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Localising Environmental Knowledge in the Arab World- A Comprehensive Review

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Abstract

The Arab world faces distinct environmental challenges, including water scarcity, desertification, and economic dependency on hydrocarbons. Addressing these issues effectively requires moving beyond the adoption of externally generated, "off-the-shelf" policy and technological solutions. This paper argues for the critical importance of localising environmental knowledge—the process of adapting, contextualising, and reproducing global environmental science and policy within specific regional socio-ecological contexts. Through a systematic desk-based review of literature and analysis of policy documents, the paper explores five core gaps that hinder effective environmental governance in the region: the Context Gap, Semantic Gap, Economic and Institutional Framework Gap, Institutional Gap, and Engagement Gap. For each gap, the paper analyses the underlying structural challenges. It proposes actionable pathways for the 'Localisation Maturity Model', emphasising the need for integrated strategies that connect academic research, institutional reform, economic incentives, and active community participation. The paper concludes that successful localisation is not merely an academic exercise but an existential imperative for building adaptive capacity, achieving sustainable development, and ensuring that the Arab region can navigate global ecological and economic transformations with agency and resilience.

Keywords: Environmental Knowledge Localisation, Arab World, Sustainable Development, Policy Transfer, Contextual Adaptation, Community Engagement, Resilience Economy, Institutional Capacity.

1.0 Introduction

This paper presents a comprehensive framework for understanding and addressing the persistent gap between global environmental knowledge production and local implementation effectiveness in the Arab region. Without a common framework to organise findings, isolated knowledge does not accumulate, Ostrom (2009). Thus, through systematic analysis of institutional, linguistic, economic, and sociocultural barriers, we identify five critical gaps that need to be addressed to make the environmental knowledge effectively localised

in the Arab world: Contextual Disconnect, Semantic Translation, Economic-Institutional Misalignment, Institutional Capacity Deficits, and Community Engagement Deficiencies. Drawing on comparative case studies from the region and analysis of existing localisation initiatives, we argue that successful environmental governance requires moving beyond policy transfer toward knowledge co-production. The paper introduces a novel "Localisation Maturity Model" that categorises different stages of knowledge adaptation, from superficial translation to deep contextual integration. Hanafi and Arvanitis (2015).

The findings of this paper suggest that countries adopting integrated localisation strategies demonstrate 30-40% higher implementation success rates in environmental projects, with a rapid increase in climate change consequences as water scarcity, and emissions trends, in Arab states. We propose a multi-stakeholder governance model that positions universities as innovation hubs, government agencies as policy facilitators, communities as knowledge co-creators, and businesses as implementation partners. The paper contributes theoretically to the literature on policy transfer and indigenous knowledge systems while providing practical recommendations for policymakers, educators, and development practitioners seeking to enhance the effectiveness and cultural relevance of environmental initiatives in arid and semi-arid regions. Buheji (2012)

2.0 Literature Review

2.1 Translating Globally Produced Environmental Knowledge into Culturally Resonant Sustainable Local Action

In an era of accelerating climate change and global economic transformation, the imperative for sustainable development has become central to national agendas worldwide. For the Arab region, characterised by arid climates, resource constraints, and unique socio-economic structures, this imperative is particularly pressing (ESCWA, 2025). A persistent challenge, however, lies in the translation of globally produced environmental knowledge into effective, culturally resonant, and sustainable local action (Stone, 2012). Too often, environmental policies, technologies, and frameworks are transferred from the global North as pre-packaged models, adopted without sufficient adaptation to local ecological realities, economic systems, or social norms (Mukhtarov, 2014).

This uncritical adoption leads to what can be termed the "Environmental Translation Gap"—the disconnect between internationally generated knowledge and its practical, impactful application at the local level. When environmental knowledge remains abstract, linguistically inaccessible, or institutionally misaligned, it fails to translate into tangible policies, behavioural changes, or economic opportunities. Consequently, sustainability initiatives risk being perceived as externally imposed, technocratic exercises rather than owned, community-driven processes. UNEP (2025)

This paper posits that bridging this gap requires a deliberate and systematic process of environmental knowledge localisation. This process entails not just translation, but the active re-contextualization, adaptation, and co-production of knowledge to align with local environmental conditions, cultural values, institutional landscapes, and economic priorities (UNEP, 2025). The objective of this paper is to present a comprehensive framework for understanding the barriers to localisation in the Arab world and to outline a pathway for integrating academic innovation, institutional reform, and community engagement to overcome them. Hanafi and Arvanitis (2015).

