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GLOBAL WATER SCARCITY TO 2060: IMPLICATIONS FOR THE WORLD ECONOMY AND FINANCIAL SYSTEM, RISKS, PROSPECTS AND STRATEGIC SOLUTIONS

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ABSTRACT. This study examines how escalating water scarcity may influence production, trade, public finance and financial stability through 2060. It employs a structured narrative review of international assessments and Uzbekistan-focused policy literature, combined with a transparent qualitative scenario framework. The analysis identifies interconnected transmission channels: agricultural yield volatility, industrial interruptions, energy-system constraints, infrastructure losses, inflationary pressures, sovereign fiscal burdens and credit risk. The evidence does not justify a single deterministic estimate of global losses in 2060; outcomes depend on emissions, water governance, investment and adaptation. A comparative risk matrix and two illustrative visualizations support a policy framework integrating water-use efficiency, transparent allocation, wastewater reuse, climate-resilient investment and financial-sector stress testing. Uzbekistan illustrates the importance of irrigation modernization and transboundary coordination. The paper argues that water security should be treated as a macro-financial resilience priority rather than solely an environmental issue.

KEYWORDS: water scarcity; 2060; climate risk; global economy; financial stability; water governance; adaptation; Uzbekistan.

INTRODUCTION

Freshwater availability is unevenly distributed across regions and seasons, while demand is shaped by population growth, urbanization, industrial production, food systems and climate change. Water scarcity refers not simply to low rainfall but to a mismatch between reliable accessible supply, environmental requirements and competing uses. Economic impacts are therefore mediated by institutions, infrastructure, technology and cross-border relationships. The United Nations World Water Development Report emphasizes the links between water security, prosperity and social stability [1].

Water risk has become relevant to macroeconomic management because water-dependent activities are embedded in supply chains and balance sheets. Agricultural output influences food prices; electricity generation and cooling depend on water; manufacturing facilities require dependable process water; and cities need resilient drinking-water and sanitation systems. The World Bank has shown that water scarcity, when compounded by inadequate policy responses, can substantially

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constrain growth in vulnerable regions [2]. Such findings are conditional scenario results rather than forecasts for every country.

The 2060 horizon is appropriate for studying long-lived capital decisions: dams, irrigation networks, industrial facilities and urban infrastructure often remain in service for decades. The central research question is: through which economic and financial channels might global water scarcity intensify by 2060, and which strategic interventions could reduce associated losses? The objective is to synthesize documented mechanisms and formulate an actionable policy-finance framework without presenting unobserved future outcomes as established facts.

MATERIALS AND METHODS

The research uses a qualitative integrative literature-review design. Ten selected references comprise multilateral scientific and policy assessments, a peer-reviewed water-risk research report, and Uzbekistan-relevant strategic documents. Sources were selected for institutional credibility, relevance to economic transmission mechanisms, and coverage of water availability, climate exposure, governance and adaptation. The analysis is not a meta-analysis and does not estimate causal coefficients from primary observations.

The analytical procedure had four stages: (i) identification of physical hazards, including drought, depletion, variable runoff and declining water quality; (ii) mapping of sectoral exposure and sensitivity; (iii) tracing impacts into prices, public budgets and financial intermediaries; and (iv) comparing adaptation instruments against implementation constraints. The qualitative scenario lens distinguishes a high-friction pathway, characterized by weak allocation and delayed investment, from a resilience pathway with efficient water use and stronger institutions. These are analytical narratives, not probability-weighted predictions.

For visualization, exposure scores from 0 to 5 are assigned to sectors solely to illustrate comparative mechanisms discussed in the literature. They are expert-style conceptual indicators, not survey responses, observed statistics or projections. Similarly, the circular chart represents an illustrative allocation of policy attention totaling 100%, not empirical spending shares. This separation prevents the false precision that can arise when qualitative evidence is presented graphically.

RESULTS

The synthesis identifies three layers of impact. The first is direct: reduced agricultural yields, intermittent industrial production, higher water-treatment costs and losses from drought. The second is indirect: increased food and electricity prices, disrupted logistics, migration pressure and lower productivity. The third is financial: deteriorating borrowers' cash flows, higher insurance claims, revaluation of exposed assets and mounting public expenditures on emergency supply and infrastructure [2, 3].

