

Indigenous Knowledge & Climate Action in the MENA Region

Examining economics, migration, and conflict as they apply to
Indigenous Knowledge Systems

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Abstract

Indigenous Knowledge Systems (IKS) are a crucial element of mitigating the effects of climate degradation. Through a global literature review, this paper examines the intersection between place-based and globalized knowledge to inform how IKS can be incorporated into policy in the Middle East and North Africa (MENA) region under three main subtopics: economics, migration, and conflict governance. Eight case studies written by the Corioli Institute in partnership with the International Organization for Migration (IOM) informed our understanding of the current status of Indigenous communities. Our inquiry into the economic case for IKS found that IKS can aid in water resource management, disaster risk reduction strategies and disaster recovery costs, and climate adaptation policy. When examining the nexus between Indigenous Knowledge Systems and migration, it becomes clear that IKS can be integrated into policy to create more resilient communities, and combining IKS with modern scientific knowledge can strengthen the abilities of both. Finally, in considering the role of Indigenous Knowledge Systems and governance structures in times of conflict, we suggest embedding IKS into agricultural processes as well as formal governance structures for conflict resolution and resource management.

Introduction

For decades, climate change has impacted communities across the globe, leading to dangerous temperatures, the loss of natural resources, and worsened human health. These effects disproportionately impact Indigenous communities, whose livelihoods are often deeply intertwined with nature and the environment. In this paper, we define Indigenous Knowledge Systems (IKS) as place-based knowledge, practices, institutions, and norms through which Indigenous, traditional, and other locally rooted communities manage land, water, livelihoods, mobility, conflict, and environmental change across generations.

The term is not limited to peoples who meet a formal legal definition of “Indigenous,” but encompasses a wide range of communities whose knowledge systems are historically embedded, collectively maintained, and central to how they govern social and ecological life. IKS have been providing communities with means to understand and interact with the physical environment for centuries, including changing weather patterns, maintaining sustainable and healthy ecosystems, and supporting biodiversity. These become increasingly important in the face of climate change. However, institutional climate policy has often failed to respond comprehensively to a worsening climate, often neglecting or threatening the delicate relationship between Indigenous communities and their environment. The prolonged lack of consideration for IKS in policy has aggravated climate degradation for communities dependent on these mitigation techniques. Our research examines the intersection between place-based and globalized knowledge to inform how policymakers can incorporate IKS to better mitigate the harmful impacts of climate change.

Our project draws upon eight case studies produced by the Corioli Institute and the International Organization for Migration (IOM). The scope of these case studies led us to focus our research on the Middle East and North Africa (MENA) region. These case studies helped us understand the crucial ways that Indigenous Knowledge Systems could influence local climate outcomes in the MENA region. We focus on three main themes within the case studies: the economic case for IKS; the nexus between IKS and migration; and IKS and governance structures in times of conflict.

We conducted a literature review to research how IKS are incorporated into policy globally, which provided insight into how IKS could better be utilized in the MENA region. IKS are place-based, and practices cannot be directly transferred to different climates and agricultural cultivation systems. However, an understanding of how indigenous knowledge is supported and incorporated into policy around the world can inform how IKS could be integrated into policy in the MENA region. We used our global literature review to inform local recommendations based on the issues that appeared in the case studies that focused on this region.

The first of the three main themes this paper focuses on is the economic case for IKS. Policymakers often use economic rationale, like cost-benefit analysis, to justify implementing certain policy measures. With our research, we hope to show that these exact frameworks can also be used to advocate for integrating IKS in policymaking. While IKS are not widely considered for their economic advantages, we find that their implementation could lead to long-term economic benefits by reducing costs associated with natural disasters, biodiversity loss, and agricultural infrastructure.

The second main theme is the migration case for IKS. Across the globe, droughts, flooding, fires, and other natural disasters have become more and more common as climate change worsens, forcing many people out of their homes.¹ This issue is even more prevalent among Indigenous groups, whose displacement leads to a loss of long-standing knowledge, resources, and ways of life. This problem inspired us to research the relationship between IKS and migration, asking how IKS can be safeguarded to prevent the loss of Indigenous knowledge through migration.

Lastly, we also investigated how IKS can mitigate the destructive consequences conflict has on communities. Indigenous knowledge offers valuable conflict resolution frameworks that could be integrated with existing policy structures to navigate resource governance. Given that conflict significantly damages infrastructure and destroys natural resources, which are already under stress due to climate change, leveraging IKS could strengthen communities and reduce the environmental factors underlying regional disputes. We examine the intersection of governance and conflict to understand the role of IKS in mitigating conflict and conflict-induced environmental destruction.

¹ McFee 2023



Economic Case for IKS

Introduction and analytical framing

Climate adaptation and development policy increasingly confront a practical economic question: How can climate-vulnerable communities reduce losses, protect livelihoods, and strengthen resilience without relying exclusively on high-cost, externally designed interventions? In this context, the evidence reviewed suggests that Indigenous knowledge is not marginal to the policy debate. Where it is recognized and supported, it can help reduce exposure to climate risk, limit environmental degradation, strengthen local production systems, and lower the recurring costs of crisis response and recovery.

This subsection argues that the economic case for Indigenous Knowledge Systems lies in their contribution to prevention, resilience, and long-term sustainability. Across water management, land stewardship, disaster risk reduction (DRR), and livelihood adaptation, these systems help communities manage climate stress in ways that can reduce both immediate losses and longer-term public expenditure. The implication is not that they replace state investment, but rather, that climate and development spending is more effective when it builds on locally embedded practices and governance arrangements rather than overlooking them.