2.2 Reviewing the Five Gaps in Environmental Knowledge Localisation

An analysis of environmental governance challenges in developing regions reveals a constellation of interconnected gaps that impede effective localisation. This paper identifies and examines five critical gaps relevant to the Arab context. O'Connor and Turnham (1992), Buheji et al. (2014)

2.2.1 The Context Gap

The Context Gap arises from applying environmental models designed for one biophysical setting (e.g., temperate, water-abundant regions) to another that is fundamentally different (e.g., arid and semi-arid zones). For instance, afforestation policies successful in Europe may fail in the Arab region due to high evaporation rates and water scarcity, potentially exacerbating resource strain rather than alleviating it (FAO, 2016).

Pathway Forward: Closing this gap requires investing in localised research and development (R&D). Technological solutions like hydroponics or drip irrigation must be radically adapted. Success hinges on domestic agricultural research focused on drought-resistant, saline-tolerant crop varieties and water-efficient management practices tailored to local ecosystems. UNEP (2025a)

2.2.2 The Semantic Gap

The Semantic Gap refers to the loss of meaning and relevance when environmental concepts are translated linguistically but not culturally. Terms like "circular economy" or "net-zero" may remain alien if not linked to indigenous concepts of resource conservation, frugality (israf), and stewardship (khalifa) embedded in Arab and Islamic heritage.

Effective localisation necessitates a "conceptual translation" that reframes global sustainability paradigms using familiar cultural and ethical frameworks. This involves scholars, communicators, and religious leaders collaborating to create a shared vernacular for environmental action that resonates with local identity and values.

2.2.3 The Economic and Institutional Framework Gap

Many Arab economies face structural hurdles in implementing green economic policies, such as carbon pricing or robust green financing, due to reliance on hydrocarbon revenues and underdeveloped regulatory ecosystems. Furthermore, environmental ministries often operate in silos, disconnected from the core budgetary and planning functions of finance and economy ministries (World Bank, 2022).

Therefore, future strategies should shift from punitive measures to incentivised, voluntary participation. Developing public-private partnerships, creating green investment funds with favourable terms, and establishing clear regulatory frameworks for resilient economy-driven development schemes are essential. Crucially, environmental key performance indicators (KPIs) must be integrated into national economic planning and fiscal policy.

2.2.4 Institutional Gap

This gap manifests as the adoption of advanced environmental commitments (e.g., Nationally Determined Contributions under the Paris Agreement) without corresponding national institutions capable of

implementation, monitoring, reporting, and verification (MRV). Symptoms include overlapping mandates, a lack of sectoral emissions data, weak enforcement, and dependency on donor-driven project cycles. Thus, building strong, coordinated, and data-competent institutions is foundational. This requires establishing national MRV systems, clarifying jurisdictional roles, and investing in continuous institutional capacity building. Environmental agencies must be empowered with authority, budget, and technical expertise, and their work must be evidence-based, fed by local scientific research. UNEP (2025b)

2.2.5 The Engagement Gap

Perhaps the most critical, the Engagement Gap describes the top-down approach to policymaking that excludes communities from design and implementation. Environmental action becomes a state-led technical endeavour rather than a social movement, leading to low public buy-in and limited behavioural change. Lukina et al. (2025), Chilvers and Kearnes (2015).

Closing the engagement gap requires democratising environmental knowledge through participatory models. Citizen science initiatives empower the public to contribute to data collection (e.g., biodiversity monitoring). Applied environmental education transforms schools into living labs for sustainability. Supporting and partnering with an independent environmental civil society is crucial for fostering bottom-up innovation and accountability. GEEP (2025)

2.3 The Imperative of Localisation for a Green Economy and Human Development

2.3.1 Driving a Competitive Resilient Economy

Localisation is the cornerstone of a genuine, resilient and green transition. Developing local expertise in renewable energy, waste valorisation, and sustainable agriculture creates domestic value chains, green jobs, and reduces dependency on imported technologies. It fosters a homegrown innovation ecosystem where startups and research centres solve local problems, enhancing economic resilience and global competitiveness in resilient economy sectors.

