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Designing for Water Scarcity: A Comparative Analysis of International Cooperation in Central Asia and the Arabian Peninsula

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Research Article

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Abstract

Saudi Arabia and the other Gulf Cooperation Council (GCC) states are trying to expand agriculture with almost no renewable water. Irrigation efficiency in the region has long hovered around 50%, while groundwater keeps falling. Central Asia faces similar agro-climatic pressures but has hosted decades of donor-funded water projects; the two regions have rarely been studied together. This paper compares six international cooperation projects implemented in Central Asia and the Arabian Peninsula between 1997 and 2024. They represent four modalities: multilateral lending, bilateral technical assistance, South–South knowledge exchange, and a partnership between a United Nations agency and a national authority. Using structured focused comparison across five dimensions, I find that the better-performing projects shared three habits: they built institutions alongside infrastructure, let beneficiaries set the agenda, and wrote gender targets into loan agreements. Two further features — explicit benefit-sharing and regional coordination — recurred in the stronger cases but were not universal. Reported outcomes include a 39% internal rate of return on a climate-smart credit line in the Aral Sea basin, near gender parity among CAMP4ASB beneficiaries, and water savings of 19–40% on selected Saudi demonstration farms, where irrigation efficiency reportedly rose from 50% to over 92%. Optimistic baseline projections, institutional turnover, and incomplete economic reporting weakened several projects and limit how far the results can be generalized. Because the Gulf's state-funded agricultural model differs sharply from Central Asia's donor-dependent one, I argue against copying projects wholesale. What travels, in my reading, is the function an institution performs, not its specific form. Instead of a blueprint, I offer a 10-step heuristic for adapting specific institutional mechanisms to GCC conditions, as preliminary input to the water reforms planned under Saudi Vision 2030.

Introduction

Few regions try to farm with as little water as the Arabian Peninsula. Agriculture accounts for about 70% of freshwater withdrawals worldwide, but in the Kingdom of Saudi Arabia (KSA) and the wider GCC the pressure is far more acute (World Bank, 2026c). Saudi Arabia's renewable internal freshwater resources amount to about 75 m³ per person per year, a fraction of the 500 m³ level that marks absolute scarcity (Falkenmark et al., 1989; World Bank, 2026c). Annual withdrawals are almost ten times the renewable resource, and agriculture accounts for about 82% of them (World Bank, 2026c; Alotaibi et al., 2023). Irrigation efficiency is estimated at around 50%, and the shortfall is met from non-renewable aquifers (FAO, 2024; Abdou et al., 2024). Saudi Vision 2030 and the National Water Strategy both make agricultural water reform a priority, yet turning these goals into practice on individual farms has been slow.

Central Asia faces a comparable crisis in a very different economy. The region rarely appears in debates on Middle Eastern water security, although its agro-climatic problems closely resemble those of the Gulf. Land degradation is estimated to cost Central Asian economies about 6% of GDP each year (World Bank, 2025). The Aral Sea has been shrinking since the 1960s, when the Amu Darya and Syr Darya were diverted for irrigation, and it remains the starkest example of the salinity and ecological damage that now affects millions of farmers in the region (World Bank, 2024). The two regions share many of the same drivers: water-hungry crops, ageing infrastructure, fragmented governance. At the same time, their responses have diverged.

Central Asia has become a proving ground for large multi-donor programs financed by the World Bank, the Asian Development Bank (ADB), the Green Climate Fund (GCF), and the Food and Agriculture Organization of the United Nations (FAO). Among them, the Climate Adaptation and Mitigation Program for the Aral Sea Basin (CAMP4ASB), the Resilient Landscapes Restoration program for Central Asia (RESILAND CA+), and the Japan–United Nations Development Programme (UNDP) water governance project have produced measurable, if uneven, gains in efficiency, landscape restoration, and institutional capacity. The GCC states, by contrast, have relied mostly on domestic, state-funded programs. This difference is not merely fiscal. It shapes what counts as evidence, who sets priorities, and how quickly a project can be redesigned when it fails.

One notable exception to the state-funded pattern is the smart irrigation initiative run by FAO and the Saudi Irrigation Organization (FAO-SIO), which reports that irrigation efficiency on participating farms rose from 50% to over 92% while water use fell by up to 40% (FAO, 2026). Another is the Agricultural Development and Enhanced Food Security (ADFS) program of the

International Fund for Agricultural Development, the Islamic Development Bank, and the UN Office for South–South Cooperation (IFAD-IsDB-UNOSSC), which built knowledge-exchange links between the Middle East and North Africa (MENA) and Central Asia (IFAD, 2014; South–South Galaxy, 2020).

Evaluations of individual projects exist, but these interventions have not yet been compared in a way that would show which design principles hold across them. This matters for GCC policymakers, who are expected to transform agriculture quickly under Vision 2030 and have little comparative evidence to guide them. The gap is particularly consequential because the two regions share a climate but not a political economy: what works in a donor-financed system may fail in a state-capitalist one, and the policy-transfer literature has long warned that institutional similarity and contextual adaptation decide whether a policy works in a new setting (Dolowitz & Marsh, 2000; Mukhtarov, 2014).

