies and ecological interdependence but differ significantly in governance systems, agricultural structures, and integration into global markets [1]. The analysis covered the period 2000–2025, encompassing the post-Soviet transition, the global mainstreaming of ESG concepts, and the adoption of sustainability-linked policies in the 2020s [17,20,25]. This time frame allowed us to observe how initial environmental concerns evolved into a structured agenda incorporating social and institutional dimensions.

The research also took into account the broader geopolitical and economic context—for instance, the growing influence of the European Green Deal and China's Green Silk Road initiative, both of which increasingly shape the policy space of Central Asia [24,33]. These frameworks were not the object of study per se but served as external reference points that helped explain why ESG language began to appear in the region's agricultural strategies [34].

2.2. Data Collection and Source Selection

At the core of the study is a structured documentary base, combining academic publications, policy reports, and statistical datasets [11–15]. The search strategy followed the general logic of the PRISMA methodology [1,10], adapted to the specificity of regional and interdisciplinary research.

The document retrieval process was carried out between January and May 2025 through databases such as Scopus, Web of Science, and Google Scholar, supplemented by institutional repositories (FAO, OECD, World Bank, UNEP, ADB) [2,8,9,35,36]. In addition, national policy documents were reviewed via open-access archives of the ministries of agriculture and national statistical committees [11–15]. The combination of academic and institutional sources made it possible to link theoretical discussion with empirical policy realities.

The Boolean search expressions combined geographical identifiers ("Central Asia", "Kazakhstan", "Uzbekistan", "Kyrgyzstan", "Tajikistan", "Turkmenistan") with thematic keywords: "agriculture", "sustainable farming", "ESG", "green finance", "water governance", "inclusive growth", "climate adaptation", "agri-food transition", and "sustainability reporting" [16–19].

This process yielded 214 documents. After removing duplicates and screening titles and abstracts, 134 were retained for detailed examination. In total, 214 records were initially identified through database and institutional searches. After screening for thematic relevance and methodological rigor, 30 sources were retained for in-depth analysis and citation in this article, as the remaining materials did not meet the content or quality criteria required for inclusion.We then applied a two-stage filtering process based on inclusion and exclusion criteria:

Inclusion criteria:

- materials addressing at least one ESG dimension within agricultural or food systems in Central Asia;
- studies presenting empirical evidence, conceptual frameworks, or policy analyses;
- sources published between 2000 and 2025, with preference for recent (post-2020) works.

Exclusion criteria:

- technical studies unrelated to sustainability (e.g., machinery design, fertilizer efficiency);
- articles without verifiable references or published in non-peer-reviewed outlets;
- opinion pieces or press releases lacking methodological rigor.

The literature screening and selection process followed the logic of the PRISMA framework, ensuring methodological transparency and reproducibility. **Figure 1** below summarizes the key stages of identification,

screening, eligibility assessment, and final inclusion. Out of 214 initial records, 134 were reviewed in full-text form, and 60 sources were ultimately selected for detailed analysis and citation in this study.

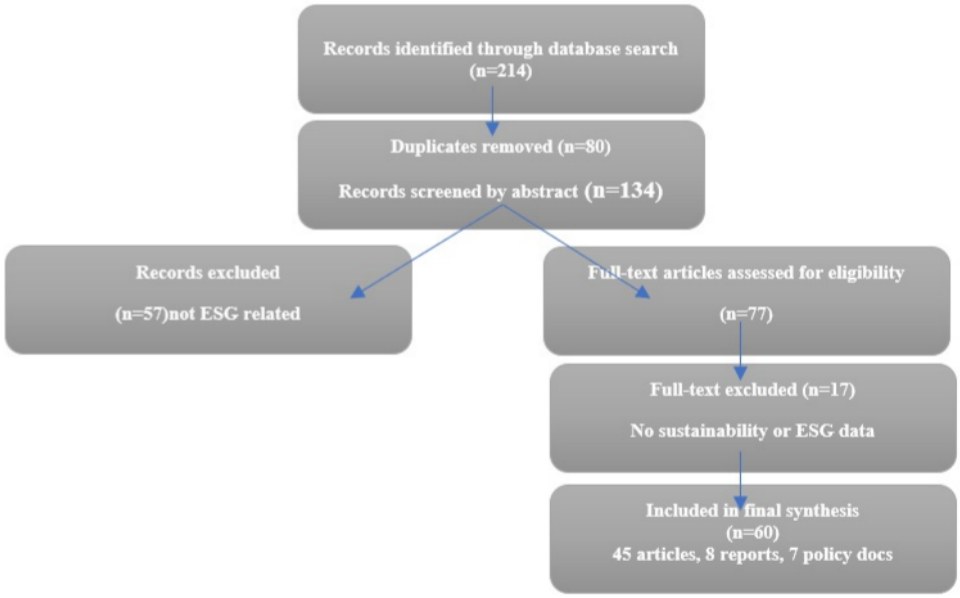

Figure 1. Simplified PRISMA flow diagram of literature selection.
Source: Compiled by the authors (2025).
Note: Out of 214 records screened, 60 sources met the inclusion criteria and are cited in the reference list.

This article is a narrative review based on systematic screening of academic and policy sources. Rather than generating new primary data, the analysis relies on a structured synthesis of peer-reviewed literature, policy documents, and international reports, with the aim of identifying recurring themes, country trajectories, and feasible pathways for ESG alignment in the region.

The study began with an extensive review of academic literature, encompassing both English- and Russian-language publications. This body of work highlights recurring themes that remain central to the region: the enduring legacy of Soviet-style monocultures and irrigation systems, the environmental degradation that followed decades of resource-intensive production, and the social challenges of rural transformation in the context of weak institutional frameworks [1,20,37]. Examining how these issues have been framed in scholarship provided a foundation for understanding the narratives and analytical categories that dominate current debates on sustainability [3].

The search strategy combined database queries and targeted harvesting of policy sources. Database searches were conducted in Scopus, Web of Science and Google Scholar using Boolean strings that paired regional and sectoral terms with ESG-related concepts (e.g., "Central Asia" AND "agriculture" AND sustainable / "water" / "irrigation" / "pasture" / "organic agriculture", along with country names). To reflect the post-Soviet reform period and recent ESG discourse, the primary window covered 2000–2025, with earlier foundational works added when necessary for historical context. English and Russian sources were considered to avoid language bias. Titles and abstracts were screened for relevance to agriculture in Central Asia, ESG dimensions, or closely related sustainability governance. Full texts were assessed when abstracts were ambiguous. Policy documents were gathered from national ministries and international organizations (FAO, World Bank) to capture official agendas and implementation signals.

Inclusion focused on peer-reviewed studies, official policy documents, and international reports with explicit agricultural relevance to Central Asia or with direct comparative value for governance tools (e.g., EU Farm to Fork, China's green subsidies). Exclusion applied to opinion pieces without methodological grounding, sources unrelated to agriculture or to the region,

and documents lacking sufficient detail to assess policy mechanisms. Disagreements on inclusion were resolved through discussion among the authors to ensure consistency.

Alongside the academic literature, national policy documents and development strategies were analyzed to assess how governments in Central Asia articulate priorities for agricultural reform. Kazakhstan's *Program for Agro-industrial Complex Development (2021–2030)*[38] and Kyrgyzstan's *National Development Program*[39], among others, were studied not only for their formal content but also for the way they signal an emerging attempt to incorporate environmental protection, organic farming, and rural development into broader modernization agendas[16]. These policy frameworks illustrate how ESG-related objectives are increasingly entering the official discourse, though often in fragmented or uneven ways[7,31].