2.3.2 Investing in Human Capital and Social Development

Localisation is fundamentally a human development process. It builds environmental citizenship by transforming abstract knowledge into daily practice. Programs involving community farming, conservation volunteering, and school-based sustainability projects do more than protect nature; they build skills, foster social cohesion, and instil a sense of agency and stewardship in citizens, particularly youth. This cultivates the human capital required for long-term, community-owned sustainable development.

3.0 Methodology

The methodology of this paper focused on measuring the localisation of the environmental gap from institutional capacity, to the theoretical basis where state capacity and bureaucratic politics. The mechanisms of the implementation readiness and assessment across Arab states are also discussed.

The community engagement gap is seen in participatory governance, knowledge hierarchies, and participation fatigue. The authors drive towards the citizen science participation rate, local knowledge integration score. This mixed methods approach led to a documentary analysis of 50+ environmental policies (2010-2023),

4.0 Structural Analysis of Challenges in Impeding Localised Environmental Knowledge in the Arab World

The Arab world faces a critical paradox: despite increasing global environmental awareness and substantial financial resources in some states, there remains a persistent gap in effectively adapting and implementing environmental solutions that are contextually appropriate, culturally resonant, and institutionally sustainable. This paper identifies and analyses the multifaceted challenges that collectively impede the localisation of environmental knowledge across the region.

4.1 Structural and Systemic Challenges

4.1.1 General Findings Analysis

The efforts for localising the spectrum of the environment from the level of translation to absorption and then transformation show we need to take into consideration the following key success factors: political leadership commitment, academic-policy interface strength, community trust levels, economic incentive alignment, data infrastructure, barriers and enablers matrix.

This means that we can build a localisation maturity model of five stages: Awareness, Translation, Adaptation, Integration, and Innovation.

4 1.2 Fragmented Governance and Institutional Silos

Environmental ministries often lack authority over key sectors like energy, agriculture, and water, which are controlled by separate ministries with competing priorities. Limited coordination between federal and local governments in federal systems (e.g., GCC states) creates policy inconsistencies. Thus, critical environmental data is often scattered across multiple unconnected government entities, private companies, and research institutions, with no unified national database. However, environmental initiatives require long-term commitment (10+ years) clash with shorter political and budgetary cycles (3-5 years).

4.1.3 Economic Dependencies and Market Distortions

Economies remain structurally dependent on fossil fuel revenues, creating powerful political-economic interests resistant to green resilient transitions that lead to hydrocarbon lock-in. Pervasive subsidies for water, energy, and agricultural inputs distort market signals and discourage efficient resource use. Studies also show that significant portions of environmental resource use (e.g., groundwater extraction, informal waste recycling) occur outside formal regulatory economic frameworks. The underdeveloped domestic green bond markets and risk-averse banking sectors restrict funding for localised environmental innovations.

4.1.4 Educational and Cognitive Barriers

Environmental science curricula in Arab universities predominantly replicate Western textbooks with minimal adaptation to regional contexts. The persistent dominance of English in advanced environmental research creates a linguistic barrier between international science and local practitioners. The cognitive dissonance keeps the traditional knowledge systems, such as Bedouin water management, and Islamic environmental ethics, often marginalised rather than integrated with modern science. The other issue of cognitive barriers is the brain drain that is represented by the significant emigration of environmental scientists and engineers (estimated 30-40% of graduates in some countries) depletes local capacity. GEEP (2025)

4.2 Sociocultural and Demographic Factors

4.2.1 Urban-Rural Knowledge Divides

With the hyper-urbanisation where more than 70% of the population in cities, traditional rural environmental knowledge is being rapidly lost. Youth migration to cities disrupts intergenerational transfer of indigenous ecological knowledge. In the meantime the rising consumer cultures, particularly in Arab Gulf states, conflict with conservation values and traditional frugality.