This paper compares six projects implemented between 1997 and 2024. The qualitative, cross-regional design is deliberate. The projects differ so much in type, funding, and reporting standards that pooling their metrics statistically would not be credible; structured focused comparison (George & Bennett, 2005) lets me look instead for recurring patterns in institutional design. The paper pursues five research questions. RQ1: How were the six projects designed, and what did they achieve? RQ2: Which institutional and technical features are associated with stronger performance? RQ3: Which risks repeatedly undermined the projects? RQ4: Which design principles can be adapted from Central Asia to the macroeconomic and institutional conditions of the GCC? RQ5: What do these findings imply for human-ecology research on institutional adaptation to water scarcity? The Discussion returns to each question in turn.

The paper brings together two bodies of experience that are usually discussed separately: the well-documented donor projects of Central Asia and the emerging, state-led agricultural model of the GCC. I shift attention from technology transfer to the adaptation of institutional design, and I set out a procedure that project designers in other water-scarce settings can repeat. The paper contributes to human-ecology research on how societies adapt resource-use institutions to environmental scarcity, and to the policy-transfer literature (Dolowitz & Marsh, 2000; Mukhtarov, 2014). I read the cases as evidence that institutional design, more than physical infrastructure, determines whether an approach can move between regions that share a climate but not a political economy.

Literature Review

Water Scarcity and Agricultural Challenges in the GCC The GCC is hyper-arid. In KSA, total freshwater withdrawals in 2022 were almost ten times the country's renewable internal resources (World Bank, 2026c). Agriculture uses about 82% of the water withdrawn yet generates only about 2.6% of GDP (World Bank, 2026c; Alotaibi et al., 2023), an imbalance that Vision 2030 aims to correct. Modeling of the water-energy-food nexus in neighboring Qatar points to similar tradeoffs across the Gulf (Shubbar et al., 2024).

Low irrigation efficiency is the main bottleneck. FAO estimates the efficiency of conventional irrigation in the Kingdom at around 50%, against global best practice of about 85% (FAO, 2024). Fossil groundwater meets 89% of agricultural demand, while desalination supplies only 9.3% (Alotaibi et al., 2023). Panel data show that water stress significantly reduces agricultural output across the GCC and that the interaction between freshwater extraction and methane emissions aggravates the effect (Abdou et al., 2024). System dynamics modeling suggests that raising agricultural water productivity would also bring climate co-benefits (Shubbar et al., 2024). Soil degradation, increasingly erratic rainfall (Abdullah et al., 2025), and the sharp rise in heat extremes projected for the region (Lelieveld et al., 2016) make supplementary irrigation unavoidable and raise the demand for precise water management. Smart irrigation systems that combine field sensors, the Internet of Things, and cloud computing have been proposed as a practical way to deliver water more precisely in arid conditions (Morchid et al., 2025).

International Cooperation in Central Asian Water Management Central Asia shares the GCC's arid climate and dependence on irrigation, but its post-Soviet economies rely heavily on donor funding. The desiccation of the Aral Sea drew international agencies into the region on a large scale, and their projects now form a substantial body of experience (World Bank, 2024).

The World Bank's CAMP4ASB program (2015–2024) was appraised at USD 44.78 million (World Bank, 2015) and later received USD 19 million in additional financing from the GCF (Independent Evaluation Group [IEG], 2025). It combined climate information services with targeted credit and grants for climate-smart agriculture in Tajikistan and Uzbekistan. The program reports a 39% internal rate of return (IRR) on its credit component and income gains among surveyed beneficiaries (World Bank, 2024).

RESILAND CA+, a regional landscape restoration program launched in 2019, works through national projects in several Central Asian countries. By April 2026 the Tajikistan project had brought 117,244 hectares under sustainable landscape management and reached about 466,000 beneficiaries, 41% of them women (World Bank, 2026a). Forest restoration relies on joint forest management, in which forest user associations hold 20-year leases on state forest land (CAREC, 2025). Under earlier joint forest management arrangements in Tajikistan, tenants typically kept 70% of the forest products and the state forestry enterprise 30% (Haider et al., 2019).

The Japan-UNDP water governance project is a USD 4.6 million package of bilateral technical assistance, signed in February 2026 for 2026–2028. It focuses on digitalization, precision irrigation, and renewable-energy desalination, and treats gender equality as a core principle (UNDP, 2026). An older case, the ADB water resources project in Kazakhstan (1997–2006), is a cautionary one. Its completion report rated it satisfactory, but ADB's Independent Evaluation Department downgraded it to "partly successful", citing doubts about sustainability, the abandonment of planned land improvement works, and increased water use in the Aral Sea basin (ADB, 2007, 2009).

Innovation Cooperation and Knowledge Transfer Development studies have increasingly questioned the conventional idea of technology transfer. Pandey et al. (2022) propose innovation cooperation instead: an equitable, multi-directional relationship in which technologies are embedded in local institutions. The argument echoes diffusion of innovations theory (Rogers, 2003) and the policy-transfer literature, which shows that institutional similarity and contextual adaptation largely decide whether a policy works in a new setting (Dolowitz & Marsh, 2000; Mukhtarov, 2014). In water management, mechanisms such as demand-driven credit (CAMP4ASB) or farmer-to-farmer training (FAO-SIO) can be read as innovation cooperation in practice, since they build on local demand rather than impose technical fixes from above. Research on common-pool resources adds a caution: externally designed rules rarely last unless local users have a stake in making and enforcing them (Ostrom, 1990).