Context

The economic impacts of climate change are being increasingly felt throughout regions facing water scarcity, climate stress, and constrained state capacity. The Middle East and North Africa (MENA) region illustrates these dynamics sharply. Regional temperatures increased by approximately 0.2°C per decade between 1961 and 1990, above the global mean, and climate projections point to further warming, higher evapotranspiration (transfer of water from the soil to the atmosphere), and more frequent drought conditions across Mediterranean and arid zones.²

² Waha et al., 2017

Given that much of the region receives less than 300 mm of annual rainfall and that rain-fed systems remain central to agricultural production, climate-induced water stress has direct implications for output, incomes, and fiscal stability.³ Estimates suggest that agricultural production losses in the region could reach an average of 0.5 percent of GDP by 2050, with country evidence from Syria and Tunisia already demonstrating yield decline and household income loss under drought conditions.⁴

In these regions, the economic significance of incorporating IKS becomes especially clear. Research on Indigenous stewardship demonstrates that lands governed through Indigenous management often sustain biodiversity levels comparable to, or higher than, adjacent protected areas.⁵ Other studies suggest that investment in Indigenous-managed land and sea programs can generate both environmental gains and positive economic spillovers for local enterprises.⁶

In disaster risk reduction (DRR) literature, the same logic appears in a different form: avoided-loss frameworks consistently show that preventive adaptation is less costly over time than repeated post-disaster response and reconstruction.⁷ Taken together, these findings support a broader proposition. The economic value of IKS lies in its ability to sustain ecological and institutional conditions that prevent economic losses over time.

IKS, water scarcity, and the economics of sustainability

The strongest entry point for understanding the economic contribution of IKS is water. In water-scarce environments, climate stress produces both physical water scarcity, through declining or increasingly variable supply, and economic water scarcity, through weak infrastructure, poor maintenance, and institutional failures that prevent reliable access even where water exists.⁸ When leveraged effectively, IKS can address both dimensions because it brings together technical practices with collective governance arrangements.

³ Selvaraju 2013

⁴ Breisinger et al. 2013

⁵ Garnett et al. 2018

⁶ Jarvis et al. 2018

⁷ UNDRR 2015; Global Commission on Adaptation 2019

⁸ International Organization for Migration 2023

In arid parts of Yemen, for example, communities have long used *wadis*, dry streams that catch and direct water flow, and macro-catchment water-harvesting systems to collect water runoff from precipitation events and sustain agriculture under highly variable rainfall conditions, as shown in.⁹ In Oman, the *aflaj* system, which consists of channels that provides water for villages, combines hydrological traditional knowledge with collective frameworks of sustainable allocation and distribution, thereby connecting resource access to community administration rather than to infrastructure alone.¹⁰ Research has found that aflaj systems work under a common pool resource framework, in which collective action and social hierarchies are informed by traditional knowledge, ensuring an equitable and effective collective management.¹¹ These practices illustrate an important policy point: Indigenous water systems are socio-ecological systems in which infrastructure, labor, rules, and legitimacy are tightly connected. Their durability depends on collective stewardship, but precisely for that reason they often perform functions that externally provided infrastructure struggles to sustain. External intervention is necessary to safeguard IKS, and can be used to apply these strategies to different communities that could benefit from their implementation.

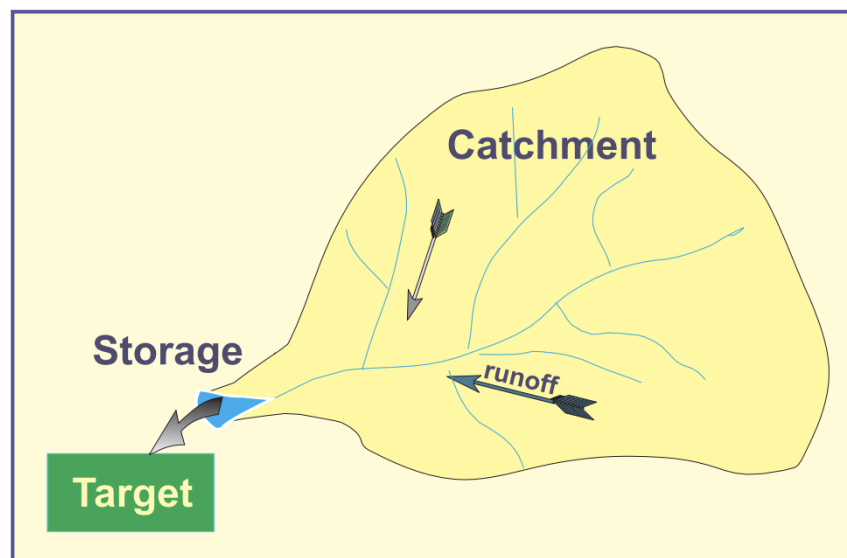


Figure 1: Wadis and macro-catchment water-harvesting systems¹²

⁹ Oweis et al. 2001

¹⁰ Kanbour 2003

¹¹ Remington 2018

¹² Oweis et al. 2001

This distinction becomes clearer when set against conventional intervention models. Across several cases in the underlying material, government or donor-supported water infrastructure improved access in the short term but proved difficult to maintain. In Turkana County, Kenya, pumps and water systems that initially improved access later fell into disrepair because no durable maintenance system existed around them. Similar patterns were reported for externally supported community projects whose long-term viability depended on continued funding or outside servicing rather than local ownership and technical continuity.¹³

By contrast, where water infrastructure was coupled with community-led management mechanisms legitimized through indigenous practices, such as water committees and locally recognized governance structures, sustainability improved because authority and accountability remained embedded within the community.¹⁴ For policymakers, this suggests that infrastructure spending without community governance can create fragile systems with high failure risk and, ultimately, poor socioeconomic returns. When local systems of knowledge are not embedded in infrastructure projects, the maintenance, ownership, and decision-making around water infrastructure can quickly fall into disrepair or disuse, risking turning scarce public and donor investment into wasted resources. In this context, IKS becomes a driving force for addressing both physical and economic water scarcity through coordinating community efforts and governance arrangements that allocate scarce resources efficiently within communities.

IKS as preventive economic infrastructure for disaster risk reduction

The economic case for IKS is equally strong when viewed through the lens of DRR. Formal DRR policy often privileges response and recovery, even though the long-term fiscal burden of reactive approaches is well established. A more holistic approach integrating IKS shifts the focus to mitigation and adaptation. It supports continuous, low-cost, context-specific practices that reduce exposure before hazards become disasters, thereby limiting both direct damage and downstream recovery expenditure.