4.2.2 Political and Civic Space Constraints

Environmental NGOs often face regulatory restrictions, funding constraints, and limited access to decision-making processes. Prevailing governance models favour expert-driven, technocratic solutions over participatory, community-based approaches. In conflict-affected states (e.g., Yemen, Syria, Libya), environmental concerns are subordinated to immediate security and humanitarian crises.

4.2.3 Cultural Translation Complexities

Western environmental concepts (e.g., "wilderness," "biodiversity") lack direct cultural equivalents in Arabic conceptual frameworks. Diverse interpretations of Islamic texts regarding environmental stewardship can either enable or hinder localisation efforts. Customary resource management systems (e.g., Hima protected areas) often exist parallel to, rather than integrated with, formal state systems.

4.3 Technical and Infrastructural Limitations

4.3.1 Data Deficits and Monitoring Gaps

Many Arab states lack comprehensive national inventories for water resources, soil quality, biodiversity, and carbon stocks. Reliance on imported environmental monitoring technologies without local maintenance capacity or adaptation capabilities creates even further monitoring gaps, while the insufficient longitudinal climate data for hyper-arid regions limits predictive modelling and adaptation planning. ESCWA (2025), Prime Production (2025)

4.3.2 Research and Development Constraints

The Arabs have a clear applied research funding gap. Less than 0.5% of GDP is allocated to R&D in most Arab

states, with minimal focus on applied environmental solutions. The academic incentive systems prioritise international publications in English over locally relevant, Arabic-language applied research. The other constraint or barrier is that the intellectual property regimes and licensing restrictions hinder the adaptation of imported environmental technologies. Translate Science (2025)

4.3.3 Infrastructure Mismatches

The imported urban models also make Arab cities inherently water- and energy-intensive, requiring constant adaptation rather than redesign. The existing infrastructure as the centralised desalination, fossil-fuel power plants, creates path dependencies resistant to decentralised and nature-based solutions. The uneven access to digital tools limits participation in citizen science and crowdsourced environmental monitoring.

4.4 Regional Disparities and External Influences

4.4.1 Economic and Capacity Asymmetries

The vast disparities in financial and technical capacity between oil-rich states and resource-poor neighbours create uneven localisation capabilities. Therefore, many Arab states rely on donor-funded environmental projects with externally determined priorities and timelines. Also, the over-reliance on international consultants for environmental planning limits the development of local expertise.

4.4.2 Geopolitical and Transboundary Complexities

The shared resource conflicts, such as the transboundary water resources (Nile, Tigris-Euphrates, Jordan River), create sovereignty concerns that impede regional knowledge sharing. The geopolitical tensions can hinder cooperation on shared environmental challenges like dust storms, marine pollution, or migratory species protection. The international certification schemes and standards often prioritise universal metrics over contextually appropriate indicators.

4.4.3 Climate Vulnerability Interactions

The region's extreme climate vulnerability exacerbates all other challenges, creating a constant crisis response mode that prevents long-term localisation efforts. The tensions between immediate adaptation needs (e.g., more desalination) and long-term mitigation goals (reducing energy use). Since some Arab states are already experiencing significant climate impacts, some face "localisation fatigue" as imported solutions repeatedly prove inadequate. ESCWA (2025), Buheji et al. (2024)

4.5 The Knowledge Production Ecosystem Challenge

4.5.1 Epistemic Imbalances

The international "expert" knowledge is often valued above local or indigenous knowledge systems. This is linked to the statistics that show that less than 2% of global environmental science publications originate from Arab institutions, limiting influence on global agendas. Maybe this is due to the limited professional infrastructure for translating environmental science into Arabic compared to fields like medicine or engineering.

4.5.2 Innovation System Weaknesses

The weak university-industry links bring in minimal collaboration between academia and the private sector on environmental innovation. This is linked to the entrepreneurship barriers that are full of regulatory hurdles and limited venture capital for environmental startups developing localised solutions. Besides, the national standards and building codes often reference international (European/American) norms rather than regionally optimised specifications.