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Table 1. Principal economic and financial transmission channels

Water-related pressure	**Real-economy mechanism**	**Potential financial consequence**
Unreliable irrigation	Yield losses and farm-income volatility	Agricultural credit deterioration; food inflation
Industrial water shortage	Plant downtime and cost escalation	Corporate margin compression; loan stress
Urban water insecurity	Higher household and utility costs	Municipal financing needs; affordability risk
Drought and energy constraints	Hydropower variability; thermal cooling limits	Electricity price and energy-sector exposure
Cross-border competition	Trade and allocation uncertainty	Investment delays; sovereign risk premium

The channels reinforce one another. For example, irrigation shortages can lower farm output and increase food-import requirements. The resulting import bill may pressure the current account, while governments may face demands for food subsidies and irrigation support. If fiscal buffers are already limited, the same physical shock can propagate from rural production into sovereign and banking-sector vulnerabilities. The World Resources Institute's Aqueduct analysis highlights the scale and geographic concentration of baseline water stress [3].

Figure 1. Illustrative comparative exposure across four sectors (conceptual scores, not observed data)

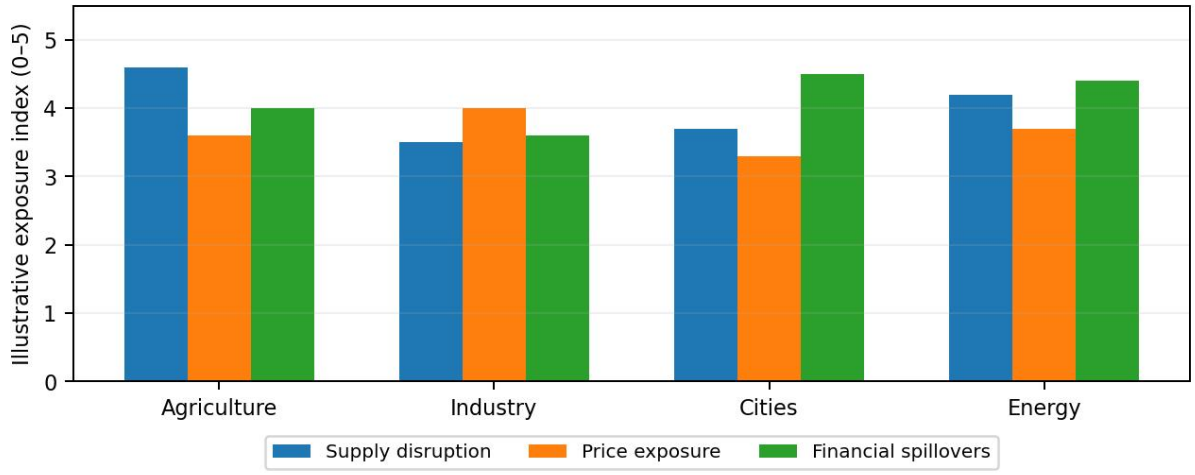


Figure 1 summarizes the relative salience of supply disruption, price exposure and financial spillovers. The chart is deliberately non-empirical: differences between bars indicate analytical emphasis, not measured sector-level losses. Agriculture is highly sensitive to water quantity and timing, whereas cities can transmit water costs through utilities, household expenditure and public

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finance. Energy-related disruptions may amplify effects across otherwise less water-intensive industries.

A longer horizon also creates asymmetric risks. Firms with access to recycling technologies and diversified water sources may maintain production, while smaller firms and low-income households have fewer adjustment options. These distributional effects matter for development finance and social stability. IPCC assessments emphasize that vulnerability and adaptation capacity differ substantially across locations and groups [4].

Table 2. Qualitative pathways to 2060: risk escalation versus resilience

Dimension	High-friction pathway	Resilience pathway
Water allocation	Fragmented, weak enforcement	Transparent basin-level allocation
Infrastructure	Deferred maintenance; leakage	Targeted upgrades and monitoring
Agriculture	Water-intensive practices persist	Efficient irrigation and crop planning
Finance	Water risk omitted from credit analysis	Scenario stress testing and disclosure
Social outcomes	Higher exposure for vulnerable users	Targeted affordability safeguards

Table 2 does not assign numerical probabilities. Its purpose is to demonstrate that future water scarcity is not a purely exogenous outcome. Governance choices determine how physical shortages become economic damage. The OECD has long identified financing, incentives and institutional coordination as central to water-security policy [5].

DISCUSSION

Macroeconomic consequences are likely to be nonlinear. A modest decline in available water may be manageable where storage, reuse and trading arrangements exist, but the same decline can cause sharp losses when a river basin is already fully allocated. Economic resilience therefore depends on the reliability of marginal water supply rather than national averages alone. Global water-cycle disruptions and degraded ecosystems may further weaken the buffers on which economies rely [6].

Financial institutions need to differentiate physical water risk from transition and policy risk. Physical risk concerns the probability and severity of shortages, floods and water-quality deterioration. Transition risk concerns changes in tariffs, abstraction permits, pollution standards and disclosure requirements. Both can affect the valuation of real estate, infrastructure, agricultural land and corporate assets. A practical stress test should map borrowers to river basins, assess water dependency and estimate the effect of plausible production interruptions on debt service.