¹³ International Organization for Migration 2023; International Organization for Migration 2024

¹⁴ International Organization for Migration 2024

In the Turkana region of Kenya, communities have used terraces and gabions, which are wire mesh cages filled with rocks that slow water flow and reduce erosion, to manage runoff and floodwaters, reducing erosion and protecting productive land before losses accumulate. In Libya and Afghanistan, local rainwater harvesting, soil conservation, reforestation, and community-based early warning systems have been documented as practical measures for stabilizing land use and reducing the impacts of floods and droughts.¹⁵

These practices are significant because they are, similar to water management systems, embedded in local patterns of observation, labor mobilization, and risk management. They often cost less than large-scale engineered responses while helping communities avoid the kinds of cascading losses that trigger humanitarian dependence and expensive reconstruction.

Preventive ecosystem management reduces exposure to shocks, while adaptation investments generate fiscal savings through avoided losses.¹⁶ Indigenous stewardship also helps preserve the ecosystem services that make landscapes less hazard-prone in the first place, including soil retention, water regulation, vegetation cover, and biodiversity. Where such stewardship is weakened or displaced, shocks are more likely to escalate into high-cost crises.

Wildfire management provides one of the clearest illustrations of the preventive value of IKS. Research on cultural burning, which is an Indigenous land management practice involving low-intensity, controlled burns conducted during safer seasonal conditions, shows that frequent, early-season fire regimes reduce fuel accumulation, break fuel continuity, and lower the likelihood of high-severity wildfire behavior.¹⁷ In practice, these approaches create patchier landscapes that are less likely to sustain fast-moving, large-scale fires; for example, Indigenous cultural burning traditions in fire-prone landscapes have long used controlled, low-intensity burns to clear understory fuel before peak fire season, thereby reducing the intensity of later wildfires.¹⁸

¹⁵ International Organization for Migration 2024; International Organization for Migration 2025; International Organization for Migration 2022

¹⁶ United Nations Office for Disaster Risk Reduction 2015; Global Commission on Adaptation 2019

¹⁷ Lake & Christianson 2019; Fernández-Guisuraga & Fernandes 2024; Stephens et al. 2020

¹⁸ Lake & Christianson 2019

Wildfires are a comparatively smaller but growing climate risk within the MENA region, and affect the eastern Mediterranean belt of Turkey, Israel/Palestine, Lebanon and Iran much more than the more arid Arabian Peninsula and North Africa. However, those more forested areas have seen increases in wildfires severity, as the average burn acreage per year Turkey experienced between 2015-2024 was 190% increase compared to 2005-2004. Moreover, wildfires and floods cost the country \$232 million in 2021 alone, underscoring the wider fiscal burden within which wildfire risk must be understood.¹⁹ Studies comparing fire management strategies likewise suggest that preventive fuel treatment can reduce long-term suppression costs and infrastructure losses relative to reactive suppression alone.²⁰

Biodiversity, land governance, and long-term economic resilience

The advantage of privileging IKS becomes particularly visible when biodiversity is understood as a productive asset. Biodiversity is often treated as an environmental issue separate from core development concerns, yet biodiversity loss has material economic consequences through its effects on food systems, soil health, water regulation, and climate resilience. Indigenous-managed lands frequently maintain ecological complexity in ways that support long-term productivity.

Traditional systems such as rotational farming, agroforestry, pastoralism, and multi-cropping can reinforce food security while conserving ecological diversity.²¹ These systems differ fundamentally from extractive or standardized land-use models that prioritize short-term output at the expense of long-term resilience. Traditional farming systems can reduce the costs associated with land degradation and ecological decline. Secondly, they can preserve the ecological services on which local economies depend.

This relationship between ecological and economic resilience is also institutional. The literature suggests that Indigenous stewardship produces stronger economic and political outcomes where

¹⁹ World Bank 2014; Sedano et. al 2025; Business Insurance 2021

²⁰ Hernandez et al. 2024

²¹ Magni 2017

land rights, participation, and governance authority are secure.²² Where such conditions are absent, the benefits of IKS are harder to sustain because communities lack the legal and political space required to govern resources according to locally tested practices. Recognizing Indigenous land and resource governance can reduce future degradation costs while strengthening rural resilience over time. Beyond the responsibility to protect biodiversity, policymakers are well-served when they recognize the interconnectedness of government stewardship and economic resilience.

Livelihood diversification and local economic recovery under climate stress

Climate change places pressure on infrastructure and ecosystems and the economic viability of everyday production systems alike. When rain-fed agriculture, grazing, or water-dependent livelihoods become less reliable, communities can often turn to alternative income sources and subsistence strategies embedded in their IKS that remain viable under changing ecological conditions.

Studies suggest that this pattern is already visible in practice. In Jordan, traditional beekeeping, agroforestry, rainwater collection, and greywater reuse continue to support rural livelihoods even as climatic pressures make conventional agricultural production less stable.²³ And, parallel to strategies employed in the MENA region, in Kenya, communities affected by decreasing agricultural yields due to water scarcity and climate change have turned to traditional income sources such as harvesting wild fruits and vegetables, collecting grass, and using locally available materials to sustain both food access and income generation.²⁴ These examples indicate that IKS can help convert ecological familiarity into economic flexibility, providing pathways for localized recovery and resilience when conventional systems fail.

At the same time, these alternative strategies have limits: Some IKS-based livelihood activities remain highly dependent on natural resource availability and may become less viable under worsening ecological stress. Others, such as charcoal production, may create secondary

²² Magni 2017; OECD 2019

²³ International Organization for Migration 2025 (Human Mobility)

²⁴ International Organization for Migration 2024

environmental risks if pursued without sustainable management. The policy question is therefore how traditional livelihood strategies with demonstrable resilience value can be supported through market access, extension services, and integration into broader rural development frameworks. When treated as emergency coping mechanisms, these practices remain marginal but when recognized as part of economic resilience policy, they can contribute to more durable local adaptation.