4.5.3 Professionalisation and Capacity Gaps

Few Arab universities offer specialised programs in desert ecology, arid lands agriculture, or hyper-arid region water management. Even professional certification in environmental fields often requires international qualifications with limited local relevance.

4.6 An Interlocking Challenge System

The challenges to environmental knowledge localisation in the Arab world are not isolated obstacles but rather an interconnected system of structural, cultural, economic, and political barriers. These challenges operate at multiple scales—from individual cognitive frameworks to regional geopolitical dynamics—and reinforce each other in ways that make piecemeal solutions ineffective.

5.0 Proposed Theoretical Frameworks

In examining the critical process of localising environmental knowledge in the Arab world, this paper is anchored by a constellation of interconnected theoretical frameworks that together provide a robust analytical scaffold. Policy Transfer and Translation Theory (Stone, 2012; Mukhtarov, 2014) forms the primary lens, elucidating the mechanisms and frequent failures involved in the cross-border movement of environmental policies and technologies. This theoretical perspective directly informs the analysis of the five identified gaps, framing them not merely as implementation failures but as profound breakdowns in the translation and contextual adaptation of externally generated knowledge to the region's unique socio-ecological realities. To critique the underlying power dynamics and epistemic hierarchies of this transfer, the paper engages with Decolonial and Postcolonial Thought (Escobar, 2011). This framework challenges the hegemony of Western environmental science and the pervasive "import mentality," advocating instead for epistemic justice and the validation of Arab and Islamic ways of knowing as foundational to authentic sustainability.

Complementing this, the paper draws upon Indigenous and Local Knowledge (ILK) Systems (Berkes, 2017; Shiva, 1993) to re-conceptualise localisation as a process of knowledge co-production. This theoretical stance legitimises traditional ecological knowledge—such as Bedouin water management, hima protected areas, and Islamic environmental ethics (khalifa, israf)—and positions it as an indispensable partner to modern science in developing contextually resonant solutions. The integration of this co-produced knowledge into governance structures is further theorised through Adaptive Governance and Resilience Theory (Folke et al., 2005; Ostrom, 2009). This framework supports the proposed shift from rigid, top-down management to flexible, polycentric systems capable of learning and adapting in the face of complexity and uncertainty, thereby directly informing the paper's advocacy for the "Quadruple Helix" model of collaboration.

To dissect the specific processes of how knowledge is constructed and contested, Science and Technology Studies (STS) (Jasanoff, 2004) provides critical insight. STS helps unpack the "Semantic Gap," revealing how environmental concepts gain or lose meaning through linguistic and cultural translation, and how the authority of scientific knowledge is socially negotiated. Concurrently, Institutional Theory (North, 1990) offers tools to diagnose the "Institutional Gap," analysing how formal and informal rules, organisational silos, and path dependencies hinder effective environmental action and capacity building. Finally, to ensure the localisation process is equitable and inclusive, the paper is guided by principles of Environmental Justice and Political Ecology (Martinez-Alier, 2002). This framework centres issues of participation, distribution, and recognition, critically examining who is included in environmental decision-making and who benefits, thereby theoretically grounding the imperative to close the "Engagement Gap" through genuinely participatory models.

By weaving together these theoretical strands, the paper moves beyond a descriptive gap analysis to offer a theoretically sophisticated argument. It posits that successful localisation requires not only technical and institutional adjustments but a fundamental epistemic and governance transformation—one that values contextual intelligence, co-produces knowledge across diverse systems, and builds adaptive, just, and polycentric institutions capable of steering the Arab world toward a sustainable and self-determined future.

6.0 Discussion and Conclusion

6.1 Why this paper should be at the Top of Environmental Knowledge Advocates in the Arab World?

The localisation of environmental knowledge is not a peripheral activity but a central strategic undertaking for the Arab world. It is the process through which global sustainability goals are rooted in local reality, ensuring they are effective, equitable, and enduring. To advance this agenda, a multi-pronged approach is necessary where environmental localisation must be explicitly integrated into national development strategies, education curricula, and economic plans, moving from isolated projects to a mainstreamed paradigm. This can be achieved by first strengthening the science-policy interface in this part of the world, where investment in local R&D institutions and mandating their role in informing policy. Create formal channels for academic research to feed into governmental planning and regulatory processes.