The research further incorporated a comparative dimension by examining international experiences. Two cases were chosen for their contrasting approaches: the European Union's *Farm to Fork Strategy*, which demonstrates how sustainability can be integrated across the entire agri-food chain, and China's green subsidy system, which shows how state-driven incentives can accelerate technological modernization while addressing ecological concerns[16,20,35]. These examples were not considered as direct models for replication but as reference points that highlight the diversity of tools available for embedding ESG principles into agricultural policy.

For each included source, data were extracted into a structured template recording country coverage, agricultural subsector or value chain, ESG pillar(s) addressed, policy instruments and implementation arrangements, empirical methods (where applicable), and key findings and limitations. Evidence was synthesized narratively through thematic coding that mapped recurring patterns to the ESG pillars and to cross-cutting regional constraints (water, land degradation, social inclusion, governance capacity). Country narratives were then developed as cross-case syntheses, with convergences and divergences made explicit.

This multi-source approach was supported by qualitative content analysis, allowing patterns to emerge from the juxtaposition of academic debates, policy commitments, and international practices[21]. Statistical data from FAO, the World Bank, and national statistical agencies were used selectively to contextualize trends in population growth, land use, and food security, but the core emphasis remained on institutional dynamics and policy frameworks[2,9,36].

Given the mixed corpus (academic and policy), a light-touch quality appraisal was applied. For academic studies, transparency of methods and data, appropriateness of analysis, and clarity of limitations were assessed. For policy documents, specificity of instruments, evidence of implementation, and traceability of outcomes were considered. Potential sources of bias include publication bias toward English-language outlets, uneven national reporting standards, and the tendency of policy texts to privilege aspirational targets over realized outcomes. These risks were mitigated by triangulating across academic evidence, official strategies, and international datasets, and by treating policy claims cautiously unless corroborated by independent analyses.

The methodology acknowledges its limitations. Data availability is uneven across the region, and many official documents emphasize aspirations rather than concrete outcomes. Moreover, ESG implementation is still at an early stage in Central Asia, which makes long-term impact assessment premature. To address these challenges, triangulation was employed across different types of sources, ensuring that conclusions rest on converging evidence rather than single datasets[21].

By combining academic, policy, and comparative perspectives, this review framework makes it possible to analyze not only the challenges facing Central Asian agriculture but also the opportunities that arise from aligning its development with ESG principles[4,10]. The approach seeks to bridge local realities with global debates, providing a basis for identifying pathways toward sustainable agricultural transformation[5,19,20]. Ethical approval was not required as no primary data collection was undertaken. The review design, however, follows the principles of transparency and replicability by outlining the search strategy, inclusion criteria, and synthesis approach. A limitation remains that no formal protocol was preregistered, which slightly reduces replicabil-

ity compared to systematic reviews.

3. Results

3.1. Regional Overview

The comparative analysis revealed that while all five Central Asian countries officially endorse the principles of sustainability, the practical translation of ESG frameworks into agricultural policy and governance remains uneven [23]. The pace and form of adoption depend not only on economic structure but also on institutional maturity, policy coherence, and exposure to international markets [21]. The findings are summarized in **Table 1**, followed by a narrative synthesis for each dimension.

Table 1. Comparative overview of ESG alignment in agriculture across Central Asia (as of 2025).

Country	Environmental Dimension (E)	Social Dimension (S)	Governance Dimension (G)	Level of ESG Integration*
Kazakhstan	Moderate progress in sustainable land use and organic certification; pilot carbon farming projects; soil degradation persists in northern steppe regions.	Rural employment remains high (27%), but aging workforce and gender imbalance persist; some inclusion programs supported by IFIs.	Governance reforms improving transparency in agribusiness; introduction of ESG disclosure in large agroholdings since 2023.	Medium–High
Kyrgyzstan	Strong focus on community-based resource management (pastures, irrigation); limited mechanization; exposure to climate risk increasing.	High rural dependence (60% of population); migration affects labor stability; grassroots cooperatives improving inclusion.	Fragmented institutions; participatory local governance more advanced than national-level coordination.	Medium
Uzbekistan	Active modernization of irrigation systems; large-scale reforestation of dried Aral seabed; sustainable cotton certification (Better Cotton, BCI).	Social diversification of rural economy; new cooperatives and women-led enterprises emerging; still limited access to green finance.	Governance centralization remains strong; partial transparency in agrarian reforms; pilot ESG disclosure programs in agri-exporters.	Medium–High
Tajikistan	Erosion control and mountain ecosystem programs; heavy dependence on external funding for adaptation.	Smallholder dominance; high poverty in rural areas; migration-driven labor shortages; community adaptation projects expanding.	Weak institutional capacity; inconsistent policy enforcement; donor dependence affects sustainability of reforms.	Low–Medium
Turkmenistan	Extensive irrigation and cotton monoculture; limited environmental monitoring; high water intensity.	Social indicators underreported; rural subsidies remain but poorly targeted; low diversification.	Closed governance system; lack of public ESG reporting or civil society involvement.	Low

Source: Compiled and interpreted by the authors based on data from FAOStat, World Bank, OECD, and national sustainability and agricultural development reports of Central Asian countries (2024–2025).
*Levels reflect relative degree of ESG integration assessed qualitatively through literature and policy analysis (Low, Low–Medium, Medium, Medium–High).

In order to complement the qualitative overview with a quantitative comparison, a simplified Composite ESG Performance Index was developed. It integrates environmental (E), social (S), and governance (G) scores for each Central Asian country on a five-point scale, providing a clearer visualization of cross-country disparities [16–18].

To facilitate comparability among the five Central Asian countries, the ESG Performance Index shown in **Table 2** was developed using a standardized normalization and aggregation approach. Each dimension—environmental, social, and governance—was derived from a set of measurable indicators sourced from FAOStat, the World Bank, OECD, and national sustainability databases.

All variables were first converted to a common 0–5 scale using min–max normalization, ensuring that higher values reflected stronger ESG alignment. Dimension scores (E, S, and G) were then calculated as averages of the normalized indicators within each category, while the overall ESG index for each country represented the arithmetic mean of the three component scores.

Table 2. Comparative ESG Performance Index across Central Asia (2025).

Country	E	S	G	Composite ESG Index
Kazakhstan	3.8	3.2	3.5	3.5
Kyrgyzstan	3.1	2.9	2.8	2.9
Uzbekistan	3.6	3.4	3.2	3.4
Tajikistan	2.7	2.5	2.2	2.5
Turkmenistan	2.1	2.0	1.8	2.0

Source: Authors' calculations based on FAOStat, World Bank, OECD, and national sustainability reports (2024–2025).

This composite method allowed the study to integrate both quantitative and qualitative aspects of sustainability performance into a single metric, capturing relative differences between countries despite data asymmetries. Scores above 4 indicate strong ESG integration, 3–4 reflect moderate progress, 2–3 suggest limited institutionalization, and below 2 signal early or declarative adoption.

The index shows that Kazakhstan and Uzbekistan outperform their regional peers, while Kyrgyzstan remains moderate. Tajikistan and Turkmenistan display the lowest composite values, highlighting persistent governance and environmental challenges.

Note: Quantitative indicators presented in **Table 2** and **Figure 2** are derived from available datasets (FAOSTAT, World Bank, OECD, national reports) and supplemented by normalized expert estimates. This approach ensures cross-country comparability and allows for consistent interpretation of ESG integration levels where official data remain incomplete or inconsistent [5,20,26,40].