Limits, cautions, and policy implications

The evidence bolstering the economic case for IKS is compelling, but uneven. In many areas, qualitative findings are stronger than precise comparative estimates of avoided losses or cost savings. Some practices are labor-intensive and depend on robust local institutions, which may themselves be weakened by conflict, displacement, or social fragmentation. Rapid climatic change may also reduce the reliability of historically grounded indicators and management patterns. For this reason, IKS should be adapted to new conditions and combined with scientific and technical support to bolster traditional systems with evidence-based indicators.

IKS are also most effective when approached as a complement to formal systems: a source of preventive capacity, institutional legitimacy, and locally grounded design that can improve the effectiveness of public investment. In this respect, the costliest policy failure is ignoring knowledge systems already performing economically relevant functions.

Recommendations

1. Position IKS-based livelihood strategies within rural economic resilience policy. Livelihood diversification rooted in Indigenous practice should be incorporated into rural resilience and local economic recovery policy. This means linking such strategies to market access, extension services, training, and relevant agricultural or natural resource support systems, so that viable IKS-based activities can contribute to more durable and climate-resilient local economies.

2. Government policies should aim to integrate IKS formally into climate adaptation and DRR frameworks such as community-based monitoring, IKS-based forecasting strategies, local stewardship systems and co-governance of these strategies through planning, implementation and evaluation processes. National and regional adaptation efforts and DRR frameworks should acknowledge IKS as a substantive component of resilience planning.
3. Prioritize state investment in water infrastructure with community-based governance and maintenance systems. In water-scarce settings, water infrastructure management often includes support for local management institutions, maintenance systems, and technical training. These micro-level interventions, when successful, should be integrated into and financially resourced by national adaptation plans and climate security policy to ensure scalability and sustainability. Policy should also account for Indigenous water-sharing norms and locally embedded allocation practices, which can improve system durability, strengthen legitimacy, and reduce the recurrent costs associated with infrastructure breakdown or underuse.
4. Rebalance public and donor financing toward preventive, locally led resilience measures. Public and donor financing should place greater emphasis on prevention rather than concentrating predominantly on post-disaster recovery and reconstruction. This includes expanding support for ecosystem management, land stewardship, community-based early warning, and other locally grounded resilience measures that can reduce exposure, limit future losses, and lower recovery costs over time.
5. Recognize Indigenous land and resource governance within biodiversity and land-use policy. Biodiversity and land-use policy should treat Indigenous land and resource governance as a core enabling condition for long-term ecological resilience. This may include securing land rights, formally recognizing community governance institutions, supporting stewardship through direct finance, and using instruments such as payments for ecosystem services

where appropriate. Such measures can strengthen both conservation outcomes and the economic resilience of local production systems.

6. Governments, development partners, and NGOs should support more systematic evidence generation on the economic value of IKS in adaptation and resilience policy as a means of expanding the knowledge base. Priority should be given to mixed methods comparative research that measures avoided losses, reduced recovery costs, ecosystem service value, and implementation efficiency, so that policy design and financing decisions are based on clearer evidence of where IKS delivers measurable returns.



The Nexus Between IKS and Migration

Introduction

Climate-related mobility is often discussed primarily in terms of crisis, instability, and humanitarian concern. Yet, for many Indigenous, pastoral, and rural communities, mobility has long formed part of how environmental variability is managed. Decisions about whether to stay, move seasonally, relocate temporarily, or disperse livelihoods across space are rarely determined by climate conditions alone. They are mediated by access to land and water, social support networks, customary institutions, local early warning systems, and shared interpretations of environmental change. In other words, they are shaped by local knowledge systems.

This subsection argues that IKS influence mobility and migration in three principal ways. First, it supports adaptation in place by helping communities sustain food systems, manage water, and reduce the risks that drive forced migration. Second, the Indigenous forms of adaptive mobility are socially legitimate and ecologically rational with effective resource governance and institutional support. Third, it affects how climate information is interpreted and acted upon, including whether warnings are trusted early enough to support orderly decisions rather than crisis displacement. Climate migration policy becomes more effective when it recognizes these roles and less effective when it treats mobility as a purely technical or security-related concern detached from local systems of knowledge and governance.

Context

Migration in the context of climate change can complicate local dynamics. The arrival of migrating populations may cause tensions with existing communities, create governance challenges, and lead to confusion and inequities in natural resource management and access.²⁵ At the same time, mobility should not be understood as a failure of adaptation. In many Indigenous societies, migration has

²⁵ McFee 2023

long functioned as a cultural and livelihood strategy for responding to seasonal climate variability, unpredictable weather, and resource scarcity.²⁶

The relevance of IKS to migration policy emerges most clearly in settings where climate stress compounds existing political and social fragility. In Libya, Sudan, Yemen, and other climate-vulnerable contexts reviewed in the source material, environmental degradation interacts with conflict, weak public institutions, livelihood insecurity, and unequal access to resources (McFee, 2023). For Indigenous and rural communities whose livelihoods are directly tied to land, pasture, forests, and water systems, climate change acts as a disruptor to the material and institutional foundations of social life.²⁷

Migration in such contexts often produces layered consequences. Out-migration can weaken community institutions and interrupt the intergenerational transmission of knowledge. In-migration can place pressure on resources, alter local power relations, and generate new tensions around land, water, and service provision.²⁸ Furthermore, climate stress and migration can create a positive feedback loop: environmental decline undermines livelihoods and increases displacement pressure; displacement then erodes the very knowledge systems and social arrangements that would otherwise support future adaptation.²⁹ Despite this evidence, many climate mobility frameworks continue to emphasize humanitarian management of displacement after the fact while paying insufficient attention to the root causes that influence whether mobility remains adaptive or becomes distress-driven.

IKS, adaptation in place, and the prevention of forced migration

The first contribution of IKS to climate mobility governance lies in its role in reducing the pressures that force people to move under duress. Forced migration is rarely caused by climate hazards in isolation. It tends to emerge when environmental stress combines with food insecurity, livelihood

²⁶ Muyambo 2019

²⁷ UN Inter-Agency Support Group on Indigenous Peoples' Issues 2008

²⁸ International Organization for Migration 2024; McFee 2023

²⁹ Ibid.

collapse, or institutional breakdown. Where IKS helps households maintain viable local livelihoods, it can therefore reduce the conditions under which migration becomes involuntary.