Human–Environment Perspectives on Irrigation Institutions Irrigation has long been a central topic in human ecology because it ties ecological limits directly to social organization. Research on common-pool resources showed that farmer-managed irrigation systems endure when users help to craft, monitor, and enforce the rules that govern them (Ostrom, 1990). The social–ecological systems framework extends this insight by treating the resource system, its users, and the governance arrangements as interacting subsystems whose fit with one another shapes sustainability outcomes (Ostrom, 2009). Work on adaptive governance adds that institutions able to learn and to coordinate across scales cope better with environmental change (Folke et al., 2005). Seen from this angle, the question of whether design features travel between Central Asia and the Gulf is a question of institutional fit: a mechanism that aligns users' incentives with resource limits in one social–ecological system may sit poorly in another, where governance, land tenure, and labor are organized differently.

South-South Cooperation and the Research Gap The IFAD-IsDB-UNOSSC ADFS program (2014–2019) organized South–South cooperation around eight thematic corridors. Among its results was the adaptation of the MEVA mobile application, developed in Uzbekistan, for pilots in Hungary, Kyrgyzstan, Sudan, and Turkey (IFAD, 2014, 2019; South–South Galaxy, 2020; Chirambo, 2024). The FAO-SIO cooperation, agreed in December 2021 with USD 6.8 million of Saudi funding (FAO, 2021), took a different route: a direct partnership between a UN agency and a national body, which relied on lead farmers acting as "ambassadors" to spread smart irrigation (FAO, 2026).

These successes remain isolated, and the literature offers no common framework for comparing them. Existing studies either document the GCC water crisis (Shubbar et al., 2024; Alotaibi et al., 2023) or evaluate single Central Asian programs (World Bank, 2024; ADB, 2009). None draws out design principles that hold across cooperation modalities. This study attempts to do so by applying the innovation cooperation framework to the Central Asia–GCC corridor.

Materials and Methods

Case Selection and Data Sources Six projects were selected using three criteria: relevance to agriculture under water scarcity; availability of verifiable public documentation, such as project appraisal documents (PADs), implementation completion reports (ICRs), and mid-term reviews (MTRs); and geographic and institutional diversity, so that four cooperation modalities are represented (Table 1). The material for the study was this public documentation, supplemented by peer-reviewed studies and institutional databases. The selection was purposive rather than systematic. No formal screening log of excluded projects was maintained, and the six cases were chosen to represent the four modalities rather than to constitute a representative sample. This is a limitation of the design, noted below.

Documentation was reviewed as available in 2026; the most recent sources are World Bank implementation status reports of June 2026, and the project status shown in Table 1 refers to mid-2026. Where an independent validation of a completion report exists (ADB, 2009; IEG, 2025), both ratings are reported. It should be noted that the selection reflects the uneven availability of public evidence: only one of the six projects (FAO-SIO) is located in the Arabian Peninsula, and one (IFAD-IsDB-UNOSSC ADFS) spans both regions.

Table 1
Selected international cooperation projects

Project name	Region	Donor / Partner	Period	Status (mid-2026)
ADB Water Resources Management and Land Improvement Project	Kazakhstan	ADB	1997–2006	Completed
Japan-UNDP Water Governance	Uzbekistan	Japan/UNDP	2026–2028	Active
CAMP4ASB	Central Asia (multi)	World Bank/GCF	2015–2024	Completed
IFAD-IsDB-UNOSSC ADFS	MENA + Central Asia	IFAD/IsDB/UNOSSC	2014–2019	Completed
FAO-SIO Smart Irrigation	Saudi Arabia	FAO/SIO	2021–2026	Approaching completion
RESILAND CA+	Central Asia (multi)	World Bank/CAREC	2019 - present	Active

Source: compiled by the author from project documents cited in the text.

Official project documents (World Bank, ADB, UNDP, FAO, IFAD) were triangulated with peer-reviewed studies and institutional databases (South–South Galaxy; Regional Environmental Centre for Central Asia, CAREC).

Analytical Framework and Method Because the interventions are so different, each project was described along the same five dimensions: coverage and scale, technological interventions, economic performance, institutional and social design, and outcomes (Table 2). The comparison follows the logic of structured focused comparison (SFC; George & Bennett, 2005). SFC requires the analyst to ask the same set of questions of every case, to record answers in a standardized way, and to use the resulting variation to identify patterns rather than to estimate effect sizes. Table 2 operationalizes this requirement: each of the five dimensions corresponds to a set of questions asked of all six projects, and the case descriptions in the Results follow the same sequence. SFC differs from qualitative comparative analysis in that it does not formalize cases as configurations of conditions and does not test necessity or sufficiency; it differs from a single case study in that it deliberately varies context across cases. With six heterogeneous cases, SFC is appropriate for identifying recurring design features, but not for causal inference.

Table 2
Analytical framework dimensions

Dimension	Indicators	Data sources
Coverage and scale	Geographic scope, beneficiaries, intervention area	PADs, ICRs, project reports
Technological interventions	Irrigation tech, digital tools, restoration techniques	Project documents
Economic performance	IRR, NPV, cost-benefit metrics	ICRs, PCRs
Institutional and social design	Governance, gender integration, benefit-sharing	Project documents, MTRs
Outcomes and lessons	Achievements, challenges, extracted lessons	ICRs, PCRs, evaluations

Source: compiled by the author.

Qualitative design features were coded by the author on the basis of project documents; no formal codebook or second coder was used, and this is a limitation. Where possible, qualitative codes were anchored in documentary evidence. A binding gender target required an explicit numerical target in a project appraisal document or a legal agreement. Demand-driven design required evidence that beneficiaries shaped investment choices, such as the CAMP4ASB beneficiary survey reporting that 87.5% of investments reflected their needs (IEG, 2025). Benefit-sharing required a documented rule allocating a defined share of benefits to resource users, such as the joint forest management leases in Tajikistan (Haider et al., 2019). These anchors reduce, but do not eliminate, the subjectivity of the coding.