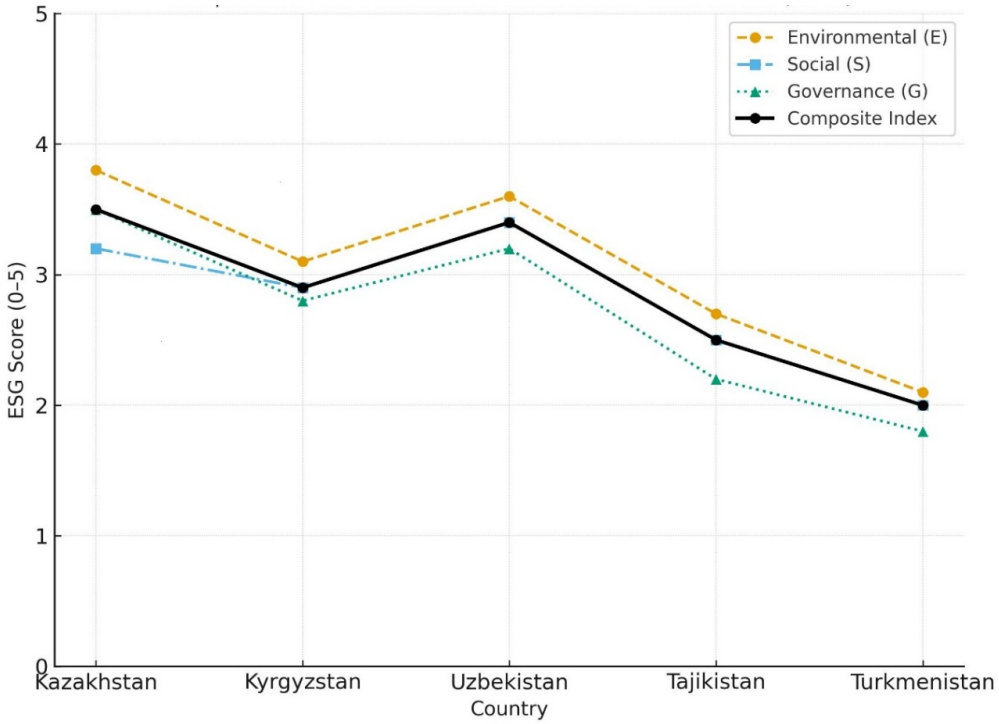

Figure 2. Comparative ESG Performance Index across Central Asia (2025).
Source: Calculated and visualized by the authors based on data from the World Bank, FAOSTAT, Transparency International, and national statistical agencies of Central Asian countries (2025).

3.2. Environmental Dimension

The environmental pillar of ESG remains the most visible yet the most fragmented across Central Asia [4,26,35]. In Kazakhstan, the transition from extensive grain production toward diversified, climate-resilient agriculture is ongoing. The country has introduced organic certification laws (2015) and initiated pilot carbon-farming projects under the Green Economy Strategy [41]. However, implementation is constrained by soil degra-

dation in the northern steppes and inefficient use of fertilizers. Satellite data from FAO (2024) show that nearly 25% of arable land is moderately degraded, primarily due to wind erosion and monocropping [20,26].

Uzbekistan demonstrates the highest level of environmental activity, largely due to state-driven programs addressing water efficiency and the Aral Sea crisis [42]. Since 2022, the government has expanded drip irrigation coverage to over 600 000 hectares, reducing water losses by 15%. Large-scale reforestation of the dried seabed has become a symbol of ecological restoration—though its long-term impact on biodiversity remains uncertain [16]. The introduction of Better 2Cotton Initiative (BCI) standards also signals gradual convergence with global ESG norms [43].

In Kyrgyzstan, environmental efforts rely on traditional community-based management systems [16]. Pasture User Unions (PUUs), established since 2009, represent one of the few functioning examples of collective environmental governance in the region [43,44]. While this bottom-up model promotes local stewardship, it remains vulnerable to climate shocks and lacks state-level coordination. The frequency of glacial melt and seasonal water scarcity has already begun to affect livestock productivity, highlighting the urgent need for digital monitoring and early-warning systems [45].

Tajikistan faces the most acute environmental constraints due to mountainous terrain and fragmented landholdings [46]. Agricultural plots are small, often below two hectares, limiting economies of scale and adaptation capacity. The government, with donor support, has launched small-scale erosion control and terracing projects in Gorno-Badakhshan, but these remain localized and dependent on foreign aid.

Finally, Turkmenistan continues to rely on water-intensive cotton monoculture under strict state procurement [47]. Despite some progress in canal modernization, overall irrigation efficiency remains below 40%, one of the lowest rates in the region. There is no transparent reporting on emissions, fertilizer use, or biodiversity, making environmental governance effectively non-existent.

In sum, environmental policies in Central Asia tend to be reactive rather than preventive, often designed to mitigate immediate damage rather than integrate long-term resilience planning [4,26,35,40]. Only Kazakhstan and Uzbekistan have begun developing ESG-compatible environmental indicators at the national level [2,8,36,48,49]. International experience, such as CIAT's climate-smart agriculture roadmap, also highlights the importance of long-term strategies for strengthening the adaptive capacity of farming systems [50]. Recent studies further emphasize that transboundary water-resource pressures remain one of the most critical environmental constraints for sustainable agriculture in Central Asia [51].

3.3. Social Dimension

The social pillar of ESG exposes a different set of asymmetries. All five countries depend heavily on rural labor—yet the quality and inclusiveness of that labor vary greatly. In Kyrgyzstan and Tajikistan, agriculture still employs more than half of the active population, but much of this work is informal, seasonal, and underpaid. Labor migration to Russia and Kazakhstan has become a structural feature of rural livelihoods. While remittances stabilize household incomes, they also contribute to the feminization of agriculture and a shortage of skilled male labor [16].

Kazakhstan's rural sector, though more mechanized, also faces demographic imbalance [17]. The workforce is aging, and youth increasingly avoid agricultural careers. However, new state initiatives—such as *Zhas Orken* youth programs and support for agricultural startups—are gradually reframing the social image of the sector [23]. Moreover, the expansion of ESG awareness among agribusiness companies, including *Eurasian Foods Corporation* and *Agrinova*, has led to better occupational safety and labor standards [1].

In Uzbekistan, the social transformation of the cotton industry after the abolition of forced labor in 2020 has become one of the region's most significant ESG milestones [51]. The introduction of independent monitoring mechanisms by the ILO and local NGOs has increased transparency and improved the country's international reputation. Simultaneously, the development of women-led farming cooperatives, supported by IFAD and UNDP, has opened new 85pathways for inclusive growth [2,9,35,48]. Still, access to green finance and rural insurance mechanisms remains limited, particularly for

smallholders outside major irrigation zones [13].

Tajikistan and Turkmenistan, by contrast, have made little visible progress on the social dimension. In Tajikistan, rural poverty rates exceed 30%, and most social protection programs are externally funded [1]. Turkmenistan maintains extensive subsidies for fuel and food, but their distribution is opaque and inefficient [47]. Social dialogue between farmers, civil society, and the state remains weak or absent .

Taken together, these findings indicate that social sustainability in Central Asian agriculture is constrained not only by income disparities but also by institutional inertia—the persistence of hierarchical governance structures that limit local participation [16–19]. Without mechanisms of collective bargaining, education, and rural innovation, the social component of ESG will remain declarative.

3.4. Governance Dimension

Governance—the least tangible but perhaps the most decisive pillar—remains the Achilles' heel of ESG transformation in the region. The study found that while policy rhetoric increasingly embraces sustainability language, institutional accountability and data transparency lag far behind.

Kazakhstan has taken the most visible steps toward building a governance framework aligned with ESG standards [1]. Since 2023, the Financial Market Regulation Agency has introduced voluntary ESG reporting guidelines for large agribusinesses. Several agroholdings have published sustainability reports referencing the GRI framework, a rare example in the region [10,22]. Moreover, Kazakhstan's *"Green Kazakhstan"* aims to integrate environmental and economic data flows, creating the foundation for evidence-based decision-making [41]. However, coordination between ministries remains problematic, and ESG reporting is still limited to large enterprises, leaving out small and medium farmers [26].