Agriculture and food systems are central in this dynamic. Indigenous practices such as crop diversification, agroforestry, seed selection, soil management, small-scale water conservation, and traditional food storage can strengthen resilience under climate variability.³⁰ In Bangladesh, micro-level practices including the use of neem leaves for grain storage, tobacco dust for pest control, and locally adapted field management techniques were reported to be widely used by farmers to maintain food security under stress.³¹ These practices can be significant to policy—when food systems are preserved, households are less likely to face the sudden livelihood collapse that pushes them toward crisis movement. For example, in Bangladesh, indigenous practices affect the capital assets of farmers, which farmers can leverage to influence the relief resources they receive from the government.³²

Traditional seed systems can similarly reduce agricultural migration pressures. Drought-resilient Indigenous varieties can sustain production under conditions in which standardized commercial seeds perform poorly, thereby reducing food-driven migration pressure.³³ More broadly, the integration of IKS into adaptation policy is necessary to address the limitations of purely technocratic and standardized “climate-smart” interventions. Such approaches may generate short-term gains, but they can also produce maladaptive effects when they displace locally adapted practices with uniform technical packages that do not match local ecological and social conditions, including in seed systems where Indigenous varieties may be better suited to drought, soil variability, and storage under stress.³⁴

Mobility and adaptation: IKS as social and institutional infrastructures

³⁰ Makate 2019; Barua & Eslamian 2021

³¹ Barua & Eslamian 2021

³² Ibid.

³³ UNDP 2023

³⁴ Felipe Pérez & Tomaselli 2021; Makate 2019

Climate mobility policy also needs to distinguish more clearly between distress displacement and adaptive mobility. In many Indigenous and pastoral systems, movement is not a sign of failure but a long-standing strategy for managing uncertainty. Seasonal migration, transhumance, labor dispersal, and temporary relocation have historically enabled communities to respond to rainfall variability, pasture scarcity, and shifting livelihood conditions without severing social or territorial ties.

Whether such mobility remains viable depends on the institutions that regulate it. In places like Yemen and Libya, customary land access rules, negotiated water-sharing arrangements, kinship networks, reciprocal obligations, and recognized local authorities help structure when movement occurs, who can move, and on what terms. These arrangements function as a form of mobility infrastructure, making movement more orderly, legitimate, and sustainable.³⁵ Among the Frafra of northern Ghana, for example, migration has historically operated as part of a relational ecological system rather than as a simple exit from environmental stress.³⁶

This distinction matters for policy because maladaptation often occurs when formal institutions disrupt adaptive movement systems. Sedentarization policies, restrictive border controls, relocation schemes that ignore grazing routes, and interventions that treat movement as disorder rather than adaptation can all make mobility more precarious and conflict-prone.³⁷ When customary systems are weakened, migration may become less governed by reciprocity and local legitimacy and more shaped by insecurity, exclusion, and competition over resources. Recognizing adaptive mobility therefore requires legal and institutional arrangements that protect land and water access, support negotiated movement, and allow climate-affected communities to use mobility strategically.

Legitimacy and knowledge systems influencing mobility

A third way in which IKS influence mobility lies in how communities interpret warning signs and decide when action is necessary. Climate information influences action when it is trusted, intelligible,

³⁵ McFee 2023; International Organization for Migration 2024

³⁶ Amo-Agyemang 2022

³⁷ Makate 2019; Felipe Pérez & Tomaselli 2021

and connected to the terms through which people already understand environmental change.³⁸ In many rural and Indigenous settings, purely technical forecasting systems can fail to meet those conditions. If warnings are perceived as abstract, externally imposed, or disconnected from lived experience, they may not trigger timely adaptation. In many indigenous contexts, purely technical satellite data is often dismissed as “backward” or disconnected from local realities, leading to lower adoption rates of safety protocols.³⁹ Under such circumstances, households are more likely to respond late and under duress.

In this context, IKS offer a basis for informational legitimacy. Ethno-meteorological indicators, including changes in cloud patterns, animal behavior, flowering cycles, and other locally observed signals, form part of longstanding systems of environmental monitoring.⁴⁰ On their own, such indicators may be increasingly strained by rapid climatic change. Yet when they are combined with scientific forecasting, they can produce more trusted and actionable systems of early warning. Existing literature refers to this as a “Two-Eyed Seeing” approach: one that brings Indigenous observation and scientific analysis into deliberate relationship rather than privileging one and dismissing the other.⁴¹

This hybrid model has practical implications for mobility. Rao and Patil state that, in India, community-based information systems such as Village Knowledge Centers combined localized forecasts, crop planning guidance, and risk communication demonstrating how climate information can be delivered in ways that communities regard as relevant and credible.⁴² Advisories that were disseminated by these local knowledge centers helped avoid yield losses, demonstrating the potential of a dual approach to aid in decision making during droughts.⁴³ Where warning systems are seen as legitimate, people are better able to decide whether to remain in place, adjust production strategies, move temporarily, or protect assets before a crisis escalates. In migration policy terms, the value of

³⁸ Dorji 2024; Kalanda-Joshua 2011

³⁹ Makate 2019; Nhemachena 2011

⁴⁰ Kalanda-Joshua et al. 2011

⁴¹ Dorji et al. 2024

⁴² Rao & Patil, 2023

⁴³ Sreedhar et. al 2009

such systems lies in reducing uncertainty and enabling mobility decisions to be made earlier, with greater agency and less distress.