The concept of innovation cooperation (Pandey et al., 2022) is used here as an interpretive frame rather than as a coding scheme. It informs the reading of demand-driven credit and farmer-to-farmer training as multi-directional relationships embedded in local institutions, but the formal comparison rests on the five dimensions in Table 2. Similarly, institutional fit (Ostrom, 2009; Folke et al., 2005) is used in the Discussion to interpret why some mechanisms travel better than others; by institutional fit is meant the degree to which governance arrangements match the biophysical and social attributes of the resource system.

A project, or a national component of a regional program, was classified as better-performing when its completion report or most recent status report showed that most of its targets had been met or exceeded, and when its overall rating was at least "Moderately Satisfactory" on the World Bank scale or "successful" on the ADB scale. Where an independent validation exists, the validated rating was used rather than the self-assessment. On this basis, CAMP4ASB and RESILAND Tajikistan count as better-performing, and the ADB project and RESILAND Uzbekistan as weaker performers. FAO-SIO, which has no formal rating, is treated as better-performing on the basis of its reported results, with the caveat that no formal rating exists; this is an analytic judgment, not a validated classification. The ADFS program, which reported only process indicators, and the Japan–UNDP project, which has no outcome data yet, were not used to identify correlates and serve only to illustrate design features. The classification is therefore the author's, based on public documentation, and should be read as a heuristic ordering rather than a measured outcome.

Limitations The study has several limitations. First, the selection of cases was purposive rather than systematic: no formal screening log was maintained, and the six cases were chosen to represent four cooperation modalities rather than to constitute a representative sample. Second, economic data are uneven: only CAMP4ASB and the ADB project in Kazakhstan provide full ex-post IRR and net present value (NPV) analyses, and four of the six projects lack public economic performance data, which limits cross-case comparison on economic grounds. Third, the projects are at different stages of completion, so ex-ante targets and ex-post results must be compared with care. Fourth, and most important, the analysis relies largely on documentation produced by multilateral development banks and implementing agencies, which may overstate results in their completion reports. To reduce this risk, the analysis concentrates on institutional design features, which are less prone to inflation than biophysical metrics, and self-reported figures are flagged explicitly. Fifth, qualitative design features were coded by the author on the basis of project documents; no formal codebook or second coder was used, and this is a limitation. Sixth, none of the projects has a counterfactual control group, so observed improvements cannot be attributed to the interventions

alone. Finally, with six cases from two regions, the findings cannot be generalized widely, and SFC is suited to identifying recurring patterns rather than to estimating effect sizes or testing causal hypotheses; the correlates should be treated as hypotheses for further testing, although the framework itself is designed to be replicated.

Results

Table 3 brings the six cases together along the five dimensions of the analytical framework; the sections that follow discuss each case in turn.

Table 3
Cross-case synthesis along the five analytical dimensions

Project	Coverage and scale	Technological interventions	Economic performance	Institutional and social design	Outcomes and status (mid-2026)
ADB Water Resources Management and Land Improvement Project (Kazakhstan)	39,259 ha rehabilitated (about 32,500 ha at design); loans of USD 30 million and about USD 10 million	Irrigation and drainage rehabilitation; planned land improvement not implemented	EIRR 15.6% (25.6% at appraisal)	22 rural consumer cooperatives and 3 water user federations; institutional support about 7% of base costs	Completed 2006; PCR: satisfactory; independent validation: partly successful, sustainability less likely
Japan-UNDP Water Governance (Uzbekistan)	More than 1,000 farming households; USD 4.6 million; 2026–2028	GIS-based digitalization, precision irrigation, renewable-energy desalination	Not yet available	Gender equality as a core principle	Signed February 2026; no outcome data yet
CAMP4ASB (Central Asia)	70,742 direct beneficiaries (target 50,000); USD 44.78 million plus USD 19 million GCF	Climate information services; credit and grants for climate-smart agriculture	IRR 39% (credit component), 27% (entire program)	Demand-driven credit; 49.9% female beneficiaries (target 35%)	Closed 2024; ICR: Satisfactory; IEG: Moderately Satisfactory
IFAD-IsDB-UNOSSC ADFS (MENA and Central Asia)	Nine countries, eight thematic corridors	MEVA mobile application	Not reported (process indicators only)	South-South knowledge exchange	Completed 2019; MEVA adapted for pilots in four countries
FAO-SIO Smart Irrigation (Saudi Arabia)	22 demonstration farms (of 320 sites assessed) in 10 regions; USD 6.8 million	Smart irrigation and digital water management	Profitability gains above 200% on date demonstration plots (selection bias)	Lead farmers acting as ambassadors	Efficiency about 50% to over 92%; water savings 19–40%; approaching conclusion
RESILAND CA+ (Central Asia)	Tajikistan: 117,244 ha under sustainable management (target: 180,000 ha by 2027), about 466,000 beneficiaries; Uzbekistan: 12,385 of 280,000 ha	Forest and pasture restoration, nurseries	Not available (ongoing)	Joint forest management leases; women 41% of beneficiaries but lead 11% of common interest groups; Regional Advisory Committee	Ongoing; Tajikistan: Satisfactory; Uzbekistan: Moderately Unsatisfactory

Note: Sources are cited in the case descriptions that follow. PCR = project completion report; ICR = implementation completion report; IEG = Independent Evaluation Group.