Kyrgyzstan illustrates a different governance model—decentralized but fragile. Local pasture and water committees demonstrate a high degree of participation, yet they operate with minimal funding and weak legal backing [52]. The country's *National Development Strategy 2040* mentions sustainability and social inclusion, but ESG terminology is absent from official agricultural policy [39].

Uzbekistan, while rapidly modernizing its agricultural sector, retains a strongly centralized system of governance [51]. Decision-making often remains top-down, and the introduction of ESG indicators into government reporting has been cautious [17,19]. Nevertheless, recent pilot projects supported by the EBRD and UN Global Compact Uzbekistan suggest a growing awareness among policymakers and exporters that ESG disclosure is essential for attracting foreign investment and meeting EU import standards.

Tajikistan and Turkmenistan stand at the opposite end of the spectrum [16,41,53]. Tajikistan's institutional landscape is fragmented; ministries compete rather than cooperate, and there is no unified sustainability reporting platform. In Turkmenistan, governance remains highly centralized and opaque, and independent monitoring of environmental or labor indicators is not permitted. The lack of data prevents meaningful evaluation of ESG progress, turning official reports into ritual statements rather than evidence-based assessments.

Across all countries, a recurring problem is the absence of harmonized metrics. ESG remains a "floating concept" used in project proposals but not integrated into national statistical systems [11–15]. As a result, regional comparisons rely on proxy indicators, making benchmarking approximate at best. Still, the trajectory is clear: international pressure from lenders, investors, and trade partners is gradually forcing governments to adopt more transparent and measurable approaches to governance.

Although ESG integration provides a framework for sustainable agricultural transformation, the overall economic weight of agriculture in Central Asian economies has been steadily declining. This structural trend affects the pace of sustainability adoption and the scope of green investment [2].

The structural decline of agriculture's share in GDP across Central Asia (**Figure 3**) does not necessarily correspond to a proportional reduction in the sector's environmental footprint [36]. While the economic importance of agriculture is decreasing, its ecological intensity remains a pressing concern.

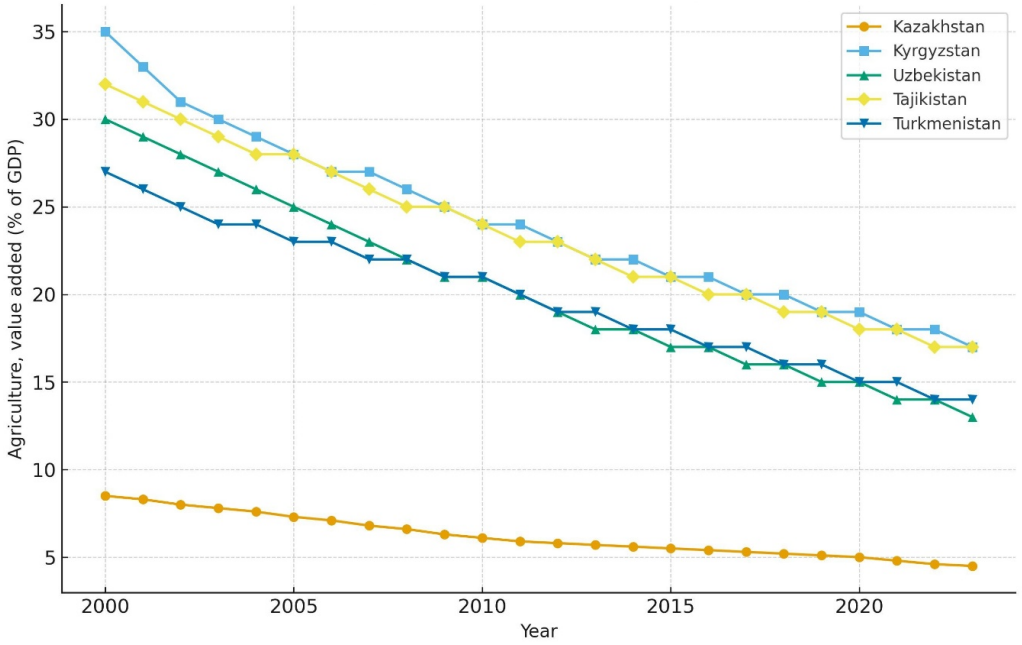

Figure 3. Agricultural Value Added (% of GDP, 2000–2023).

Source: Designed and visualized by the authors using data from the World Bank (2024) [2,9].

The figure shows that despite policy efforts toward modernization, the share of agriculture in GDP has declined in all Central Asian countries, reflecting gradual economic diversification and labor migration to other sectors.

Figure 4 illustrates the trends of agricultural CO_2 emissions per unit of output across Central Asian countries over 2000–2023.

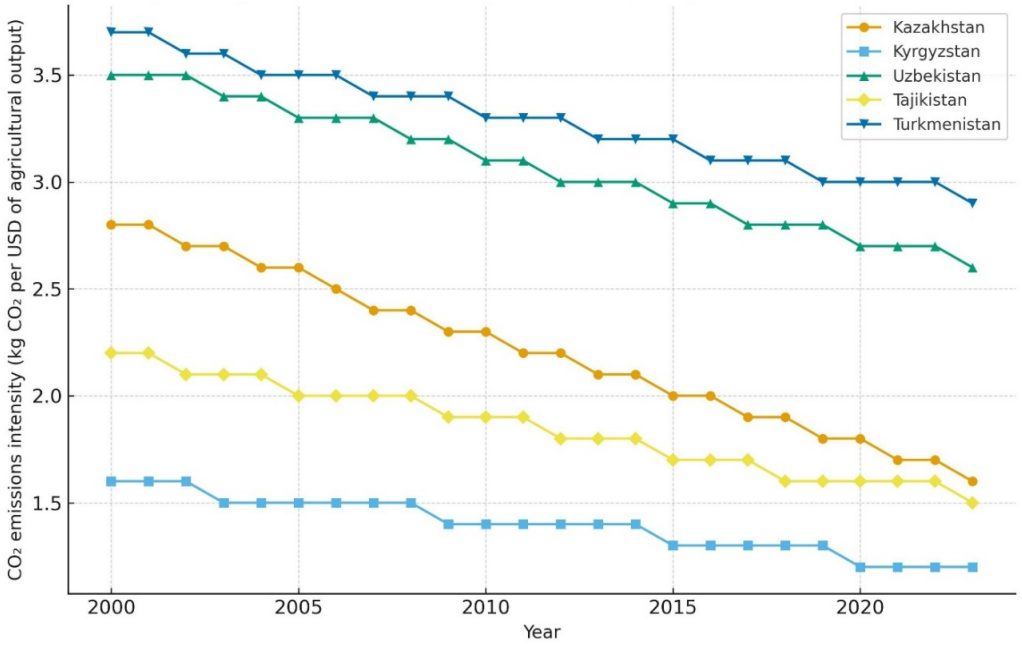

Figure 4. Agricultural CO_2 Emissions per Unit of Output (kg CO_2 per USD, 2000–2023).

Source: Designed and visualized by the authors using data from FAOSTAT (2024) [36].

The emissions intensity of agriculture remains highest in Uzbekistan and Turkmenistan, where irrigated monocultures dominate [13,15]. Kazakhstan shows moderate improvement due to soil conservation and pasture management reforms [18,30]. Kyrgyzstan's emissions remain low but stable, consistent with its smallholder production model.

3.5. Cross-Cutting Trends and Regional Patterns

The comparative analysis allows several broader observations. First, the regional ESG landscape is characterized by vertical asymmetry: environmental policies are often more developed than social and governance frameworks [4,27]. Second, there is a visible north–south divide: Kazakhstan and Uzbekistan show relatively advanced ESG integration, while Tajikistan and Turkmenistan lag behind [10]. Kyrgyzstan occupies an intermediate position, combining participatory governance with limited financial capacity [54].