Gendered mobility, unequal risk, and the erosion of knowledge systems

A holistic, integrated account of IKS and climate mobility policy should also consider migration's differential effects on gender. Climate-induced mobility tends to be experienced unevenly because gender norms shape who can move, who remains behind, who carries the burden of adaptation, and whose knowledge is recognized in formal systems. In many pastoral and Indigenous contexts, men are more likely to migrate in search of income, pasture, or water, while women remain responsible for sustaining households under increasingly difficult environmental conditions. Evidence from Kenya, Sudan, and Afghanistan suggests that these dynamics intensify under climate stress, leaving women to absorb expanding burdens of water collection, caregiving, food provision, and local resource management while facing their own mobility constraints.⁴⁴

In addition to the social burden, there are epistemic and institutional implications. Women often hold critical knowledge related to seed systems, water management, food storage, household resource allocation, and the everyday practices through which ecological knowledge is reproduced. When women are excluded from planning processes, when legal or bureaucratic barriers restrict their movement, or when climate stress consumes the time and security needed to sustain these practices, the transmission of IKS themselves are weakened.⁴⁵ This dynamic is particularly pronounced in relation to water collection and service access, where women and girls may face long travel distances, insecurity, or exclusion from assistance channels that are not designed around their circumstances.

A key takeaway for policy is that gender responsiveness cannot be reduced to representation alone. Climate mobility frameworks need to recognize women as central knowledge holders within the fabric of IKS, address the legal and administrative barriers that constrain their adaptation options in

⁴⁴ International Organization for Migration 2024; McFee & Agrawal 2026; Al-Qaryouti & McFee 2025

⁴⁵ Pérez & Tomaselli 2021; IOM 2024; McFee 2023

culturally appropriate ways, and ensure that mobility governance reflects the differentiated risks borne by those who remain as well as those who move.

Limitations and policy implications

As in the previous subsection on the economic case for IKS, a balanced analysis requires caution. IKS are not static, and rapidly changing climatic conditions may undermine some historically reliable indicators or mobility patterns. Nor can locally grounded knowledge be generalized across contexts without losing the specificity that makes it effective. Structural constraints such as conflict, land dispossession, documentation barriers, and restrictive mobility regimes may also prevent communities from using adaptive strategies even when such strategies are known and desired.

The broader lesson is that IKS are place-based because they are relational: tied to ecosystems, social networks, and repeated practices of use. Displacement can therefore erode adaptive capacity even when it provides short-term physical safety. Migration governance that measures success only in terms of relocation, registration, or service access may fail to capture this deeper loss. Effective climate mobility policy must therefore treat migration as bound up with community knowledge, institutions, and rights.

The most effective approach is one that combines formal planning with locally grounded systems of observation, governance, and mobility practice. Consequently, the policy challenge is twofold: first, to reduce the pressures that produce distress displacement; and second, where mobility does occur, to protect the institutional and social conditions under which knowledge can be retained, adapted, and transmitted.

Recommendations

1. Require formal roles for customary and community institutions in climate mobility governance. National and regional climate mobility, adaptation, and displacement frameworks should assign customary institutions, pastoral councils, community leaders, and

other locally legitimate bodies defined roles in consultation, implementation, and review. This should include participation in local risk assessments, mobility planning, resource allocation decisions, and post-displacement recovery processes.

2. Develop hybrid early warning and seasonal planning systems that communities can act on. Governments and development partners should combine scientific forecasting with Indigenous and local indicators in early warning, seasonal planning, and public communication systems. These systems should deliver localized information on rainfall, water availability, crop timing, pasture conditions, and hazard risk in formats that support practical decisions on planting, asset protection, temporary movement, and livelihood adjustment.
3. Protect adaptive mobility through legal access and conflict-sensitive resource governance. Where pastoral movement, seasonal migration, transhumance, or temporary relocation function as adaptive responses to climate stress, policy should protect them through negotiated access to land and water, recognition of customary routes and use rights, and administrative measures that reduce unnecessary restrictions on movement. These changes may increase the likelihood of violence; governance arrangements should also proactively include dispute-resolution mechanisms to reduce conflict in areas of transit and destination.
4. Local governments should embed Indigenous food systems and livelihood practices in migration prevention policy. Climate mobility policy should treat Indigenous agriculture, traditional seed systems, small-scale water conservation, food storage practices, and locally grounded livelihood strategies as part of the preventive core of migration governance. Public support should link these systems to extension services, relevant inputs, and adaptation finance so that households can maintain production and income under climate stress.
5. Local governments should make gender responsiveness operational across climate mobility policy. Climate mobility frameworks should move beyond generic inclusion commitments and address the specific constraints women face as knowledge holders, service users, and

adaptation actors. This should include reducing barriers to women's access to documentation, mobility options, water and agricultural support services, and decision-making spaces, while ensuring that evidence collection considers the differentiated impacts of mobility and immobility on women and girls.

6. Governments and international actors should treat secure rights to land, water, and local governance authority as enabling conditions for both adaptation in place and orderly mobility. This includes recognizing community and customary tenure arrangements, protecting access to shared resources, and ensuring that relocation, land-use, or border policies do not sever communities from the ecological and institutional systems on which resilience depends.
7. Climate mobility monitoring systems should track not only population movement and service access, but also the effects of displacement on intergenerational knowledge transfer, intragroup sociocultural practices, customary institutions, social support networks, and everyday resource practices in both origin and destination areas. This would allow policy to identify where adaptive capacity is being eroded and where targeted support is needed to sustain community-based resilience.

IKS and Governance Structures in Times of Conflict

Introduction

Existing research on armed conflict and the environment often focuses on physical destruction and its effects on livelihoods. Yet, as with the forced migration discussed in the previous subsection, conflict also degrades the social and institutional arrangements through which communities regulate access to scarce resources, organize maintenance, and contain disputes before they escalate. The cumulative effect is a dual erosion: of ecosystems, and of the governance systems designed to protect them. Armed conflict damages ecosystems and infrastructure while simultaneously undermining the local governance arrangements through which those resources are allocated, maintained, and restored.

Socioinstitutional resource governance such as customary water-sharing rules, pastoral access norms, dispute-resolution practices, and community institutions for land, irrigation, and collective maintenance all help shape how environmental stress is managed, particularly where formal institutions are weak, contested, or disrupted by violence.⁴⁶ In this subsection, we argue that Indigenous Knowledge Systems (IKS) are policy-relevant in conflict settings because they are embedded in local environmental governance.