A coherent response combines five complementary priorities: efficiency, governance, reuse, resilient capital investment and data-based early warning. Water-saving technologies alone may not

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produce basin-level savings if the conserved water is used to expand irrigated areas; effective allocation rules and monitoring are needed to avoid rebound effects. The Global Commission on the Economics of Water argues for managing water as a shared, systemically important resource [6].

Figure 2. Illustrative distribution of strategic policy attention (not actual budgets)

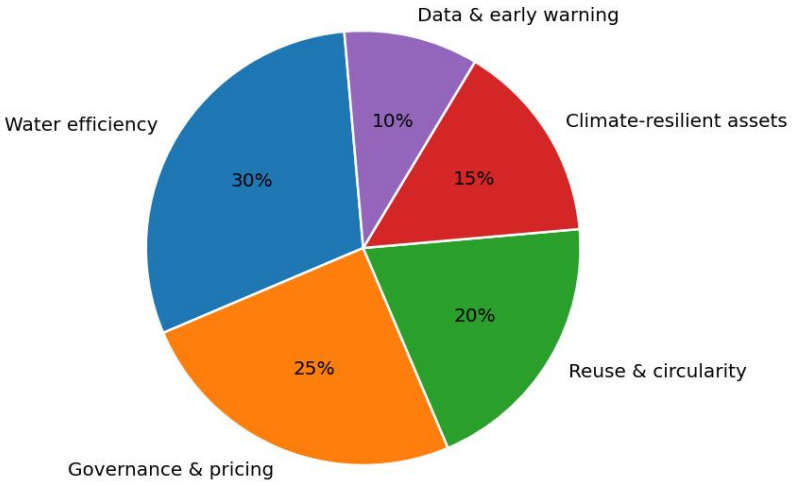


Figure 2 is a planning heuristic, not an empirical estimate of optimal expenditure.

Its proportions demonstrate that no single intervention is sufficient. Infrastructure investments without pricing reform may encourage inefficient use; price reforms without affordability protection can increase social burdens; and digital monitoring without institutional enforcement may yield limited improvements. Policy sequencing should reflect local hydrology, institutional capacity and household vulnerability.

The Central Asian context underscores these trade-offs. Uzbekistan has a large irrigation-dependent agricultural system, and water security is influenced by shared river basins, aging conveyance networks and climate variability. The country's 2020–2030 water-management concept sets directions for water accounting, efficient technologies and sector modernization [7]. The World Bank's Uzbekistan Country Climate and Development Report identifies climate-related pressures on water, agriculture and infrastructure and stresses the need for adaptation-oriented investment [8].

For Uzbekistan, practical priorities include rehabilitating canals where losses are economically material, expanding metering and digital accounting, improving incentives for efficient irrigation, supporting crop choices consistent with basin constraints and strengthening regional data exchange. Policy evaluation should distinguish water withdrawn from water consumed: return flows can remain important for downstream users. FAO AQUASTAT offers a framework for consistent water-sector indicators, although the completeness and reporting years of national data require careful interpretation [9].

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At the global level, multilateral development banks and domestic regulators could encourage standardized water-risk disclosures, basin-specific asset mapping and longer-term adaptation finance. Financing structures should account for project maintenance, social tariffs and the possibility of climate-related revenue volatility. The United Nations 2023 water conference agenda and related reporting emphasize cooperation, data and integrated management as cross-cutting enabling conditions [10].

The analysis has limitations. First, a review of ten sources cannot exhaust the fast-growing literature. Second, no original econometric model was fitted, so numerical GDP or financial-loss forecasts for 2060 would be unwarranted. Third, country-level averages can conceal local hotspots. Fourth, illustrative graphics are explanatory rather than evidentiary. Future research should couple basin-scale hydrological projections with input-output models, bank-level credit exposure and distributional household data under explicitly stated climate and policy scenarios.

CONCLUSION

Water scarcity through 2060 may act as a systemic economic and financial risk by transmitting localized physical constraints into food prices, industrial costs, energy reliability, public debt and credit quality. The severity of these outcomes will depend on adaptation capacity and policy choices rather than on hydrological stress alone. A strategic response should integrate basin-level water accounting, efficient and equitable allocation, wastewater reuse, resilient infrastructure, cross-border cooperation and water-sensitive financial supervision. For Uzbekistan and other irrigation-dependent economies, coordinated investment and governance reforms offer a more credible path to resilience than isolated technical measures. Future empirical studies should quantify the causal transmission channels and test policy packages against alternative climate scenarios.

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