Third, the process of ESG alignment in Central Asia is externally stimulated but internally fragmented [39,51,53]. Most ESG-related reforms are driven by donor initiatives—FAO's "Green Agri-Finance," ADB's "Climate Resilient Agriculture," and World Bank's "Digital Pasture" project—yet domestic ownership remains weak [5,20,26,40]. This creates a paradox: sustainability rhetoric is strong, but national mechanisms of accountability are still developing [1].

Fourth, digitalization is emerging as a potential accelerator of ESG transformation. The expansion of remote sensing, online traceability platforms, and open-data portals could bridge the current gap between reporting and real action [11–15]. Shadkam and Irannezhad (2025) emphasize that agent-based modeling and data-driven decision tools can reduce the cost of ESG compliance by making resource flows visible and predictable [6]. Kazakhstan and Uzbekistan have already begun integrating such tools in pilot form, signaling a gradual move toward "Agriculture 4.0" [46,55].

Lastly, the comparative synthesis suggests that regional cooperation could become the decisive factor in scaling ESG practices. Water management, energy exchange, and agri-trade corridors all depend on shared ecosystems and infrastructures [8,16,30,36,56]. A regional ESG framework—possibly coordinated under CAREC or the Eurasian Economic Union—could harmonize reporting standards, facilitate data exchange, and create incentives for collective investment in sustainable agriculture [6,31].

3.6. Summary of Findings

The evidence indicates that ESG integration in Central Asian agriculture remains in an incipient and uneven stage. Environmental initiatives are visible but often project-based; social inclusion progresses slowly and unevenly; governance reforms are limited by institutional inertia [38,39,51,57]. Nevertheless, the regional trajectory shows clear movement toward convergence with global sustainability norms [5,25,26,40].

In short, the results highlight a paradox typical for transitional economies: the discourse of sustainability is already global, but the practice of sustainability is still local. Bridging that gap will require not only financial investment but also the cultivation of a new governance culture—one that values transparency, long-term vision, and participation [22,23,40].

These country-level variations can be better understood through key structural and institutional determinants presented in **Table 3**. The comparative indicators highlight how differences in economic capacity, energy intensity, and governance transparency shape the pace of ESG integration across Central Asia.

The indicators presented in **Table 3** were selected to capture the main structural and institutional determinants shaping the pace of ESG integration in Central Asia. Quantitative variables such as GDP per capita, the share of agriculture in GDP, energy intensity, and CO_2 emissions per capita were drawn from harmonized datasets of the World Bank and IMF for 2024, while governance quality was represented through the Corruption Perceptions Index published by Transparency International.

Table 3. Comparative Determinants Influencing ESG Integration in Central Asia (2024).

Indicator	Kazakhstan	Kyrgyzstan	Uzbekistan	Tajikistan	Turkmenistan	ESG Implication
GDP per capita (USD)	13,800	2400	3200	1500	10,800	Higher GDP per capita correlates with better institutional and technological capacity to adopt ESG frameworks.
Share of agriculture in GDP (%)	5.2	12.5	17.3	20.1	10.4	Economies with high agricultural dependence (KG, TJ, UZ) face greater exposure to environmental risks and social vulnerabilities.
Energy intensity (MJ/$PPP 2017)	5.8	~5.0	7.5	n/a	>8.0	High energy intensity limits decarbonization progress; Kazakhstan and Uzbekistan have begun efficiency reforms.
CO_2 emissions per capita (t)	10.9	1.2	4.6	0.8	14.1	Strong divergence in emission profiles reflects structural and technological differences.
Corruption Perception Index (2024, TI)	40	25	32	19	17	Governance and transparency explain much of the ESG adoption gap.
Green finance instruments available	Yes (ESG bonds, green loans)	Limited	Pilot stage	No	No	Financial ecosystem strongly linked to ESG uptake.
Institutional "green" strategy	"Green Economy" Concept (2013, updated 2023)	Program for Green Growth (2019–2023)	"Green Economy Strategy" 2019–2030	NDC Implementation Plan (2024)	Climate Strategy (2012)	Policy frameworks are uneven; early adopters (KZ, UZ) show stronger ESG integration.

Source: Authors' calculations based on data from the World Bank Open Data, IMF World Economic Outlook, Transparency International, and official national statistics (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan) [11–15].

For institutional and financial variables—including the presence of green finance instruments and formal "green economy" strategies—a qualitative assessment was applied, coded on an ordinal scale (0 = absent, 0.5 = pilot or partial implementation, 1 = fully operational). These categories were verified using official government programs and sustainability reports of each state.

The resulting comparative matrix does not rely on numerical aggregation; rather, it synthesizes diverse data sources to show how economic capacity, energy efficiency, and governance transparency jointly influence ESG readiness. By juxtaposing structural indicators with institutional context, the table complements the quantitative ESG Index (**Table 2**), revealing that variations in income, energy use, and policy coherence remain the decisive factors explaining differences in sustainability performance across the region.

4. Discussion

The results of this study provide a nuanced view of how Central Asian agricultural systems are navigating the transition toward sustainability within the ESG framework [4,5,20,26,35]. Although the notion of ESG integration is still relatively new in the region, the emerging patterns reveal both promising developments and persistent structural constraints. The overall picture that emerges from **Tables 1** and **2**, supported by **Figures 2–4**, suggests that while policy discourse increasingly incorporates sustainability language, practical implementation remains uneven and largely dependent on external initiatives [25,28].

A first key observation concerns the environmental dimension. Across the region, agricultural modernization programs have focused primarily on irrigation rehabilitation, soil fertility improvement, and land

restoration [16–19]. However, these measures have often been driven by short-term efficiency goals rather than by a commitment to long-term ecological resilience. The high CO_2 emission intensity observed in Uzbekistan and Turkmenistan (**Figure 4**) is largely explained by the dominance of water- and input-intensive monocultures, which require substantial irrigation energy, fertilizer use, and fuel consumption. In contrast, Kazakhstan shows gradual progress due to the expansion of conservation agriculture and rotational grazing practices [17]. Kyrgyzstan's low but stable emissions profile reflects its smallholder production structure, where limited mechanization reduces energy use but also constrains productivity growth [5,26,40]. These findings indicate that without systemic investment in climate-smart technologies and precision farming, environmental improvements will remain incremental rather than transformative [1].

The social dimension reveals a more complex and fragmented landscape [7,10,31]. Despite efforts to strengthen rural inclusion, social disparities persist. Migration has become a structural feature of rural economies, particularly in Kyrgyzstan and Tajikistan, where remittances substitute for weak domestic labor demand. In Uzbekistan, recent reforms promoting women-led cooperatives and inclusive agribusiness models represent a significant step forward, yet access to green finance and extension services remains limited [9,23,24]. The demographic challenge of an aging rural workforce, noted in Kazakhstan and Turkmenistan, underscores the need for generational renewal through vocational programs and incentives for youth entrepreneurship in agriculture. Thus, the social pillar of ESG in Central Asia remains underdeveloped, often overshadowed by economic stabilization priorities.

When it comes to governance, the contrasts are even sharper [4,17,18]. Kazakhstan and Uzbekistan have taken initial steps toward institutionalizing ESG disclosure in agro-industrial enterprises, aligning national frameworks with international reporting standards [10,24]. However, governance remains highly centralized, and accountability mechanisms are still evolving. In Kyrgyzstan, the governance structure is more participatory at the community level but lacks vertical coordination between local and national policies [5,40]. Tajikistan and Turkmenistan continue to face systemic constraints—limited data transparency, weak environmental monitoring, and restricted civil-society engagement. Overall, the governance component lags behind environmental and social progress, creating a bottleneck for the region's sustainable transformation. Similar patterns are observed globally, where well-designed public–private partnerships have demonstrated strong economic benefits for smallholder farmers, particularly in developing regions [58].