Our analysis proceeds in three steps. First, we show how conflict erodes IKS through environmental destruction and institutional breakdown. Second, we explain why environmental degradation worsens when local governance loses authority, reach, and legitimacy. Finally, we draw out the implications for environmental governance and recovery in conflict-affected settings.

Context

In conflict settings, environmental damage is not confined to land, crops, or water sources. Controlling or disrupting access to resources is often a tool leveraged during conflict, affecting the

⁴⁶ International Organization for Migration (CCM Study) 2023

infrastructure through which water and other resources are accessed, distributed, and maintained. When irrigation networks, pipelines, wells, and sanitation systems are disrupted, service provision declines, maintenance becomes more difficult, and access often grows more unequal. These pressures, in turn, strain the local institutions through which scarcity is managed and disputes are contained. Yemen and Libya offer two stark examples of this dynamic.⁴⁷

In Yemen, armed conflict has damaged water sources and infrastructure, disrupted environmental legislation and programming, and weakened environmental institutions. Water has also been used as a weapon of war. Damage to water systems in Al Hodeidah and Marib has produced shortages and increased the cost of water trucking. In that context, the finding that water disputes account for 70–80 percent of rural conflicts illustrates how war and water scarcity can reinforce one another.⁴⁸

The same problem has occurred at a larger scale in Libya. The country depends heavily on the Great Man-Made River Project, which by June 2023 supplied 6.5 million cubic metres of fresh water per day to nearly 7 million people through 13,000 deep wells and more than 2,800 kilometres of pipelines.⁴⁹ Water infrastructure has been leveraged in times of civil conflict; between 2011 and 2021 water infrastructures were targeted 49 times.⁵⁰ Armed conflict has additionally repeatedly interrupted supply, damaged network sites, and delayed construction and repair because of insecurity. Between 2018 and 2021, the capacity of the Great Man-Made River Project was reduced by 36% due to damaged wells.⁵¹ This has weakened the capacity of Libya's principal water institutions to manage scarcity, particularly given the scale and geographic dispersion of the system.⁵²

⁴⁷ International Organization for Migration (CWSM Desk Review) 2023; International Organization for Migration (Yemen) 2025

⁴⁸ International Organization for Migration (Yemen) 2025

⁴⁹ International Organization for Migration (Libya) 2024

⁵⁰ Weinthal & Sowers 2023

⁵¹ Ibid.

⁵² Ibid.



Figure 2: Incidents of infrastructure targeting in Libya⁵³

In such war-affected settings, IKS systems can often provide part of the practical basis on which access, repair, and dispute management continue when formal institutions are weakened. At the same time, when conflict erodes IKS, environmental governance becomes more fragile and communities' ability to cope with stress is reduced.

How armed conflict erodes IKS

Armed conflict can erode IKS through three connected processes: material disruption, the weakening of social authority, and the breakdown of transmission. IKS depend on continued interaction with land, water, infrastructure, and shared production systems. When wells, irrigation channels, grazing routes, flood-control structures, or agricultural assets are damaged, the conditions

⁵³ Weinthal & Sowers 2023; Omara et al. (2023)

under which knowledge is applied begin to erode. In Marib, Yemen, well-water availability declined through higher temperatures and increased evaporation, conflict-related disruption (including displacement), damage to irrigation channels, erosion, and power outages that were undermining agricultural viability.⁵⁴ These pressures reduce communities' ability to collectively maintain infrastructure, coordinate access, and sustain agricultural production, while displacement and insecurity separate communities from the ecological settings in which knowledge is practiced. As livelihoods become more dependent on humanitarian aid and emergency survival strategies, it becomes harder to apply local knowledge to water allocation, irrigation management, and agricultural production.

War-related disruption can also weaken the social authority through which IKS are interpreted and enforced. In Yemen, traditional informal dispute-resolution mechanisms have been weakened by armed conflict and by their increasing marginalization within a more politicized and fragmented governance environment, even as land and water disputes have intensified.⁵⁵ Such resolution mechanisms include the assembly of different political leaders for negotiation purposes, as armed conflict disrupts the ability of mediators, tribal authorities, and community leaders to convene safely, maintain legitimacy across divided communities, or enforce negotiated outcomes. For example, the UN World Food Programme struggled to deliver critical aid to Yemeni citizens, as they were denied access to at-risk communities by four different parties to the conflict.⁵⁶ These disruptions highlight how gatherings can be logistically difficult to plan and execute, given the tension between factions. As a result, the inability to gather can hinder dispute-resolution and directly impact the ability of people to mitigate the conflict.

Displacement can also separate clans and kinship networks that once sustained these mechanisms, while political fragmentation and militarization may privilege some groups over others, narrowing whose authority is recognized and whose knowledge informs governance.⁵⁷ When armed factions control territory, it becomes difficult for knowledge to be dispersed across areas. Moreover, the

⁵⁴ International Organization for Migration (Yemen) 2025

⁵⁵ Sowers and Weinthal 2021

⁵⁶ Ibid.

⁵⁷ International Organization for Migration (Yemen) 2025

large-scale displacement and casualties of populations which accompanied the armed conflict in Yemen resulted in the destruction of key institutions such as the national mechanism for disease reporting, further emphasizing how a failure to protect civilians and the infrastructure upon which they depend breaks down the systems and governance mechanisms necessary for the provision of basic services.⁵⁸ In this manner, armed conflict may undermine the institutions who interpret norms, mediate disputes, and make rules operative.

Finally, armed conflict can lead to the breakdown of knowledge transmission. IKS are reproduced through repeated practice, intergenerational exchange, and the social routines of everyday life. Displacement, insecurity, and disrupted livelihoods make those processes harder to sustain. In Turkana County, Kenya, drought, flooding, intercommunal conflict, and cross-border raids have altered pastoral mobility, dispersing households, and weakening the institutions that once organized movement, rites of passage, and local order.⁵⁹ As those collective settings erode, the ecological knowledge and customary practices tied to them become harder to reproduce across generations.