ADB Water Resources Management (Kazakhstan) The ADB project (Loans 1592 and 1593[SF], of USD 30 million and about USD 10 million) aimed to raise farm incomes in Makhtaar district by rehabilitating irrigation and drainage and by handing system

management to water users' associations. Of the USD 30 million ordinary loan, USD 4.2 million was cancelled and USD 24.28 million (81%) was disbursed; about USD 3.4 million of the concessional loan was also cancelled (ADB, 2007). The project rehabilitated irrigation and drainage networks on 39,259 hectares, against about 32,500 hectares envisaged at design, and established 22 rural consumer cooperatives and three water user federations, which took over operation and maintenance in 2006. Implementation took more than eight years instead of five, with three extensions. The completion report estimated an economic internal rate of return (EIRR) of 15.6% against 25.6% at appraisal, and rated the project satisfactory (ADB, 2007). The independent validation rated it partly successful: the planned land improvement works were dropped, there was no evidence of higher water use efficiency, institutional support (about 7% of base costs) ended with the project, and sustainability was judged less likely (ADB, 2009). As the completion report itself concludes, rehabilitated infrastructure deteriorates again unless institutions and maintenance financing are built in from the start. This is the clearest cautionary case in the set.

Japan-UNDP Water Governance (Uzbekistan) Funded by the Government of Japan (USD 4.6 million), this project was signed on 27 February 2026 and runs until 2028. It aims to improve water access and farm productivity for more than 1,000 farming households through institutional strengthening, digitalization based on geographic information systems (GIS), precision irrigation, and renewable-energy desalination, with gender equality as a core principle (UNDP, 2026). Implementation has only just begun, and no outcome data are yet available. For the purposes of this comparison, it illustrates the bilateral technical assistance modality rather than providing evidence on outcomes.

CAMP4ASB (Central Asia) The 2024 implementation completion report rated the World Bank/GCF project P151363 "Satisfactory", with "Substantial" efficiency (World Bank, 2024). The IEG review downgraded the outcome to "Moderately Satisfactory" and efficiency to "Modest", noting that targets were not raised after the GCF added USD 19 million (IEG, 2025). The program closed in May 2024 after eight restructurings and a 35-month extension, having disbursed 99% of its funds. Table 4 compares its key indicators with the targets.

Table 4
CAMP4ASB key performance indicators, targets and results (World Bank, 2024; IEG, 2025)

Indicator	Target	Actual
Direct beneficiaries	50,000	70,742
Female share of direct beneficiaries	35%	49.9%
Beneficiaries reporting that investments reflected their needs	80%	87.5%
IRR, Component 2 (credit)	0–44% (appraisal); 0–60% (GCF phase)	39%
IRR, entire program	–	27%

Source: compiled by the author from World Bank (2024*) and IEG (2025).*

The credit component (Component 2) reached an IRR of 39%, while the IRR for the project as a whole was 27%. The gap reflects substantial spending on capacity building and institutional reform, which carries high upfront costs but is meant to build resilience over the longer term.

The ICR reports income gains from beneficiary surveys without a control group. In Tajikistan, 82% of about 400 respondents reported higher incomes, with average annual household income rising from USD 2,100 in 2021 to USD 3,300 in 2024. In Uzbekistan, recipients of GCF grants reported an increase from USD 600 to USD 2,800 per person over the same period (in 2024 prices), and 87% of sub-loan beneficiaries reported higher incomes (World Bank, 2024). The ICR itself conservatively assumes that only half of the increase was due to the program, and its main text gives a different figure for Uzbekistan (USD 3,500), which shows how fragile such self-reported data are. Stronger evidence that the program matched local demand comes from the 87.5% of beneficiaries who reported that program investments reflected their needs, against a target of 80% (IEG, 2025).

IFAD-IsDB-UNOSSC ADFS (MENA + Central Asia) Between 2014 and 2019 the program operated in nine countries and eight thematic corridors, documented 71 innovations, and adapted the MEVA mobile application in four pilot countries (IFAD, 2014, 2019). Some 700 participants took part in 12 workshops. The program reported mostly process indicators, such as innovations documented and pilots completed, rather than biophysical or financial results. Its performance therefore cannot be compared with CAMP4ASB in economic terms, but it illustrates a distinct, capacity-building modality. In the comparison that follows, it serves as the South–South case rather than as a source of outcome evidence.

FAO-SIO Smart Irrigation (Saudi Arabia) Under the cooperation launched in December 2021 (FAO, 2021), the initiative assessed 320 sites in 10 regions of KSA and selected 22 of them as demonstration farms; about 300 farmers took part in training sessions (FAO, 2026). Table 5 summarizes outcomes by region and crop.

Table 5
FAO-SIO demonstration-farm results by region and crop (FAO, 2026)

Region	Crop	Result
Jazan	Mango	19% water reduction
Al-Baha	Greenhouse	24% water savings
Asir	Grapes	40% water reduction
Al-Ahsa	Dates	> 200% profitability increase

Source: compiled by the author from FAO (2026). Profitability gains are reported for demonstration plots selected partly for readiness to adopt new practices; they should not be read as representative of the wider farm population.