From a macroeconomic perspective, the declining share of agriculture in GDP (**Figure 3**) suggests structural diversification rather than outright deagriculturalization. This transition could create both opportunities and risks [5,20,23,26,40]. On the one hand, reduced dependence on agriculture may allow governments to pursue quality-driven rather than volume-driven production strategies, prioritizing sustainability and value addition. On the other hand, if industrial and service-sector growth fails to absorb rural labor, socio-economic vulnerability could deepen. Therefore, ESG-oriented agricultural reform must be coupled with broader rural-development strategies that include infrastructure, logistics, and human-capital investments. Comparable evidence from other regions also shows that effective risk-management and investment frameworks are essential for reducing vulnerabilities in the agricultural sector [59].

An important implication of these findings is that ESG adoption in agriculture cannot be externally transplanted [4,16,17,20]. It must evolve from within national development agendas and institutional contexts. International partners—such as FAO, IFAD, the World Bank, and regional development banks—play a catalytic role in introducing methodologies and pilot projects, but long-term progress depends on domestic political commitment. The tendency to equate ESG compliance with external reporting requirements risks turning sustainability into a bureaucratic exercise rather than a transformative process [10,23]. As noted by similar studies in Southeast Asia and Latin America, local ownership and policy coherence are decisive factors in translating ESG frameworks into tangible outcomes.

Another layer of discussion relates to the measurement of ESG performance [16–19]. The composite index developed in this paper offers a first approximation, but it also highlights the urgent need for standardized regional metrics. Current national statistical systems in Central Asia lack consistent data on water efficiency, soil health, and emissions from livestock. Without harmonized indicators, cross-country benchmarking remains partly subjective. Developing a shared ESG assessment framework under regional platforms—such as the CAREC Program or the Eurasian Economic Union—could enhance comparability and policy learning among member states [5,20,26,40].

The move toward standardized ESG assessment in agriculture aligns with global disclosure frameworks such as the EU Corporate Sustainability Reporting Directive (CSRD) and the Global Reporting Initiative (GRI) Standards [10,23]. These instruments provide structured methodologies for measuring and reporting non-financial performance across sectors, including agriculture. While Central Asian countries are not formally subject to CSRD requirements, their gradual adoption of ESG reporting principles reflects the same logic of transparency, comparability, and accountability that underpins these global models. Adapting such frameworks to local realities—through region-specific indicators and simplified data protocols—could accelerate policy convergence and strengthen trust between agricultural producers, regulators, and investors.

In the broader global context, Central Asia occupies a unique position between resource-intensive agricultural economies and emerging green innovators. The region's abundant land and water resources, if managed sustainably, could position it as a competitive supplier of low-carbon agri-products to Asian and European markets [6,7,49]. However, this potential is constrained by inadequate digital infrastructure, limited access to green finance, and weak integration into global certification systems. Overcoming these barriers requires coordinated action between governments, private sector actors, and international donors to establish pilot "green value chains" and ESG-compliant clusters that can demonstrate both environmental and economic returns.

Finally, this discussion points to a broader conceptual insight: sustainability in agriculture cannot be achieved in isolation [6,33]. ESG principles must intersect with national strategies for food security, climate adaptation, and rural well-being. In Central Asia, the success of such integration will depend on whether policy reforms can shift from reactive, donor-driven programs toward proactive, evidence-based governance. The experiences of Kazakhstan and Uzbekistan show that progress is possible when regulatory reforms are supported by investment incentives and knowledge transfer [10,23]. For the region as a whole, embedding ESG logic into agricultural policy is not only a normative goal but a pragmatic necessity to ensure resilience in the face of environmental and socio-economic shocks.

Policy Implications

The findings of this study have direct implications for policy design in the Central Asian agricultural sector [16–19]. While most countries in the region have adopted sustainability-related strategies, ESG principles have not yet become operational tools for agricultural governance. To move beyond declarative frameworks, governments must integrate ESG standards into their national agricultural development programs, public procurement systems, and financial-incentive schemes. For instance, agricultural subsidies could be gradually restructured to reward farmers and enterprises that reduce emissions intensity, adopt water-saving technologies, or engage in certified organic and fair-trade production.

A critical step forward involves the institutionalization of ESG reporting and monitoring mechanisms. The experience of Kazakhstan, where large agribusinesses have started publishing sustainability disclosures since 2023, shows that data transparency can drive both accountability and innovation. Establishing national ESG data platforms—linked with FAOStat and regional statistical systems—would enable governments to track progress on emissions, land degradation, and social inclusion indicators in real time [2,3,8,36,48]. These mechanisms could also serve as the empirical foundation for "green" credit scoring, thereby attracting climate finance and impact investment into the agricultural sector.

The regional dimension is equally important [8,30,36]. Central Asia's shared ecosystems—rivers, pastures, and mountain zones—require coordinated governance. Aligning ESG implementation across borders through regional frameworks such as the *CAREC Green Growth Strategy* or the *Eurasian Economic Union's Environmental Agenda* would foster mutual learning and reduce policy fragmentation [55,60]. This cooperation could also help harmonize certification standards and facilitate cross-border trade in sustainable agri-products.

At the international level, donors and development partners should shift from short-term project funding to capacity-building and institutional partnerships. Instead of isolated pilots, what the region needs are scalable models of ESG integration—ranging from digital monitoring systems to sustainable irrigation clusters—that can be replicated across multiple agro-ecological zones. Equally vital is investment in human capital: training farmers, extension officers, and policymakers to understand ESG not as a reporting requirement but as a developmental paradigm linking economic competitiveness with ecological and social responsibility [4,22,40].

Ultimately, implementing ESG-based agricultural reform in Central Asia is not about compliance—it is about creating a resilient agricultural model capable of withstanding climatic volatility, market shocks, and social transformation [16–19]. Policy coherence, data transparency, and regional collaboration are the pillars upon which such a transformation can rest. If governments succeed in embedding ESG logic into the everyday functioning of rural economies, Central Asia could evolve from a resource-dependent producer into a recognized contributor to the global transition toward sustainable agri-food systems.

5. Conclusions

This study has examined the evolving alignment between agricultural development and ESG objectives in the Central Asian region, revealing a complex interplay between environmental, social, and governance factors. The empirical assessment demonstrates that while each country has embarked on its own sustainability trajectory, the overall regional progress remains fragmented. Environmental reforms—particularly those focused on soil conservation, irrigation modernization, and ecosystem restoration—are gaining traction, yet they are not always matched by improvements in governance or social inclusiveness. As a result, ESG integration in agriculture is advancing asymmetrically, shaped by distinct institutional legacies and policy priorities.

The analysis underscores that sustainable transformation cannot be achieved through environmental measures alone. The social dimension—rural livelihoods, gender equity, and community engagement—plays a decisive role in shaping long-term resilience. Likewise, governance remains the most critical bottleneck: without transparent institutions, participatory mechanisms, and consistent policy enforcement, ESG frameworks risk remaining normative rather than transformative. The experience of Kazakhstan and Uzbekistan illustrates that progress becomes tangible only when political will, data transparency, and financial incentives converge.

At a broader level, the findings of this research reaffirm that the ESG paradigm offers not merely a reporting tool but a strategic compass for agricultural modernization. Embedding ESG principles into national and regional development agendas can enhance both economic competitiveness and ecological stability, positioning Central Asia as a responsible player in the global agri-food transition. Achieving this vision requires long-term commitment, cross-border cooperation, and systematic investment in institutional capacity.