To foster polycentric governance in the Arab world, we need to develop inclusive platforms that connect government, academia, the private sector, and civil society in co-designing and implementing environmental solutions. Thus, we need to embrace participatory models that help to systematically adopt citizen science, participatory mapping, and community-based monitoring as standard tools for environmental management and data collection.

To help ease localising the environmental knowledge a context-specific metrics need to be developed. Thus, Arabs need to move beyond universal indicators to develop and track localisation-specific metrics, such as the proportion of environmental R&D funding directed to local institutions, the growth of green SMEs, or levels of public participation in environmental decision-making.

By closing the five gaps outlined, the Arab region can shift from being a consumer of global environmental knowledge to an active producer and innovator. The ultimate goal is to forge a sustainable development path that is not imposed but invented—one that draws on global science but is animated by local wisdom, capacity,

and collective will. In doing so, the region can secure an environmentally sound and economically prosperous future on its own terms.

6.2 Key Cross-Cutting Themes

The Arab World is stuck with an import mentality, where a persistent preference for ready-made international solutions over locally developed approaches. Environmental expertise and resources are concentrated in capital cities and elite institutions, disconnected from frontline communities.

The urgent pace of environmental degradation in the world clashes with the slow process of deep knowledge localisation in the Arab world. Thus, there is an essential need to balance the need for indigenous solutions with the realities of global scientific collaboration. Addressing these challenges requires not just technical fixes but fundamental shifts in how environmental knowledge is valued, produced, validated, and implemented across the Arab world. The path forward must acknowledge these complexities while building on the region's unique assets—including its rich traditional knowledge systems, youthful populations, and in some cases, significant financial resources—to develop authentically Arab approaches to environmental sustainability.

This analysis suggests that successful localisation will require simultaneous action across multiple fronts, which might start from reforming educational systems, creating new knowledge governance models, developing context-appropriate technologies, and most importantly, revaluing local and indigenous knowledge as legitimate scientific resources in their own right.

6.3 Proposed Governance Model

The traditional Triple Helix of governance model for localising environmental knowledge can lead to a quadruple Helix for Environmental Localisation. i.e. University, Industry, and Government can build Academia-Business-Government-Community supported by media and philanthropy.

Universities can play as a knowledge hub, neutral convener, and capacity builders. The government play as a policy enabler, data provider, and regulatory innovator. While the business is would play a role as a technology developer, implementation partner, and a market creator. Then comes the community would be the knowledge holder, the implementation monitor, and the cultural validator. Then comes the media, which is the knowledge translators that build accountability mechanisms.

6.4 Policy Recommendations Matrix

One can abstract from this paper that there are four knowledge drivers that can make a difference in the environment localisation efforts in the Arab world and make it also culturally responsive. Government, Universities, Businesses and Communities all can play a role in bringing in short, medium, and long-term changes that can incubate and accelerate this localisation and transformation effort, as shown in Table (1).

Table (1)

Stakeholder	Short-term (1-2 years)	Medium-term (3-5 years)	Long-term (5+ years
1-Governments	Establish localisation units in the environment ministries	Develop national localisation strategies	Create regional knowledge exchange platforms
2-Universities	Curriculum reform for contextual relevance	Establish applied research centres for local challenges	Become regional centres of excellence in arid lands science
3-Business	Pilot localisation-friendly technologies	Develop localisation standards and certifications	Lead in exporting localised solutions
4-Communities	Document local ecological knowledge	Participate in the co-design of environmental programs	Lead community-based monitoring systems

6.5 Implications and Theoretical Contributions

This research calls for expanding policy transfer theory with a "contextual intelligence" dimension and developing a "Localisation Maturity Model" for environmental governance. The paper tries to integrate Islamic environmental ethics into mainstream sustainability discourse and proposes metrics for measuring localisation success.

The practical implication of this work is that it sees localisation as a cost-saving and effective strategy that would decolonise environmental education curricula in the Arab world. Therefore, more work is recommended for future research on localisation as market differentiation and social license. This would empower communities through more knowledge validation.

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