FAO reports that irrigation efficiency on these farms rose from a baseline of about 50% to more than 92% (FAO, 2026). The profitability gains of over 200% on demonstration plots should be read with caution, since farms were chosen partly for their readiness to adopt new practices. The more robust results are the water savings of 19–40% and the successful test of the peer-to-peer "farmer-ambassador" extension model. The extension model, in my reading, is the more transferable of the two findings: it does not depend on the specific technology and can be adapted to different farm sizes.

RESILAND CA+ (Central Asia) Results differ markedly between countries. In Tajikistan, where implementation is rated Satisfactory, the area under sustainable landscape management reached 117,244 hectares by April 2026 (target: 180,000 hectares by 2027), and about 466,000 people had benefited, 41% of them women (World Bank, 2026a). The project supports 64 pasture user unions, 181 forest user associations, and 748 common interest groups; women make up 43% of common interest group members but lead only 11% of the groups (CAREC, 2025). Half of the supported groups have at least one woman on their board or council, meeting the project target, and groups led mainly by women received 16% of sub-grants (World Bank, 2026a). In Uzbekistan, by contrast, progress is rated Moderately Unsatisfactory: by June 2026 only 12,385 of the targeted 280,000 hectares were under sustainable management (World Bank, 2026b). At the regional level, the program convenes a Regional Advisory Committee (RAC) for cross-border exchange (CAREC, 2025).

Across the six cases, five design features recur in the projects that performed better on the criteria set out in the Methods: integration of hard and soft interventions, demand-driven design, binding gender targets, explicit benefit-sharing, and regional coordination. These are inductive observations from a small and heterogeneous set of cases, not causal estimates; the Discussion examines each in turn, together with the risks that recurred across projects and the implications for transferring design principles to the GCC. I read the Tajik–Uzbek contrast within RESILAND as a warning against treating a regional design as a guarantee of national results.

Discussion

Institutional Fit as the Interpretive Lens I read the five correlates discussed below through the lens of institutional fit (Ostrom, 2009; Folke et al., 2005). They have something in common: each aligns the incentives of resource users with the limits of the

resource system. In Central Asia this alignment was pursued through donor-financed credit, water users' associations, joint forest management leases, and cross-border advisory bodies, and it failed where, as in the ADB project, the supporting institutions lapsed once external funding ended. In the GCC, where the state rather than donors finances agriculture, the same functions would have to be performed by different instruments, such as conditional state subsidies, water allocations tied to metered use, or long-term use rights for rangeland users. What travels, in my reading, is the function an institution performs, not its specific form. Figure 1 summarizes this framework: the five correlates mediate the translation from donor-dependent Central Asian cases to the state-capitalist GCC context, and the right-hand column lists the adapted mechanisms discussed in the Recommendations.

Correlates of High Performance Five features were associated with better project performance. Because the analysis is inductive and draws on self-reported data, I treat them as empirical correlates rather than proven causes. Three of them recurred in every better-performing case; two were present but not universal, and I flag that difference where it matters.

Integration of hard and soft interventions. Infrastructure alone did not secure lasting results. In the ADB project, institutional support made up only about 7% of base costs and ended with the project, leaving water users' associations without the means to maintain the rehabilitated networks (ADB, 2009). CAMP4ASB, which combined investment with climate knowledge services and community support, was rated more favorably, even after independent review (IEG, 2025). The contrast is instructive: the same kind of rehabilitated network, two different fates, and the difference is whether the institution outlived the loan.

Demand-driven design. Where beneficiaries helped shape the project, adoption rates were higher. CAMP4ASB's credit allocation and FAO-SIO's ambassador model both suggest that participatory design reduces friction during implementation.

Binding gender integration. Where gender targets were set at appraisal, they were met: women made up 49.9% of CAMP4ASB's direct beneficiaries against a target of 35% (IEG, 2025), and RESILAND Tajikistan reached its target of women on half of group boards (World Bank, 2026a). Participation, at the same time, did not automatically translate into leadership. Women lead only 11% of RESILAND's common interest groups (CAREC, 2025), and the gap between membership and leadership is the part of the gender story that targets alone do not fix. I read this as consistent with Ostrom's (2009) argument that formal rules matter less than the positions from which users can negotiate them.

Explicit benefit-sharing. RESILAND's joint forest management leases give forest users a defined share of the benefits from the land they restore (CAREC, 2025; Haider et al., 2019). The contrast between Tajikistan and Uzbekistan shows, at the same time, that the same regional design can produce very different national results.

Regional coordination. RESILAND's Regional Advisory Committee provides a platform for cross-border exchange (CAREC, 2025), and the IFAD-IsDB-UNOSSC program organized South–South cooperation around eight thematic corridors (IFAD, 2019). Neither platform, however, has yet been evaluated for its effect on national outcomes.

Persistent Risks Four risks recurred across the cases: over-optimistic appraisal assumptions (the ADB project's EIRR fell from 25.6% to 15.6%, and its scale and costs were misjudged at design); institutional instability and delays (changes in the structure of Kazakhstan's Ministry of Agriculture under the ADB project and in the implementing agency in Uzbekistan under CAMP4ASB; ADB, 2009; IEG, 2025); weak economic reporting requirements in project design; and weak follow-through after closure, with support to water users' associations ending when the ADB project closed (ADB, 2009). These risks are not independent. Over-optimistic appraisal and weak reporting together make it difficult to detect failure early, and institutional turnover then compounds the problem. The evidence suggests the ADB case is the clearest illustration of how the four risks interact.