Ultimately, the region's agricultural future will depend on its ability to balance growth with stewardship—to produce more with less harm, and to turn sustainability from an external expectation into an internal economic logic. If Central Asian states can align their agricultural policies with ESG-driven innovation, they will not only improve resilience and food security but also redefine their role in the emerging global architecture of sustainable development.

Funding

This research was conducted within the framework of the 101177914-2024 ESGCA Project funded by the European Union's Erasmus+ Programme.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

All data supporting the findings of this study are derived from publicly available sources, including the World Bank, FAOStat, OECD, and national statistical agencies. Derived data supporting the conclusions of this article are available from the corresponding author upon reasonable request.

Acknowledgments

The authors express their sincere gratitude to the reviewers and editors of Research on World Agricultural Economy for their constructive feedback and valuable recommendations, which significantly improved the quality and clarity of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest. The authors also confirm that the manuscript was collaboratively prepared and manually revised by all co-authors to ensure originality and compliance with academic integrity standards. No generative AI tools were used in the preparation of this manuscript. All research design, data analysis, visualization, and writing were conducted manually by the authors.

References

[1] Qin, Y., Jiawen, H., Miao, W., 2022. Challenges threatening agricultural sustainability in Central Asia: Status and prospect. International Journal of Environmental Research and Public Health. 19(11), 6200. DOI: https://doi.org/10.3390/ijerph19106200

[2] World Bank, 2023. World Development Indicators: Agriculture, forestry, and fishing, value added (% of GDP). Available from: https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=TM-KZ-KG-UZ-TJ (cited 19 September 2025).

[3] Ben Hassen, T., El Bilali, H., Strassner, C., 2025. Sustainable Agri-Food Systems: Environment, Economy, Society, and Policy—2nd Edition. Sustainability. 17, 1667. DOI: https://doi.org/10.3390/su17041667

[4] Gao, H., Seng Teck, T., Nellikunnel, S., 2024. Navigating the complexities of ESG integration: Challenges, opportunities and path to sustainable corporate development. Journal of Business and Social Sciences. 2024(1). DOI: https://doi.org/10.61453/jobss.v2024no27

[5] Deme, E.H.Y., 2025. The economic growth, good governance and agricultural development in the West African Economic and Monetary Union (WAEMU) countries: Analysis of the impact of official development assistance. Review of World and Asian Economics. 6(2). DOI: https://doi.org/10.36956/rwae.v6i2.1524

[6] Shadkam, E., Irannezhad, E., 2025. A comprehensive review of simulation optimization methods in agricultural supply chains and transition towards an agent-based intelligent digital framework for agriculture 4.0. Engineering Applications of Artificial Intelligence. 143, 109930. DOI: https://doi.org/10.1016/j.engappai.2024.109930

[7] Sakkaraeva, D., Abdurashitov, A., 2024. Application of environmental, social and governance practices in agriculture. Scientific Horizons. 27(12), 116–127. DOI: https://doi.org/10.48077/scihor12.2024.116

[8] Eurasian Development Bank, 2023. Efficient Irrigation and Water Conservation in Central Asia. EDB: Almaty, Kazakhstan.

[9] World Bank, 2023. Data for Kazakhstan, Kyrgyz Republic, Uzbekistan, Tajikistan. Available from: https://data.worldbank.org/?locations=KZ-KG-UZ-TJ (cited 19 September 2025).

[10] Shapsugova, M., 2023. ESG principles and social responsibility. E3S Web of Conferences. 420, 06040.

[11] Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, n.d. Available from: https://stat.gov.kz/en/ (cited 15 September 2025).

[12] National Statistical Committee of the Kyrgyz Republic, n.d. Available from: https://www.stat.gov.kg/en/ (cited 17 September 2025).

[13] Agency on Statistics under the President of the Republic of Uzbekistan, n.d. Available from: https://stat.uz/en/ (cited 19 September 2025).

[14] Agency under the President of the Republic of Tajikistan, n.d. Available from: https://www.stat.tj/en/ (cited 10 September 2025).

[15] State Committee of Turkmenistan on Statistics, n.d. Available from: https://stat.gov.tm/en/ (cited 10 April 2025).
[16] Kasymov, U., Hamidov, A., 2017. Comparative analysis of nature-related transactions and governance structures in pasture use and irrigation water in Central Asia. International Journal of the Commons. 9(9), 1633.
[17] Kuandykova, M., Akpanov, A., Tleubaeva, S., et al., 2023. Attracting investment for rural development: Introduction of organic agriculture and ESG principles in Kazakhstan. Journal of Environmental Management and Tourism. 14(6), 2196–2206. DOI: https://doi.org/10.14505/jemt.v14.5(69).04
[18] Kurbonov, J., 2016. Public and Private Sector Relations for Economic Growth: Evidence from Uzbekistan. European Journal of Business and Management. 8(6). DOI: http://dx.doi.org/10.2139/ssrn.2884730
[19] Khaydarov, N., 2015. Agricultural development in Uzbekistan: Agricultural reforms versus transboundary water issues. Developing Country Studies. 5(10), 103–108.
[20] Razakova, D., 2018. Kazakhstan's protectionist model of agricultural market development in EAEU conditions. Journal of Eurasian Studies. 9(4), 123–137.
[21] Collste, D., Aguiar, A.P., Harmáčková, Z.V., et al., 2019. Participatory pathways to the Sustainable Development Goals: Inviting divergent perspectives through a cross-scale systems approach. Ecology and Society. 24(3), 32. Available from: https://iopscience.iop.org/article/10.1088/2515-7620/acce25
[22] Generalova, N.V., Soboleva, G.V., Kolosova, D., et al., 2023. Investment issues of agricultural enterprises in the context of the development ESG agenda. E3S Web of Conferences. 402(4), 13016. DOI: https://doi.org/10.1051/e3sconf/202340213016
[23] Zhao, W., 2024. Research Trend in the Development of Environmental, Social, and Governance (ESG). Advances in Economics, Management and Political Sciences. 122(1), 183–194.
[24] Yap, C.K., Al-Mutairi, K.A., 2024. A Conceptual Model Relationship between Industry 4.0—Food-Agriculture Nexus and Agroecosystem: A Literature Review and Knowledge Gaps. Foods. 13, 150.
[25] Page, M.J., McKenzie, J.E., Bossuyt, P.M., et al., 2021. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. Systematic Reviews. 10, 89. DOI: https://doi.org/10.1186/s13643-021-01626-4
[26] Stringer, L.C., Fraser, E.D.G., Harris, D., et al., 2020. Adaptation and development pathways for different types of farmers. Environmental Science and Policy. 104, 174–182. DOI: https://doi.org/10.1016/j.envsci.2019.10.007
[27] Broniewicz, E., Jastrzębska, E., Lulewicz-Sas, A., 2024. Environmental disclosures according to ESRS in ESG reporting of selected banks in Poland. Economics and Environment. 88(1), 1–19.
[28] Musarova, Z.A., Adamkulova, C.U., 2023. Geopolitics in the region: Risks and prospects for ensuring food security in the Kyrgyz Republic. Proceedings on Engineering Sciences. 5(S2), 423–430. DOI: https://doi.org/10.24874/PES.SI.02.018
[29] Adamkulova, C.U., Aitbaev, Z., 2023. Ensuring climate resilience in Central Asia through the establishment of a water management education program. Journal of Water and Climate Change. 15(4), 1551–1564. DOI: https://doi.org/10.2166/wcc.2023.560
[30] Adamkulova, C.U., Aitbaev, Z.K., Dankov, A.G., et al., 2024. A new stage in solving transboundary river issues in Central Asia (2016–2023). Vestnik Tomskogo gosudarstvennogo universiteta. Istoriya. 87, 114–120. DOI: https://doi.org/10.17223/19988613/87/13
[31] Adamkulova, C.U., Akylbekova, N., Omurova, S., et al., 2025. Digital farming platforms as a tool for strengthening cooperation between Kyrgyzstan and China: Potential and prospects. Ekonomika APK. 32(2), 63–75. DOI: https://doi.org/10.32317/ekon.apk/2.2025.63
[32] Adamkulova, C.U., Akylbekova, N., Zhakshylykova, K., et al., 2025. The dairy industry as a driver of economic growth. Scientific Horizons. 28(4), 70–83. DOI: https://doi.org/10.48077/scihor4.2025.70
[33] Cremasco, C., Boni, L., 2022. Is the European Union (EU) Sustainable Finance Disclosure Regulation (SFDR) effective in shaping sustainability objectives? An analysis of investment funds' behaviour. Journal of Sustainable Finance & Investment. 14, 1018–1036.
[34] Cristea, M., Noja, G.G., Thalassinos, E.I., et al., 2022. Environmental, Social and Governance Credentials of Agricultural Companies—The Interplay with Company Size. Resources. 11(3), 30.
[35] Ganda, F., 2023. The influence of agricultural policy on carbon emissions in selected OECD countries. Heliyon. 9(9), e19881. DOI: https://doi.org/10.1016/j.heliyon.2023.e19881
[36] FAO, 2023. AQUASTAT – FAO's Global Information System on Water and Agriculture. Available from: https://www.fao.org/aquastat/en/databases/maindatabase/ (cited 19 September 2025).
[37] Dale, V.H., Kline, K.L., Lopez-Ridaura, S., et al., 2020. Towards more sustainable agricultural landscapes: Lessons from Northwestern Mexico and the Western Highlands of Guatemala. Frontiers in Sustain-