Environmental degradation and conflict as a governance problem

Environmental degradation worsens when local governance loses the capacity to regulate access, mediate competing claims, and retain sufficient legitimacy under pressure. In this context, IKS matter as institutions of allocation, repair, and conflict containment.

In Sudan, environmental stress is often managed through organized problem-solving committees that address water, food, housing, health, education, displacement, and conflict. These committees bring together residents, community leaders, religious leaders, and local administration officials, who work together to help prevent localized disputes from escalating into wider tribal violence.⁶⁰ In this context, Sudan's local problem-solving committees demonstrate how IKS functions as practical institutions of allocation, mediation, and conflict containment, helping communities maintain governance capacity and legitimacy under environmental stress.

⁵⁸ International Organization for Migration (Yemen) 2025

⁵⁹ International Organization for Migration (Kenya) 2024

⁶⁰ International Organization for Migration (CCM) 2023

In Yemen, local conflict over land and water is closely tied to weak rule-of-law institutions, limited local-authority capacity, and the continuing importance of tribal norms in mediating access. A particularly clear example comes from Ta'iz Governorate, where women drawing on tribal principles helped negotiate civilian access to water tanks during conflict.⁶¹ Such responses demonstrate how women have played a crucial role in conflict resolution and resource access, further recognizing the challenges of the lack of regulation in natural resources.

Similarly, in Kufra in southeastern Libya, conflict damaged environmental infrastructure, threatened access to water, and contributed to the destruction of farms through water cuts, while some wells were reportedly subject to sabotage or seizure by force. In response, tribal leaders developed charters and treaties and ceased to protect members who violated them. In one instance, leaders lifted tribal immunity to facilitate transparent monitoring and improved security.⁶² The response of tribal leaders in Kufra illustrates how IKS can regulate access to scarce resources, helping contain conflict and mitigate further environmental degradation even under conditions of instability.

Integrating IKS into programming

Following this analysis of how environmental degradation intensifies under weakened governance and how IKS can function as institutions of allocation, mediation, and conflict containment, there are several implications of these findings for environmental programming in conflict-driven settings. Programs addressing environmental stress in conflict-affected settings need to identify which local institutions continue to command sufficient recognition to organize access, mediate disputes, and coordinate upkeep, and then determine how formal systems can support and amplify those functions without displacing them. This means building on existing capacities, designing inclusive decision-making arrangements, strengthening governance and conflict-resolution mechanisms, and coordinating across sectors rather than treating adaptation, conflict, and mobility as separate domains.

⁶¹ International Organization for Migration (Yemen) 2025

⁶² International Organization for Migration (Libya) 2024

An important caveat, however, is that locally-led governance systems may exclude women, youth, displaced people, or socially disadvantaged groups, even where they retain authority in the eyes of dominant constituencies. Beyond being a question of representation, this matters as a question of governance capacity itself. Where women and other groups facing exclusion play central roles in mediating access to resources or sustaining agricultural and household knowledge, their exclusion weakens environmental governance in practical terms.

These findings also suggest limits to what IKS can realistically be expected to provide under conditions of prolonged conflict and institutional collapse. IKS should not be treated as a substitute for public responsibility or international accountability. They are still responsible for mitigating attacks on water systems, agricultural infrastructure, and the ecological basis of civilian life. Community institutions may support resilience and recovery, but they cannot absorb the burden created by impunity, state failure, or repeated destruction.

Recommendations

1. Conflict-sensitive environmental programming within policy should evaluate the condition of customary and community-based institutions alongside damage to ecosystems and infrastructure in participation with community leadership. This includes water-user associations, tribal mediation structures, local committees, pastoral authorities, and other forums through which land and water access are governed.
2. Government rehabilitation of wells, irrigation systems, flood structures, and grazing corridors should be paired with support for the allocation rules, maintenance arrangements, and mediation mechanisms that govern them. Recovery programs should specify together with communities who manages, who maintains, and who arbitrates access once physical rehabilitation is complete.
3. Post-conflict environmental governance should combine technical expertise and legal recognition with locally legitimate actors where these still retain credibility. Water-user

associations, municipal actors, tribal leaders, pastoral and agricultural authorities, camp leadership, and technical agencies should be brought into co-governance arrangements that clarify roles and reduce the risk that reconstruction itself becomes a new site of contestation.

4. NGO and government actors should strengthen existing dispute-resolution capacities. Local mediation forums can prevent disputes over water, land, and livelihoods from escalating. These mechanisms should be strengthened through training, documentation support, and structured links to formal authorities.
5. Recovery programs should work with communities to ensure that local arrangements governing land, water, and environmental repair include meaningful participation by women, youth, displaced populations, and socially marginalized groups, particularly in decisions over allocation, upkeep, and mediation in culturally sensitive ways.
6. Monitoring and evaluation frameworks for conflict-affected environmental programming should assess not only the rehabilitation of assets such as wells, irrigation systems, and flood structures, but equally whether the governance arrangements around them are functioning. These frameworks should include insight into who participates in decision-making, whether maintenance responsibilities are being carried out, whether access disputes are being resolved, and whether local arrangements retain sufficient legitimacy across affected groups.

Conclusion

We attempted to conduct a holistic analysis of how IKS are leveraged in the MENA region, seeking to apply our findings to three key areas: measuring their economic value in relation to environmental degradation, understanding how they are threatened by climate-induced migration, and how they can influence governance in times of conflict. Through literature reviews, we developed an understanding of how IKS have been used globally, often in tandem with policy and governance structures. Although the IKS themselves are place-based and often not able to be extrapolated beyond a local region, the ways in which they are supported and promoted by NGOs and governments can often be applied on a broader scale. The recommendation section following each subtopic aims to provide pragmatic suggestions that could be implemented to safeguard IKS in the MENA region. By coupling IKS with local and regional governance structures and monitoring systematic evidence generation on issues involving IKS, this policy brief outlines ways in which IKS can be safeguarded and implemented through policy. Leveraging these approaches, Indigenous communities that have long been disproportionately impacted by climate degradation can be given a more active role in shaping climate policy that leads to more equitable and sustainable outcomes.

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