Comparative Assessment by Modality The four cooperation modalities differ systematically in their strengths and weaknesses (Table 6). Multilateral lending brings strong economic documentation but slow implementation; bilateral technical assistance moves quickly but documents outcomes weakly; South–South exchange is adaptable but relies on process indicators; and UN–national agency partnerships build local capacity rapidly but rarely scale beyond a single country.

Table 6
Assessment of cooperation modalities

Modality	Strength	Weakness	Example
Multilateral	Strong economic documentation (IRR, NPV)	Slow implementation	CAMP4ASB
Bilateral TA	Fast implementation, targeted tech	Weak economic documentation	Japan-UNDP
South-South exchange	Multi-directional learning, high adaptability	Process-oriented metrics; no IRR	IFAD-IsDB-UNOSSC
UN–national agency	Rapid local capacity building, high efficiency	Limited to single-country scale	FAO-SIO

Source: compiled by the author.

Recommendations

A 10-Step Heuristic Framework The five correlates can be translated into a 10-step heuristic for designing projects in water-scarce environments (Table 7). The steps are not a fixed sequence but a set of design principles to be adapted to local conditions. They are derived inductively from six heterogeneous cases; the quantitative thresholds mentioned in the table are indicative starting points, not universal benchmarks.

Table 7
10-step heuristic framework for project design

Step	Action	Basis from analysis
1	Conduct rigorous ex-ante feasibility analysis with uncertainty ranges	ADB Kazakhstan; CAMP4ASB
2	Design for demand-driven implementation	CAMP4ASB (87.5% of beneficiaries report needs met)
3	Balance hard and soft interventions (meaningful share to soft components)	CAMP4ASB, RESILAND
4	Embed binding gender targets from the outset	CAMP4ASB (49.9% female beneficiaries); RESILAND
5	Establish benefit-sharing mechanisms with clear rules	RESILAND (joint forest management leases)
6	Create regional coordination mechanisms	RESILAND (RAC), IFAD-ADFS
7	Employ farmer-to-farmer knowledge transfer	FAO-SIO
8	Build in institutional contingency (succession plans, counterpart funding)	CAMP4ASB
9	Monitor, evaluate, and adapt with baseline data	CAMP4ASB (MTR)
10	Document and disseminate lessons, including failures	ADB Kazakhstan; RESILAND

Source: derived by the author from the six cases. Quantitative thresholds are indicative starting points, not universal benchmarks.

Transferability to the GCC

Not every mechanism travels equally well. Table 8 scores each candidate component on institutional similarity to GCC governance, technology maturity for arid environments, and strength of evidence. The scores are the author's analytic

judgments, not independently validated measurements; they are intended as a heuristic for sequencing pilots, not as a substitute for feasibility studies.

Table 8
Transferability ratings for GCC adaptation

Component	Source	Inst. Similarity (1–3)	Tech Maturity (1–3)	Evidence Strength (1–3)	Total	Rating
Farmer credit mechanism	CAMP4ASB	2	3	3	8	High
Benefit-sharing (forest leases)	RESILAND	2	3	2	7	High
Farmer-to-farmer training	FAO-SIO	3	3	2	8	High
Digital irrigation management	FAO-SIO	3	3	2	8	High
Regional advisory committee	RESILAND	2	3	2	7	High
Gender targeting	RESILAND	1	3	2	6	Medium
MEVA app adaptation	IFAD-ADFS	2	3	3	8	High

Source: compiled by the author. Scores reflect (1) institutional similarity to GCC governance; (2) technology maturity for arid environments; (3) strength of evidence (ex-post = 3, mid-term = 2, design-stage = 1). Total 7–9 = High, 4–6 = Medium. Scores are the author's analytic judgments, not independently validated measurements; they are intended as a heuristic for sequencing pilots, not as a substitute for feasibility studies.

A Sequenced Agenda for the GCC (2027–2032) Three priorities follow from the transferability assessment. First, it is advisable to move the FAO-SIO model from a 22-farm pilot to a statistically representative scaling phase (2027–2030), using stratified random sampling across all 10 administrative regions to validate water savings before smart metering is made mandatory nationwide. Second, a GCC Regional Water Advisory Committee (2027–2028), modeled on the RESILAND RAC, could harmonize water-efficiency standards across the six GCC states. Third, it is proposed to adapt the CAMP4ASB credit model as a state-subsidized revolving facility (2027–2032): a donor-credit model does not fit the GCC, but a state-subsidized facility could tie concessional finance to metered water savings and binding gender targets, following the CAMP4ASB precedent of 49.9% female beneficiaries against a 35% target.

Three further steps would close gaps identified in this analysis: binding gender targets of at least 40% female beneficiaries with systematic collection of gender-disaggregated data (from 2027); pilot benefit-sharing arrangements in landscape restoration (2027–2029), adapting the joint forest management lease model to restored rangelands; and formal South–South technical exchange missions with Central Asia on horticulture and pasture management (2027–2029). Throughout, it is advisable for all state-funded agricultural projects to publish ex-ante IRR calculations and summary indicators (from 2027), so that the evidence base for future adaptation is stronger than the one available for this study.

Closing Gaps in the Evidence Base A quantitative meta-analysis should follow as more IRR and NPV data become available. CAMP4ASB and RESILAND beneficiaries should be followed over the long term; GCC-specific adaptation pilots should be designed and evaluated against baselines; and the political economy of water governance in both regions deserves separate treatment. These are tasks for a research program, not for a single paper.