able Food Systems. 124, 102647. DOI: https://doi.org/10.1016/j.futures.2020.102647

[38] Government of the Republic of Kazakhstan, 2021. Concept for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2021–2030 (Decree No. 960, December 30, 2021). Government of Kazakhstan: Astana, Kazakhstan.

[39] Government of the Kyrgyz Republic, 2025. National Development Program of the Kyrgyz Republic until 2030. Ministry of Economy and Commerce: Bishkek, Kyrgyz Republic.

[40] Madyan, M., Widuri, S.K., 2023. Environmental, Social, Governance (ESG) Performance and Capital Structure: The Role of Good Corporate Governance. Journal of Theory and Applied Management. 16(3), 560–570. DOI: https://doi.org/10.20473/jmtt.v16i3.47483

[41] Ministry of Ecology and Natural Resources of the Republic of Kazakhstan, 2023. National Project "Green Kazakhstan". Available from: https://www.gov.kz/memleket/entities/ecogeo/documents/details/627677?lang=ru (cited 19 September 2025).

[42] Kuwahara, S., Turaev, A., 2023. Public perceptions of the Aral Sea disaster in Uzbekistan. Journal of Disaster Research. 18(7), 783–795. DOI: https://doi.org/10.20965/jdr.2023.p0783

[43] Better Cotton Initiative, n.d. Better Cotton Initiative in Uzbekistan. Available from: https://bettercotton.org/where-is-better-cotton-grown/better-cotton-in-uzbekistan/ (cited 19 September 2025).

[44] United Nations Development Programme (UNDP) in the Kyrgyz Republic, 2025. Early warning system in the Kyrgyz Republic: Real-time risk monitoring. Available from: https://www.undp.org/ru/kyrgyzstan/stories/early-warning-system-kyrgyz-republic-real-time-risk-monitoring (cited 19 April 2025). (in Russian)

[45] World Bank, 2022. Protecting lives and livelihoods from natural disasters in Tajikistan [Feature story]. Available from: https://www.worldbank.org/en/news/feature/2022/09/12/protecting-lives-and-livelihoods-from-natural-disasters-in-tajikistan (cited 19 May 2025).

[46] Gabdualiyeva, R., Melekova, A., Jakupova, A., et al., 2024. Digitalization of the agricultural sector in Kazakhstan. BIO Web of Conferences. 82, 05038. DOI: https://doi.org/10.1051/bioconf/20248205038

[47] Gylychlyev, J., 2024. Main Directions of Socio-Economic Development of Turkmenistan. Vestnik Nauki. 5(74). Available from: https://cyberleninka.ru/article/n/osnovnye-napravleniya-sotsialno-ekonomicheskogo-razvitiya-turkmenistana/pdf (cited 19 September 2025). (in Russian)

[48] Wang, W., Wei, N., Wei, F., et al., 2025. Research on the progress of Carbon Capture, Utilization, and Storage (CCUS) technologies based on bibliometric analysis. Journal of Cleaner Production. 529, 146826. DOI: https://doi.org/10.1016/j.jclepro.2025.146826

[49] Elsner, F., Herzig, C., Strassner, C., 2025. Policy intermediation for agri-food system transition: Food policy groups from middle Europe, Australia and United States. Environmental Science & Policy. 173, 104227. DOI: https://doi.org/10.1016/j.envsci.2025.104227

[50] Center for Tropical Agriculture (CIAT), 2017. CIAT in Africa Roadmap 2017–2020. International Center for Tropical Agriculture (CIAT): Nairobi, Kenya. p. 20.

[51] Government of the Republic of Uzbekistan, 2019. Strategy on the Transition of the Republic of Uzbekistan to a Green Economy, 2019–2030. Available from: https://climate-laws.org/document/strategy-on-the-transition-of-the-republic-of-uzbekistan-to-a-green-economy-2019-2030_6bed (cited 19 September 2025).

[52] CAMP Alatoo Public Foundation, 2015. Pasture management guide for pasture committees. CAMP Alatoo Public Foundation: Bishkek, Kyrgyz Republic.

[53] Government of the Republic of Tajikistan, 2022. Decree on the "Strategy for the Development of a Green Economy of the Republic of Tajikistan for 2023–2037". Available from: https://www.fao.org/faolex/docs/pdf/taj221507.pdf (cited 19 September 2025).

[54] Government of the Kyrgyz Republic, 2019. Resolution No. 605 of 14 November 2019 "On the Approval of the Green Economy Development Program of the Kyrgyz Republic for 2019–2023". Available from: https://www.fao.org/faolex/docs/pdf/kyr229001.pdf (cited 19 September 2025).

[55] International Food Policy Research Institute, 2019. Agriculture development in the Central Asia Regional Economic Cooperation (CAREC) member countries: Review of trends, challenges, and opportunities. IFPRI: Washington, DC, USA.

[56] Adamkulova, C.U., Akylbekova, N., Imakeeva, A., et al., 2025. Transboundary water resources management: The case of Central Asia. Water Conservation & Management. 9(4), 595–602. Available from: https://www.watconman.org/wcm-03-2025-595-602/

[57] Dias Bernardes Gil, J., Reidsma, P., Giller, K.E., et al., 2018. Sustainable Development Goal 2: Improved targets and indicators for agriculture and food security. Ambio. 48, 685–698. DOI: https://doi.org/

10.1007/s13280-018-1101-4

[58] Aseete, P., Barkley, A., Katungi, E., et al., 2023. Public–private partnership generates economic benefits to smallholder bean growers in Uganda. Agricultural Economics. 15, 201–218. DOI: https://doi.org/10.1007/s12571-022-01309-5

[59] Institute for Cooperation on Agriculture & Centre for Agricultural and Rural Cooperation, 2015. Managing hazards, reducing risks and increasing investments in agriculture – some perspectives: Critical analysis of policy issues for repositioning agriculture in the Caribbean. Technical Centre for Agricultural and Rural Cooperation: Wageningen, Netherlands.

[60] Eurasian Economic Commission, 2021. Climate Agenda. Available from: https://eec.eaeunion.org/en/comission/department/dotp/klimaticheskaya-povestka (cited 19 July 2025).