Conclusions

Principal Findings This comparison suggests that, in water-scarce agriculture, project success depends less on deploying technology than on particular institutional design choices. In the cases examined, demand-driven mechanisms and binding

gender targets set at appraisal were associated with stronger outcomes than top-down, infrastructure-heavy approaches. Benefit-sharing rules and regional coordination platforms gave beneficiaries a stake in the results and helped avoid the incentive problems that have undermined many large irrigation projects. Central Asian projects offer a useful stock of design features, but applying them in the GCC will require careful adaptation to its different labor markets, land tenure arrangements, and fiscal conditions. I read the evidence as supporting a modest claim: design features can travel, but only when their institutional function is preserved and their form is allowed to change.

Limitations and Future Research These conclusions are subject to the limitations described in the Methods: uneven economic data, projects at different stages of completion, reliance on self-reported MDB documentation, purposive case selection, author-only coding, and the absence of counterfactuals. They should be applied with care beyond the six cases examined here. Future research could undertake a quantitative meta-analysis as more IRR and NPV data become available, follow CAMP4ASB and RESILAND beneficiaries over the long term, design adaptation pilots specific to the GCC, and examine the political economy of water governance in both regions.

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Declarations

Author Contribution

All stages of article preparation were carried out by a single author.

Clinical trial number

Not applicable. This study did not involve human participants, animals, or plants, and no ethical review or informed consent was required.

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Figures

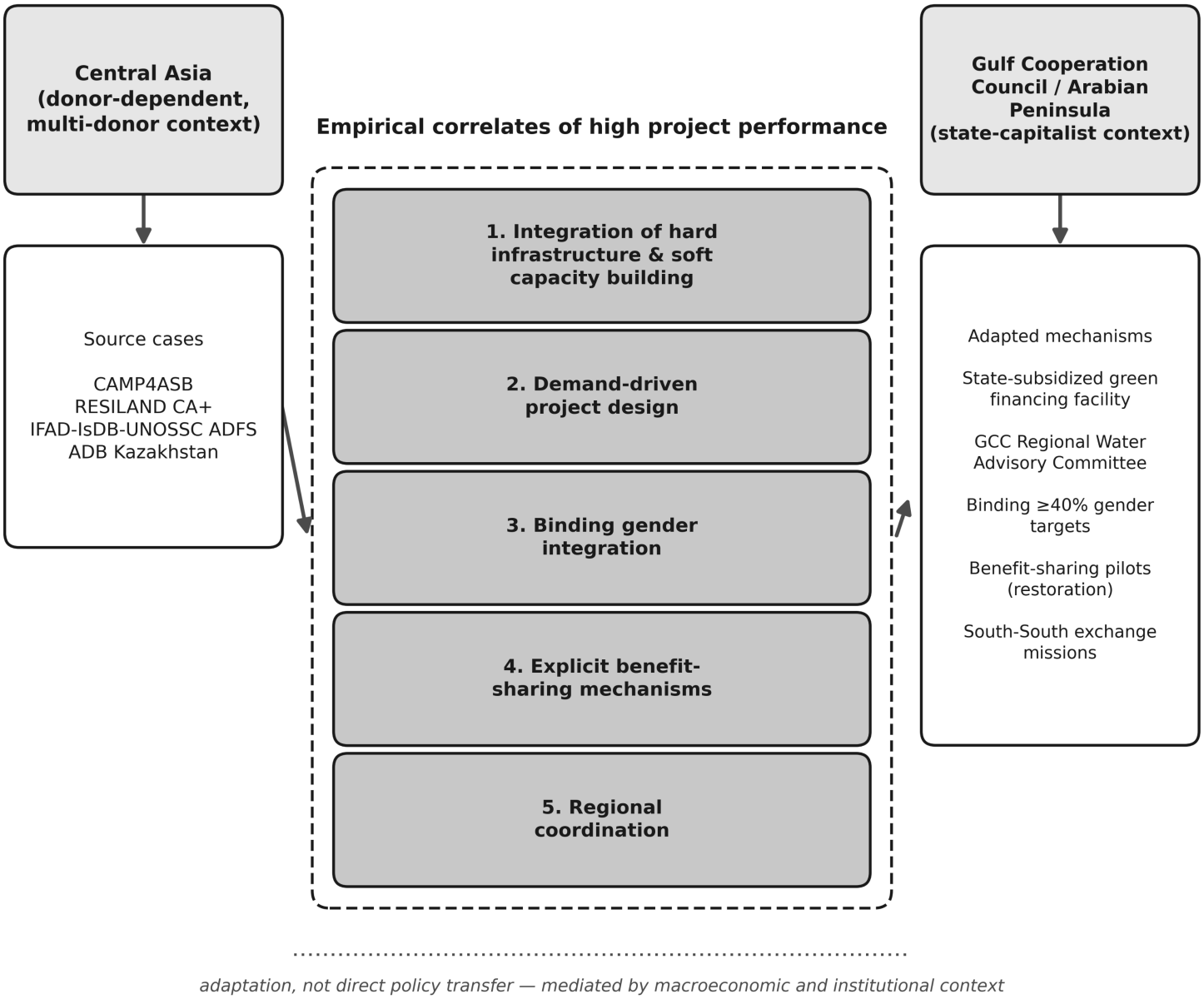


Figure 1

Conceptual framework for adapting institutional design mechanisms from Central Asia to the GCC. The framework illustrates the transition from donor-dependent contexts to state-capitalist models, mediated by five core correlates of high performance